AMID

Advanced Manufacturing by Innovation and Design

TAACCCT Round 3

Final Evaluation Report

September 30, 2017

Thank You

To the leadership of Nashua Community College for your support and active engagement throughout the evaluation.

To AMID staff, faculty, and Lab Assistants for your hard work in implementing the initiative, and your valuable insights about the program.

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Executive Summary

Program/Intervention Description and Activities

In October 2013, Nashua Community College (NCC) in Nashua, New Hampshire received a $2.6 million Trade Adjustment Assistance Community College Career Training (TAACCCT) grant from the United States Department of Labor (USDOL) in support of the Advanced Manufacturing in Innovation and Design (AMID) program. AMID's overarching goal was to provide relevant training and increase workforce skills in advanced manufacturing occupations for individuals negatively affected by changes in the economy. Most participants were incumbent workers seeking to improve their skills.

NCC stakeholders leveraged the TAACCCT funding to update the learning environment to make it more conducive to development of in-demand skill sets through instructional design innovations and equipment and space improvements. The AMID program also implemented a Success Navigator model to help students navigate the college and career development processes, supporting them throughout the program to increase persistence and retention. Specifically, AMID:

- Developed a competency-based, technology-enabled and enhanced education model for two existing associate degree programs in Precision Manufacturing and Mechanical Design Technology, and an existing certificate in Machine Tool Technology CNC Programming;
- Improved the equipment and lab space capacity for Precision Manufacturing and Mechanical Design Technology courses;
- Provided individualized, wrap-around support to students based on their academic and social needs to promote success (the Student/Success Navigator intervention) and
- Developed academic pathways for Precision Manufacturing and Mechanical Design Technology programs via articulation agreements, and Prior Learning Assessments to allow students to gain academic credit for work experience and expedite time to completion.

Evaluation Design Summary

The AMID evaluation had two primary goals. First, the evaluation aimed to provide formative assessments and build capacity to integrate evidence-based practices into the program over the life of the program. The second major goal of the evaluation was to build the evidence base for similar programs and initiatives at NCC and in other institutions. The evaluation utilized both qualitative and quantitative (mixed) methods to accomplish these goals. The two distinct, but integrally related, components of the evaluation included an implementation study and an outcomes/impact study.

The implementation study tracked and documented program progress and outputs, key contextual factors, and lessons learned; measured implementation accelerators and barriers, and catalogued stakeholders' perceptions of program impact. The implementation study offered both formative (ongoing) analysis of the program, and in this report, a final cumulative analysis. This study followed AMID's initial theory of change

and logic model and tracked short-term participant outcomes to the extent possible, as well as indicators of institutional capacity building and partner benefits experienced from the program. Research questions for the implementation analysis can be found in the Implementation Evaluation Study Design section of the report. Data for the implementation study was obtained from program documents and artifacts, monthly and quarterly calls with program staff and stakeholders, on-site interviews and focus groups (at two intervals during the project) and capacity-building indicators data. This included Identification of specific TAACCCT Round 3 program elements that expanded institutional capacity to deliver high-quality academic pathways, support students, and fulfill workforce needs of local businesses, diffusion of lessons learned of TAACCCT Round 3 program elements throughout the institution, institutional arrangements for technology and knowledge transfer; level of AMID program leadership and staff commitment, and level of employer and community partner (AMID council) response and commitment. A general inductive thematic approach,[1] with influences of applied phenomenology,[2] was used to analyze the qualitative data generated from the focus groups and interviews. The analytical framework used for the analysis included a time-dependent gradient (changes occurring in each year of program implementation) and a program-dependent gradient (analyzing the program components.) Emerging themes were then developed according to the analytical framework and through a review of program documents and notes and analysis of qualitative data generated through interviews and focus groups.

An outcomes and impact study sought to document AMID participants' persistence, retention, completion, and employment outcomes. In addition to the descriptive outcomes analysis, a quasi-experimental design (QED) using propensity score matching to demonstrate the impact of the AMID program on participants was intended to be conducted. In this design, students pursuing three AMID majors (AS Degree in Precision Manufacturing, AS Degree in Mechanical Design Technology, and a certificate in Machine Tool Technology CNC Programming) were to be matched to another technical program major (Electrical Engineering Technology, EET) that is similar but adhered to a more traditional learning model. Groups were to be compared to each other in terms of relevant outcome measures and models of selection bias were to be developed to facilitate assessment of AMID's impact on these measures. Due to the small sample size of the EET group, as well as potential cross-contamination that was identified (some EET students in the control group were found to have taken AMID courses), the QED impact analysis was not conducted. The final study design was limited to a one-group descriptive analysis, with several chi-square test procedures to determine if group membership (different levels of participation to AMID courses) was associated with program persistence and completion outcomes. Research questions for the outcomes study can be found in the Outcomes and Impact Study Design section of the report. Data sources for the outcomes evaluation included the college's student information system (student demographics, enrollment, and completion); the Community College System of New Hampshire's data warehouse (student demographics, enrollment, and completion); the National Student Clearinghouse (enrollment in higher education outcomes); New Hampshire Employment Security (participant employment information); intake and exit surveys (student demographics, incumbent worker

[1] Thomas, D.R. (2006). *A general inductive approach for analyzing qualitative evaluation data.* American Journal of Evaluation, 27, 237-245.
[2] Guest, Greg, MacQueen, K.M., and Namey, E.E. *Applied Thematic Analysis*. Thousand Oaks, CA. SAGE Publications, Inc., 2011.

status, post-completion and employment status, and student perception of program feedback) and a post-graduation social media search analysis (post-graduation employment data.)

Implementation Findings

Key findings from the implementation study are summarized below. These findings highlight AMID program accomplishments and successes, challenges and barriers, and indicators of expanded institutional capacity.

Accomplishments and Successes

- Through AMID, NCC created and implemented a unique competency-based education model incorporating technology-enhanced courses in alignment with institutional context and employer needs for advanced manufacturing occupations. NCC staff, faculty, administrators, partners, and stakeholders explored a range of competency-based education approaches and ultimately ended up designing their own to accommodate scheduling and financing constraints of the institution, while adopting key tenets of focus on demonstration of skills attained. Two Associate Degree programs and one certificate program were fully redesigned in this unique competency-based model, and another certificate program was created.
- Through AMID, faculty and an Instructional Designer developed and implemented a variety of technology-enhanced learning models, in tandem with the program competencies identified. Tools such as Blackboard, Tooling U modules, and videos filmed to demonstrate and reinforce key skills were combined with hands-on instruction to provide a well-rounded learning experience for students.
- AMID facilitated formalization of a Prior Learning Assessment process for the college.
- AMID facilitated a significant renovation to the laboratory space and advanced manufacturing equipment, positioning the school to be viewed as a premier facility in the state by industry partners and faculty, and allowing students to learn on state-of-the-art machines.
- AMID provided students access to two Success Navigators, who were instrumental in student success. Navigators used a risk stratification system to understand student needs and risk factors, removed barriers to navigating college processes and accessing academic and non-academic resources as needed, and connected students to employment opportunities and resources. They also played a role in strengthening overall student employability through a focus on soft skills.
- AMID facilitated improved industry relationships, leveraging significant contributions from partners to identify training and equipment needs and develop curriculum, and opening pathways to internships and jobs.
- Highly-qualified faculty guidance and the additional lab assistants helped increase participants' access to important hands-on learning opportunities, providing greater proficiency.

Challenges and Barriers

- Several factors significantly delayed AMID's implementation, including a federal government shutdown. After administrators, faculty, and partners realized the original plan for redesigning the advanced manufacturing curriculum into a competency-based format would have to evolve, the initial design period of the project extended a full two years into the period of performance. No participants were enrolled until the Fall 2015 semester. Additionally, AMID did not have an onsite project manager until approximately twenty months into the period of performance. Prior to this, a remote contracted project manager was handling program startup and administration, which contributed to problems with follow-up on necessary action items to move progress along.
- Prior to this round of TAACCCT funding, NCC had limited experience with administering and complying with the requirements of federal grants, and some of the processes required a change in processes and philosophy around spending. Additionally, data and reporting for the project proved to be cumbersome when the Community College System of New Hampshire launched a new data warehouse project that changed procedures for extracting data on participant enrollments and outcomes.
- Some participants had trouble with the online and technology-enhanced components of the program, particularly older students, some of whom lacked home computers. Faculty learned that the earlier in the program students were exposed to the technological enhancements, the smoother adoption tended to go.

Indicators of Expanded Institutional Capacity

- Certain elements of the AMID program will be sustained and diffused throughout NCC after the end of the period of performance. For example, NCC adopted the Success Navigator model for all technical education programs, supporting the position with Perkins funds. NCC is currently working on becoming a NIMS-accredited testing facility due to the equipment purchased under the grant, and administrators and faculty are interested in expanding NCC's unique model of competency-based education to other programs across the college. Additionally, through the process of technology enhancement and getting feedback from students, staff have gained valuable insight into how to approach the enhancements, and what formats work the best for their students. This knowledge will serve the school well as they seek to offer other courses with online components
- Due to the work completed under AMID, NCC now has a defined Prior Learning Assessment process that allows faculty and staff to provide concrete, consistent information to students about how their prior education and work experience can substitute for certain certificate and degree course requirements.
- Experience gained in managing federal grants and compliance requirements has expanded NCC's institutional knowledge and positions them well to be competitive for future funding.

Participant Impacts and Outcomes

As discussed above, relevant comparison group sample size and potential contamination precluded the planned quasi-experimental design impacts analysis for this study. The analysis conducted was mostly descriptive in nature, with several chi-square test procedures to determine if group membership

(different levels of participation to AMID courses) was related to program persistence and completion outcomes.

Due to implementation delays discussed above in and in other sections of this report, the first participants for the program were counted in Fall 2015, two years into the project's period of performance. Because most of the participants began their programs in Fall of 2015, and the programs were two years long (both Associate degrees were two years, and the Machine Tool Technology CNC Programming certificate was also designed as a two-year program), there was insufficient time to conduct a comprehensive assessment of program completion and post-completion employment and educational outcomes. Most program completers within the timeframe of the study were comprised of two distinct groups: participants with AMID majors who began their studies prior to Fall 2015 but finished in the program taking a few revised courses, and participants who took AMID courses but were not AMID majors. Therefore, much of the analysis is descriptive in nature and analyses pertaining to post-completion outcomes are limited due to small sample size.

- *Enrollment by Program Type:* The outcomes study focused on 269 unique participants[3] enrolled in AMID programs or courses during the fall 2015 through spring 2017. Seventy-one% of the participants were enrolled in AMID degree or certificate programs, with 29% enrolled in AMID-related courses but not seeking AMID credentials. The largest number of participants in AMID credential programs was in the AS in Precision Manufacturing (35%), followed by the AS in Mechanical Design Technology (19%).
- *AMID Participant Demographics and Characteristics at Entry:* Seventy-three percent of participants were white, 90% were male, and about 50% were over the age of 25. Over half of the participants were employed at program entry (65%), with almost half of those incumbent workers (42%) expecting to work more than 40 hours per week. Seventy-nine percent of the participants lacked a college degree at intake.
- *Retention and Completion Outcomes by Program Type:* When separated into four groups (AS in Precision Manufacturing students, AS in Mechanical Design Technology students, Machine Tool Technology CNC Programming students, and degree-seeking students pursuing other fields but taking AMID courses), there was a statistically significant association between group membership and program completion (χ^2=27.88, p<0.05, Cramer's *v*=0.35), and group membership and program dropout (χ^2=13.02, p<0.05, Cramer's *v*=0.24), but not between group membership and program retention (χ^2=5.13, p<0.05, Cramer's *v*=0.15.)
- *Program Completion:* Because of the program's delayed start, most completers (n=50) did not complete their programs until 2016 or 2017. The majority that completed earned Associate degrees, as opposed to certificates.
- *Continuation to Further Education Post-Completion:* Of the 50 degree- or credential-seeking students who completed their programs of study, 4% elected to pursue further education.
- *Employment Post-Completion:* The post-completion employment analysis focuses only on those individuals who completed prior to 2017, because all individuals who completed in 2017 were May graduates, meaning quarter one after graduation data (July-September 2017) was not available as of this report. Of the 23 AMID graduates who completed prior to 2017, nearly three-

[3] 10 students elected not to sign consent forms and therefore are not included in the analyses.

quarters were employed as of the first quarter after graduation. All Mechanical Design Technology program students were employed, and 77% of the Precision Manufacturing graduates were employed at program completion.

- *Student Perception of AMID Program:* In general, participants believed AMID had benefitted them in their career. According to the 2016 Exit Survey, 87.5% agreed or strongly agreed that completing the program of study improved their career prospects. Of combined respondents on both the 2016 and 2017 surveys, (64.5%) indicated that they had acquired a new job in their field of study because of the programs they completed.

Conclusions

Key Considerations for Program Replication

- *Allow for flexibility in student support roles*—Originally, the Success Navigator role was anticipated to provide resources and support to students in need of public assistance and meeting basic needs, but staff quickly discovered that students more frequently requested assistance in academic-related areas, soft skills, career development, and use of technology. Future programs should allow fluidity in the Success Navigator role, allowing staff the flexibility to offer different types of services in accordance with what students indicate are top priorities.
- *Develop familiarity with federal grant requirements and processes to optimize resources*—NCC staff and administrators had to quickly become familiar with processes required for purchasing and budgeting at the federal level, and underspent in one budget category, which led to an inability to expend all funds available in the grant.
- *Assess the costs and benefits of different instruction models:* AMID courses primarily taught by adjunct professors, which meant that any curricular redesign work had to be completed under additional dedicated resources since it was outside the scope of their contract. When implementing a program that requires significant faculty involvement in a curriculum revision process, it is important to assess the capacity of current faculty and determine early on what the best route is for ensuring adequate capacity. In some cases, it may be more cost-effective and allow for greater involvement in the process to hire full-time faculty, but in that case, it is important to develop a strong sustainability plan for when grant funding ends.
- *Develop mechanisms to build faculty buy*-in: Having early buy-in from a faculty member was vital to getting others on-board with the project and ensuring its success. In re-designing curriculum for a program, providing opportunities input from faculty on the process can help to increase buy-in and ensure that faculty will be committed to making the changes work.
- *Immerse students in technology-enhanced instruction early in their programs*-- Faculty indicated that students exposed from the beginning of their programs to the technology enhancements in courses adjusted more easily than those who experienced the enhancements midway or more through their coursework.

Implications and Suggestions for Future Research

- Future research into competency-based technical education program models in a community college setting should investigate the degree to which competency-based technical education programs facilitate participant success in higher education and in the labor market. In addition, future research could examine the extent to which different types of competency-based models accelerate students' ability to complete their degree programs.
- Additional research should explore the dynamics and outcomes of competency-based technical education programs that serve populations with different demographic characteristics and in different geographic areas and labor markets.
- As Student Navigator-type models have been identified as a potential promising practice, especially in working with non-traditional students, research could examine the ways in which additional student supports have an impact on student persistence and completion, particularly for students who are older or working while in their college programs.
- Future research could explore managers' perceptions of the performance of workers educated in a competency-based framework. Ideally, this type of research could be analyzed through a quasi-experimental design (QED), in which a comparison group of similar students who did not participate in competency-based education is analyzed alongside a group of students who participated in competency-based education.
- Policymakers and higher education administrators can learn from the process NCC underwent to design a model that incorporated some key tenets of more traditional models, but did not incorporate the open entry/open exit characteristic because it was incompatible with its institutional structure and rendered the program ineligible for Title IV financial aid. Strong evidence about the impact of different types of competency-based education programs on student outcomes will equip policymakers and administrators to make effective decisions on whether to incentivize or facilitate these models through adaptation of institutional operations and federal financial aid policy.

Program Description and Implementation Narrative

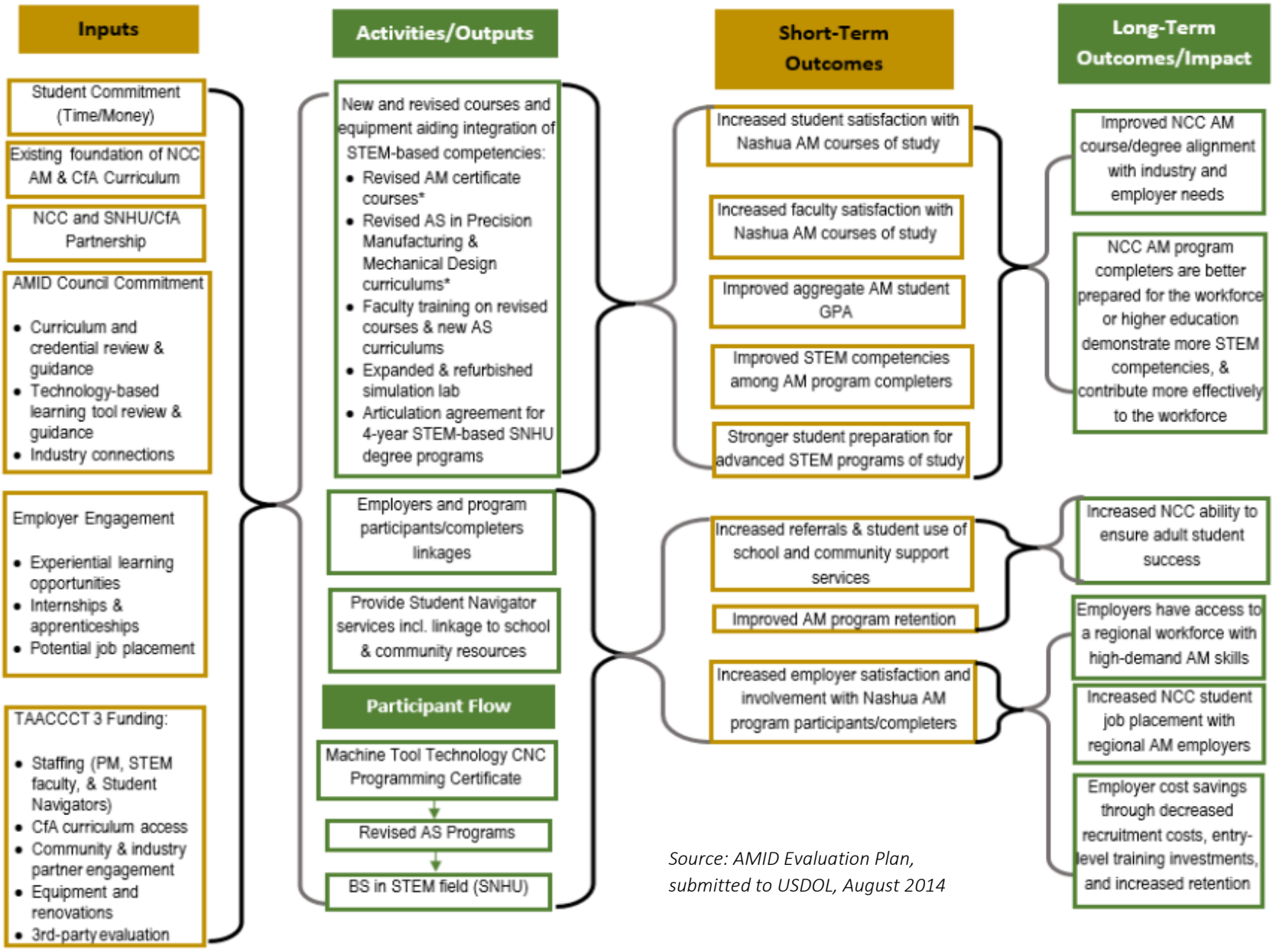
Program Description

In October 2013, Nashua Community College (NCC) in Nashua, New Hampshire received a $2.6 million Trade Adjustment Assistance Community College Career Training (TAACCCT) grant from the United States Department of Labor (USDOL) in support of the Advanced Manufacturing in Innovation and Design (AMID) program. AMID's overarching goal was to provide relevant training and increase workforce skills in advanced manufacturing occupations for individuals negatively affected by changes in the economy. In addition, NCC stakeholders sought to leverage the funding to update the learning environment to make it more conducive to development of in-demand skill sets. Specifically, the project would:

- Develop a competency-based, technology-enabled and enhanced education model for two existing associate degree programs in Precision Manufacturing and Mechanical Design Technology, and an existing certificate in Machine Tool Technology CNC Programming;
- Improve the equipment and lab space capacity for Precision Manufacturing and Mechanical Design Technology courses;
- Provide individualized, wrap-around support to students based on their academic and social needs to promote success (the Student/Success Navigator intervention) and
- Develop academic pathways for Precision Manufacturing and Mechanical Design Technology programs via articulation agreements, and Prior Learning Assessments to allow students to gain academic credit for work experience and expedite time to completion.

As a recipient of previous rounds of TAACCCT funding, NCC intended to build upon previous infrastructure enhancements to offer a holistic approach to instruction via the AMID program. The original plan for this approach relied on a partnership with College for America (CfA) to transform the existing Precision Manufacturing and Mechanical Design Technology programs into a competency-based format. The partnership was envisioned to ensure student attainment of specific competencies and skills; offer accelerated learning strategies expediting time to completion; increase technology enhancements to courses and use of simulation; enhance articulation agreements (both between NCC programs and at other institutions); and provide wrap-around supports to reduce barriers to persistence and completion that non-traditional students can experience. The following logic model outlines the theory of change behind the AMID program.

Figure 1: Original AMID Logic Model



Source: AMID Evaluation Plan, submitted to USDOL, August 2014

NCC envisioned that an Advisory Council would oversee and guide the various elements of AMID's design and implementation. The Advisory Council would be comprised of the following groups of stakeholders and form work groups to provide expertise and support to different components of the project:

- NCC Administrators (including the President, the Associate Vice President of Institutional Research and Academic Affairs the Vice President and Associate Vice President of Academic Affairs, and the Vice President of Student and Community Affairs)
- Program staff (Interim Program Director and Project Coordinator, Student/Success Navigators[4])
- Faculty Program Directors
- Government agency representatives
- Industry partners
- Social service providers

The implementation strategy for certain AMID components materialized differently than originally planned, as discussed in the Program Implementation Background Narrative below. However, NCC administrators, AMID faculty and program staff, and external partners and stakeholders adapted to the constraints and circumstances they encountered to:

- Design an approach to competency-based education compatible with the traditional academic term and infrastructure, revising course delivery and structure for two Associate of Science degrees (Precision Manufacturing and Mechanical Design Technology) and the Machine Tool Technology CNC Programming certificate, and creating the new Metrology and Quality Control for Precision Manufacturing certificate;
- Integrate technology and new equipment to help students develop skill sets needed in the workplace;
- Support AMID students in navigating college processes and preparing for careers through the Student/Success Navigators;
- Enhance NCC's ability to facilitate graduates' articulation to four-year degrees; and
- Build institutional capacity to incorporate certain elements of AMID (competency-based course design, meaningful industry engagement) into other technical education programs at the college.

[4] In the early phase of the project Success Navigators were referred to as Student Navigators. Both terms are used throughout this report, depending upon which title was in use during the event or finding discussed.

Key AMID Program Components: Implementation Narrative[5]

This report section describes AMID's governance and staffing structure as well as important background information and implementation details of two of AMID's core elements: revised, competency-based Precision Manufacturing and Mechanical Design Technology programs and the Student/Success Navigator intervention. Additionally, it provides context for major program decisions and highlights institutional and external factors that affected the implementation decisions, strategies, and processes around the competency-based education model chosen for implementation and the Student/Success Navigator role.

Program Governance and Staffing

AMID Council

NCC administrators and the Interim Program Director formed the AMID Council to serve as a governance structure for the project and ensure that all AMID project components were designed with meaningful input from a collection of internal and external stakeholders and experts. Additionally, the AMID Council committees and work groups were intended to provide ongoing support and guidance to different key elements of the program after the initial design phase.

In early May 2014, NCC hosted an AMID kick-off meeting to inform key stakeholder groups about the project and generate interest, gather input on project priorities, strategies, and desired outcomes, and solicit partner involvement. NCC administrators and the Interim Program Director began planning for this meeting in April 2014, developing lists of representatives from community agencies, organizations, and regional employers to invite. They intended to involve stakeholders who could inform AMID curriculum development, ensuring the revised competency-based offerings would develop students' skills aligned with industry demands and needs; service providers who could inform a unique approach to supporting non-traditional student success; and relevant government agency officials to inform alignment with regional and local workforce and economic development strategies. Key attendees internal to NCC included the President, Vice President of Academic Affairs, Associate Vice President for Academic Affairs, the Vice President of Student and Community Affairs, and the Associate Vice President of Institutional Research and Academic Affairs. Seventy-five external attendees included NCC business partners, representatives from public agencies, including social service organizations and the local Workforce Development Board, and elected officials. Key topics of discussion included an overview of the various elements and goals of the AMID program, an introduction of planned CfA's role to conduct a curriculum gaps analysis to identify discrepancies between advanced manufacturing employer skill needs and availability of these skillsets in the workforce, and subsequent plans for CfA to facilitate AMID curriculum redesign to a competency-based structure[6]; and how to further generate interest and solicit participation in the project from the appropriate stakeholders. In the months following the kick-off meeting, while simultaneously advancing other aspects of the project, NCC administrators and the Interim Program

[5] Sources for the Program Implementation Narrative section of the report include program documents and artifacts, including: the original grant application; AMID Council Work Group reports and deliverables; project management documents and reports; meeting records (notes and rosters, PowerPoint presentations); course outlines; program promotional materials, and notes from monthly and quarterly calls.

[6] See Competency-Based Curriculum Redesign Process section for an explanation of CfA's planned role and how it evolved during the project design phase.

Director revised the plan for the governance structure and extended personal invitations to certain stakeholders to take an active role in the project design and implementation and attend the next meeting.

The second convening of the Council took place in September 2014. The thirty-two participants included:

- Representatives of several regional manufacturing employers (technical/engineering and HR staff);
- Representatives of state agencies (NH Department of Labor, NH Department of Resources and Economic Development, and NH Department of Health and Human Services,)
- Representatives from community service providers and resource organizations;
- CfA representatives;
- NCC administrators and AMID faculty Program Directors, the Interim Program Director, and third-party evaluators.

This second meeting represented a significant milestone in securing internal stakeholder and external partner commitment to the AMID project and leveraging partners' contributions to bring different elements of the program to fruition. During to this meeting, the contracted Interim Program Director and NCC administrators presented a draft governance infrastructure for the project. The proposed governance council structure included both committees and Work Groups. It was envisioned that the Committees would oversee certain broad areas of implementation over the course of the entire AMID project, while Work Groups were intended to complete specific tasks necessary to define and develop curriculum and student support. Most of the Work Groups were intended to dissolve at different points during the project, when relevant tasks had been completed. By the end of the meeting, many of the attendees had signed up to participate in committees and Work Groups The following table outlines the original plan for major tasks and responsibilities for each committee and Work Group, as well as stakeholders that committed to participate after the September 2014 meeting.

Table 1. Planned AMID Council Committee and Work Group Tasks and Responsibilities

Name	Summary of Major Tasks and Responsibilities	Initial Membership
COMMITTEES		
Executive	Provide oversight and guidance to all aspects of AMID implementation; develop and implement a sustainability plan	Employer partner representative, NCC President, state agency representatives
Workforce Development	Facilitate linkages to existing workforce development programs and referral systems for the AMID program; ensure strategic alignment with workforce policies and programs	WDB representative, nonprofit organization representatives
Industry Linkages	Inform efforts to align curriculum focus, content, and projects with industry skill needs; support work-and-learn arrangements; refer incumbent workers	Employer partner representatives
Academic Resources	Oversee AMID curriculum assessment and redesign efforts; facilitate development of policies and	NCC Administrators (VP Academic Affairs, NCC faculty)

Name	Summary of Major Tasks and Responsibilities	Initial Membership
	procedures for curricular approval and articulation agreements	
Community Resources	Facilitate linkages to existing community services for AMID students; oversee the design and implementation of the Student Navigator program	State agency representative (NH DHHS, service provider representatives
Work Groups		
Gaps Analysis	Work with CfA to plan and implement curriculum gaps analysis; review gaps analysis final report	NCC administrator, NCC faculty, employer partner representatives
Curricula Assessment	Evaluate existing Precision Manufacturing and Mechanical Design Technology Curricula; establish key competencies for each course; make recommendations for curriculum redesign	NCC administrator, NCC faculty, employer partner representatives
Academic Mapping	Develop schematic linking competencies to Precision Manufacturing and Mechanical Design Technology courses; work to establish articulation agreements	NCC administrator, NCC faculty, CfA representative
Curriculum Redesign	Re-design courses to address competencies defined and integrate technological resources; design assessment rubrics.	NCC administrator, NCC faculty, CfA representative, community service provider
Student Services	Develop Student Navigator program logic model; develop needs assessment/intake sheet and data collection system; identify community services to address needs; develop risk stratification rubric	State agency representative (DHHS); NCC Administrator
Cyber Learning	Identify best practices for cyber learning and ensure integration into re-designed curriculum.	CfA representative, NCC faculty, employer partner representative
Marketing	Develop and oversee internal and external AMID marketing strategy	NCC staff

Source: AMID Governing Structure Functions Document, October 2014

This complex project governance structure simplified quickly after the September 2014 meeting, and remained significantly more streamlined for the duration of the AMID project. Additionally, the Program Coordinator assumed a critical role in managing Work Group processes, decision-making, and follow-up.

This simplification of the AMID governance structure, and one additional Work Group (Policies and Procedures Work Group) resulted from several factors:

1) ***The Gaps Analysis Work Group*** stopped meeting in late 2014 after it completed its main task—assisting CfA and NCC with the curriculum gaps analysis.
2) The Committees and Work Groups with curricular functions ***(Academic Resources Committee and the Curricular Assessment, Academic Mapping, Curricula Redesign, and Cyber Learning Work Group)*** merged in December of 2014 to form the ***Competency-Based Education Work Group.*** Many of the

tasks around curriculum redesign were integrally linked, and both internal and external stakeholders emerged as leaders to determine how to approach the curriculum redesign process.

3) ***A Policies and Procedures Work Group*** was formed to determine the most practical ways to develop a competency-based education approach in consideration of various CBE models and their operational and policy implications. This group was comprised of internal NCC administrators and the Data Analyst/Project Coordinator, and facilitated administrative tasks necessary to implement NCC's unique competency-based model for AMID.
4) The ***Community Resources Committee and Student Services Work Group*** merged into the ***Student Navigator Work Group*** to design and oversee the Student Navigator component of the AMID program, as well as advise NCC on community resources available to support students.
5) Other functions, including facilitating and implementing the work of the committees, marketing, partnership cultivation, and administrative tasks were eventually absorbed by the full-time NCC Project Coordinator, when hired in April 2015.

AMID Staffing

USDOL's period of performance for the third round of TAACCCT projects began on October 1, 2013, but due to administrative delays, NCC's contract with USDOL was not executed until April 1, 2014. As such, during the first six months of the period of performance, no funds could be expended. After the execution of the USDOL contract, NCC administrators contracted with a private consultant who had assisted the college with the TAACCCT grant application to facilitate start-up activities. These included planning and developing the AMID governance structure and early program development tasks such as working with CfA on the curriculum gaps analysis and curriculum redesign plan, overseeing the bid process for lab renovations, and creating job descriptions for grant-funded positions.

Initially, NCC planned to hire a Project Coordinator for the AMID program, as well as a Data Analyst, two Student Navigators, a Math Instructor, and a Lab Assistant. Internal stakeholders expected to play a significant role in program implementation included Precision Manufacturing and Mechanical Design Technology Program Directors and adjunct faculty. Administrators including NCC's President, the Associate Vice President for Institutional Research and Academic Affairs, the President and Associate Vice President of Academic Affairs, and the Vice President of Student and Community Affairs also consistently lent support to the program by participating in AMID Council Work Groups; providing curriculum and policy/procedures revisions guidance; leadership and facilitation of work; designing the Student Navigator program; managing student data and reporting and representing the program to industry partners and other external stakeholders.

Job postings for the Project Director position initially yielded no qualified applicants, so NCC decided to continue to work temporarily with the external consultant to facilitate the AMID Council and manage initial start-up activities. NCC administrators, and faculty maintained a high level of involvement during this time, supporting the work of the consultant and AMID Council Work Groups. In November 2014, six months after the USDOL contract execution, NCC hired a Data Analyst to oversee AMID participant data collection and analysis, complete reports, and assist with continuous program improvement efforts. The Data Analyst gradually absorbed more of the project management and coordination duties over the course of the next several months, and officially assumed the full-time AMID Project Coordinator position

in April 2015. This was due to the Project Coordinator's competencies and prior experiences with NCC's technical education programs as well as increasing challenges with the project management functions being managed by an external consultant.

In early 2015, based on the work of the AMID Council Competency-Based Education Work Group, NCC hired an Instructional Designer to teach the faculty and adjunct instructors how to design activities and assessments to reinforce key curricular competencies the Work Group had defined, modularize courses accordingly, and create assessments. The Instructional Designer began work in March 2015. Throughout the spring and summer 2015, the Instructional Designer, full-time faculty, and adjunct instructors worked together to adapt existing modules, activities, and assessments to address the competencies defined for the AMID foundational courses (MTTN 101 and MTTN 111.) In Fall 2015, the first cohort of Precision Manufacturing AS degree and certificate and Mechanical Design Technology AS degree students took the revised foundational courses, in addition to the new Technical Communications course designed specifically for the certificate program. Over the academic year, the Precision Manufacturing and Mechanical Design Technology Program Coordinators continually worked with the Instructional Designer to complete modifications for more courses. In Fall 2015, NCC hired a Lab Assistant to support the AMID faculty with hands-on instruction and skills assessments in the lab. Another Lab Assistant was hired as Program Coordinators and faculty determined there was a greater need for this additional position than the Math Instructor position originally included in the grant proposal. This change was approved by the Federal Project Officer through a budget modification.

In Fall 2015, after the Student Navigator Work Group had completed the Navigator program design, NCC hired the first Student Navigator position. The second Navigator joined the program early in the Spring 2016 semester. By the end of the period of performance, NCC had transitioned one of the Student Navigator positions to the Academic Affairs division of the college, to provide services to students in all technical programs. In spring 2016, NCC hired contractors to advance work around developing guidance for Prior Learning Assessments and articulation agreements with four-year programs.

Competency-Based and Technology-Enhanced Curriculum Redesign Process

At the core of NCC's plan for the AMID program was a curricular redesign for the Precision Manufacturing and Mechanical Design Technology program. The intention of the redesign was to create a new, more flexible model of education that emphasized hands-on demonstration and practice of technical skills and competencies, allowing students to progress through the material at their own pace. The process of the curriculum redesign would begin with a thorough needs assessment to evaluate the relevancy of NCC's current programs to industry dynamics, then use those findings to adjust course content, skills taught, and delivery methods, and advance articulation agreements.

College for America (CfA) was identified as the original partner for the work of the curriculum redesign. CfA, partnered with Southern New Hampshire University (SNHU), is a competency-based, self-paced, fully online general studies program (offering both Associate of Arts and Bachelor of Arts degrees) designed to diminish barriers non-traditional, working students face to college completion, such as rising tuition costs and inflexible schedules. Students demonstrate competency mastery through projects assessed by rubrics and move though the material at their own pace, repeating projects if necessary.

In early AMID Council meetings, CfA presented its approach to competency-based education and worked with the Gaps Analysis Work Group, the Interim Project Director and NCC administrator to gather data through manufacturing company staff focus groups to identify in-demand occupations and skill sets, needed skills and competencies, and NCC curriculum gaps. Representatives from eight area manufacturing companies as well as several agencies and community organizations attended focus groups to give input in October 2014. The resulting report highlighted key skill gaps that influenced several adaptations to AMID courses during the redesign phase.

Over the next several months, however, NCC administrators, faculty, employer partners and staff realized that CfA's model of competency-based education was incompatible with employer needs and NCC's institutional constraints and context, for the following reasons:

1) Non-term based academic programs are typically not structured in alignment with requirements for US Department of Education Title IV financial aid application, which creates affordability barriers for students and scheduling and faculty compensation complexities for the institution. Additionally, the model would require a Substantive Change report to, and approval from, the New England Association of Schools and Colleges (NEASC) NCC's accreditor.
2) The CfA model was designed for arts and humanities fields as opposed for technical fields like Precision Manufacturing and Mechanical Design Technology. After learning more about CfA's model, faculty and industry partners expressed concern that the fully online format would not allow for necessary hands-on, lab-based experience.
3) Industry partners were concerned that CfA's practice of allowing students to make multiple attempts to complete projects or assessments that assessed mastery of competencies as many times needed to pass would not ensure students have the necessary mastery of skills. In the manufacturing work environment, multiple failed attempts to complete tasks are costly and can be dangerous, so this practice was incongruent with the advanced manufacturing work environment.

In late 2014 and early 2015, the Competency-Based Education and Policies and Procedures Work Groups developed a CBE model unique to NCC, focusing first on two Machine Tool Technology CNC programming certificate program courses, which overlap with foundational courses for both Associate degrees. This model incorporated some major tenets of more traditional models, including defined skills, knowledge, and proficiencies students should be able to demonstrate after each course and module; technology-enhanced courses, including flipped classrooms; and prior learning assessments aligned with competencies. NCC's model also provided an option for students to condense the amount of time spent in the program. This was accomplished by adding a cohort of first semester first-year students in spring and offering the second semester courses during the summer, allowing students to shorten their calendar time in the program by a semester. Finally, AMID courses were condensed in a ten-week format (one class is offered in an eight-week format) for an expedited learning timeline that still conforms to the term schedule to retain Title IV financial aid program eligibility and eliminate the need to complete a Substantive Change report for NEASC. Figure 2 outlines the key characteristics of NCC's unique CBE model, and the differences between conventional "seat time" education delivery models and less conventional CBE models.

Figure 2. NCC's Competency-Based Education Model for Precision Manufacturing and Mechanical Design Technology

WHAT Competency-Based Education LOOKS LIKE

The shape and depth of competency-based education (CBE) shifts each time a college or university starts a CBE program, because each institution's needs are different. Generally speaking, however, CBE programs distinguish themselves by "clearly defining and communicating what their graduates are required to know and be able to do," according to a report for the National Institute for Learning Outcomes Assessment. What follow are cross-sections of postsecondary elements meant to illustrate a spectrum of CBE, from the more traditional to the more experimental. While necessarily non-exhaustive, the illustration is meant to give a quick introduction to how learning and other aspects of college and university work can differ according to how much CBE is applied.

More conventional	NCC AMID Model	Less conventional
EDUCATIONAL MODEL - Competencies embedded in courses - Faculty and Textbooks	- Shorter/modular classes - Prior-learning assessment - Competencies and assessments - Credentials	- No formal classes - Referrals to open education resources - Prior-learning assessment
FACULTY ROLE Vertically Integrated Roles: Designing and Teaching and Assessing and Advising	Partially Disaggregated Roles: Designing and/or Teaching and/or Assessing and/or Advising	Disaggregated Roles: Designing or Teaching or Assessing or Advising
LEARNING SUPPORT Faculty-based advising	Dedicated coaching and mentoring within the program with strong connections to community services	- Online mentoring - Informal learning groups
TECHNOLOGY Web enhancements to classroom-based course	- Some online delivery - Flipped classroom - Open lab time	- Adaptive learning
TYPICAL STUDENTS - More traditional students - May be employed part time	- Non-traditional - Some postsecondary experience - Work experience - Incumbent workers - School and work highly integrated	- Non-traditional - Some postsecondary experience but no degree - some work experience - School and work highly integrated
FEE STRUCTURE - Time-bound - Pay per term or credit hour - Title IV eligible	- Time-bound - Pay per term or credit hour - Title IV eligible	- Subscription model (all you can learn within a given time) - Direct assessment - Few programs are Title IV eligible

Modified from Infographic: What Competency-Based Education Looks Like, American Council on Education, 9/9/2014

Source: CBE and Policies and Procedures Work Group, spring 2015

When the Work Groups came to consensus about the type of CBE model to use, the Competency-Based Education Work Group, led by the Associate Vice President for Academic Affairs, began defining the process of revising existing courses to incorporate these elements, focusing first on the Machine Tool Technology CNC Programming Certificate. The Work Group reviewed and updated outcomes and defined key competencies for the certificate program and each course.

The Work Group defined the next step in the process as developing modules within each course for a single or related group of competencies, then creating activities (in-class, online, and in lab) and assessments for each module. NCC hired an Instructional Designer to work with faculty and adjunct instructors (on contract) to complete this process for each course specific to the Precision Manufacturing and Mechanical Design Technology certificate and degrees. Three redesigned courses rolled out in the Fall 2015 semester:

- MTTN 101: Manufacturing Processes (a foundational class for the certificate and both degrees)
- MTTN 111: Machine Tool Processes and Theory I (a foundational class for the certificate and Precision Manufacturing degree)
- MTTN 105N, Technical Communications (new class for the certificate)

Through the 2015-2016 and 2016-2017 academic years, the Precision Manufacturing and Mechanical Design Technology Program Coordinators, faculty and adjunct instructors continually worked with the Instructional Designer to define competencies for, modularize, and create activities and assessments for the remaining technical courses for the certificate and degree programs. The general education courses required for the degree programs were still delivered in the traditional curricular format, as well as some required courses taught in other technical education departments at the college.

By the end of redesign process, all technical courses specific to the Precision Manufacturing certificates and degree and Mechanical Design Technology degree had been revised to NCC's competency-based format through the objective/competency working sessions with the Instructional Designer and faculty. Additionally, all AMID technical courses incorporated technology enhancements by the end of the grant period, some including Tooling U modules and training resources. By the end of the project, NCC had fully hybridized multiple courses: MTTN101 (Manufacturing Processes), MTTN105 (Technical Communications) and MTTN 201N, (Lean and Green Manufacturing Methods.) Until Fall of 2015, none of the AMID courses included any technological enhancements; by the end of the project, they all included technological enhancements. During the objective-competency working sessions, full-time faculty, adjunct instructors, and the Project Coordinator identified specific uses of Blackboard and additional technological tools to reinforce key concepts learned in each course.

All courses with a lab requirement (identified in the Program Offerings table) retained a robust hands-on, face-to-face training component. AMID faculty and staff continually evaluated and modified AMID delivery modalities. For example, MTTN 101, a foundational AMID course with no lab component, was first offered face-to-face. After the first round of design iteration, it was offered fully online. Finally, this course was redesigned as a hybrid format. This curriculum redesign process was iterative in nature and faculty and staff continually evaluated the process and the outcomes of curriculum changes and adjusted as necessary.

One new course was created in the curriculum redesign process: MTTN 105N, Technical Communications. MTTN 201N, Metrology and Quality Control, was first developed and taught at another college, then the instructor brought it to NCC. This course teaches inspection, precision measurement, and quality control skills and utilizes equipment purchased through grant funding to facilitate the hands-on learning activities. Leveraging this existing course and the curriculum redesign work completed for the Machine Tool Technology CNC Programming certificate, NCC began offering a certificate in Metrology and Quality Control for Precision Manufacturing by the end of the grant period.

Table 2 outlines NCC's competency-based Precision Manufacturing and Mechanical Design Technology program offerings in Academic Year 2016-2017, the end of the grant period.

Table 2: AMID Program Offerings, AY 2016-2017

Certificates							
	Machine Tool Technology CNC Programming (48 credits)			Metrology and Quality Control for Precision Manufacturing (27 credits)			
Course Number and Name	Class Hours	Lab Hours	Credits	Course Number and Name	Class Hours	Lab Hours	Credits
MTTN 101N: Manufacturing Processes	3	-	3	MTTN 101N: Manufacturing Processes	3	-	3
MTTN 105N: Technical Communications	4	-	4	MTTN 105N: Technical Communications	4	-	4
MTTN 111N: Machine Tool Processes & Theory I	3	9	7	MTTN 111N: Machine Tool Processes & Theory I	3	9	7
MATH 110N: Algebra & Trigonometry or MATH 105N: Technical Math	4	-	4	MATH 105N: Technical Math	4	-	4
MTTN 122N: Machine Tool Processes and Theory II	3	9	7	CAD 131N: Technical Drawing	2	3	3
CAD 131N: Technical Drawing	2	3	3	MTTN 201N: Lean and Green Manufacturing Methods	3	-	3
MTTN 123N: Principles of CNC	2	3	3	MTTN210N: Metrology and Quality Control	2	3	3
MTTN 231N: Advanced Machine Tool Processes & Theory I	3	9	7				
MTTN 223N: Computer Aided MFR	2	3	3				
MTTN 232N: Advanced Machine Tool Processes & Theory II: A Capstone Experience	3	9	7				
Associate of Science Degrees							
	Associate of Science in Precision Manufacturing (71 credits)			Associate of Science in Mechanical Design Technology (66 credits)			
Course Number and Name	Class Hours	Lab Hours	Credits	Course Number and Name	Class Hours	Lab Hours	Credits
First Year-Fall Semester							
MTTN 101N: Manufacturing Processes	3	-	3	CAD 111N: CADD 1	3	4	5
MTTN 111N: Machine Tool Processes & Theory I	3	9	7	MTTN 101N: Manufacturing Processes	3	-	3

ENG101N: College Composition	4	-	4	ENG101N: College Composition	4	-	4
FYE101N: First Year Experience	1	-	1	MATH 110N: Algebra & Trigonometry	4	-	4
MATH 110N: Algebra & Trigonometry or MATH 105N: Technical Math							
First Year-Spring Semester							
MTTN 122N: Machine Tool Processes and Theory II	3	9	7	CAD112N: CADD II	3	4	5
CAD 131N: Technical Drawing	3	3	3	MTTN118N: Machining Technology	2	3	3
MTTN 123N: Principles of CNC	2	3	3	MDTN 110N: Automation Programming	3	1	3
English/Communications Core Requirement	2	0	3	PHYS130N (Physics I) OR PHYS101N (Physical Science)	3	2/3	4
Science Core Requirement	2	2/3	4				
Second Year Fall Semester							
MTTN 231N: Advanced Machine Tool Processes & Theory I	3	9	7	CAD215N: CADD III (Pro E)	3	6	5
MTTN 223N: Computer Aided MFR	2	3	3	ELET131N: Circuit Analysis I	3	3	4
Science Core Requirement	3	-	3	ELMT203N: Applied Mechanics I	3	1	3
Behavioral Social Science Core Requirement	3	-	3	English/Communications Core Requirement	3	-	3
				History/Political Science Core Requirement	3	-	3
Second Year Spring Semester							
MTTN 232N: Advanced Machine Tool Processes & Theory II: A Capstone Experience	3	9	7	MDTN285N: Capstone Project	3	2	4
MTTN 201N: Lean and Green Manufacturing Methods	3	-	3	ELMT 203N: Fluid Power Design	2	1	2
ARTS 140N: Welding & Metal Craft OR Humanities/Fine Arts Core Requirement	1	4	3	ELMT 210N: Applied Mechanics II	2	1	2
History/Political Science Core Requirement	3	-	3	MTTN 201N: Lean and Green Manufacturing Methods	3	-	3
				ARTS 140N: Welding & Metal Craft OR Humanities/Fine Arts or Global Awareness Core Requirement	1	4	3
				Behavioral Social Science Core Requirement	3	-	3

Source: Nashua Community College Catalogue, 2016-2017

Success Navigators

NCC based its plan for Success Navigators as part of the AMID program on the premise that non-traditional, working age students tend to experience barriers to academic program persistence and completion due to their multiple responsibilities and subsequent support needs. The Navigators were intended to coordinate academic and social support services internal and external to NCC, and to coach and guide AMID students throughout their programs, serving as advocates to improve the probability of persistence and retention.

The Student Navigator Work Group included participants from the New Hampshire Department of Health and Human Services, community organizations, and AMID staff. The Work Group identified a network of internal NCC and external state and community-based resources, programs and services available to help address a variety of potential student needs. These included academic assistance and coaching, as well as navigating various systems and processes like admissions, registration, and financial aid access. To facilitate this process, Success Navigators would be linked to financial aid office, registrar, and advising staff. Thus, Navigators would supplement and coordinate resources available at the college. Additionally, it was anticipated that some students may need help with things like medical and mental health care, childcare or elder care, transportation and housing assistance, and financial, food and utility assistance. The Navigators could facilitate access to these services through state, local, and community-based agency and organization referrals. Figure 3 on the following page outlines the Work Group's logic model for the program.

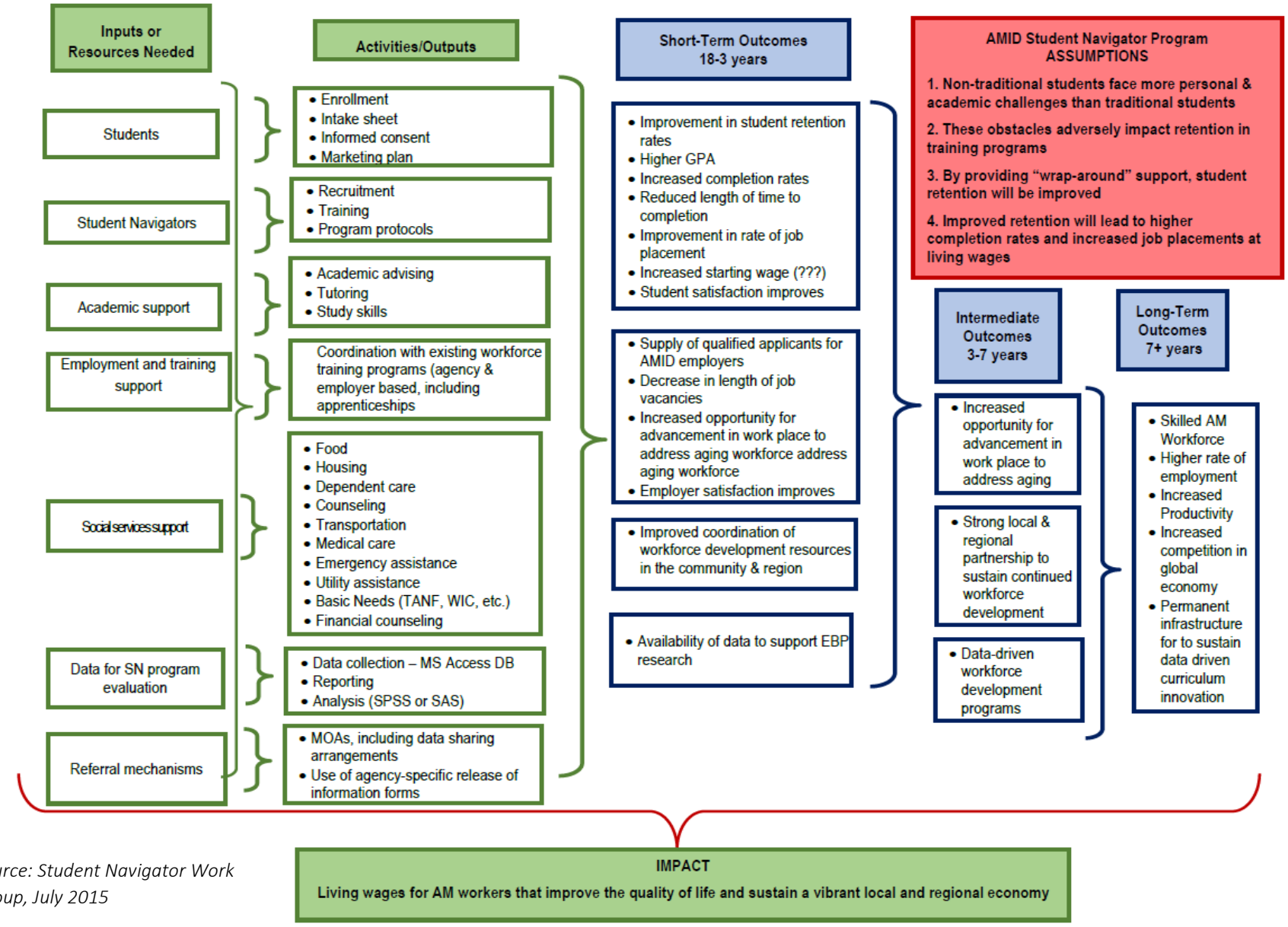
The Work Group identified one primary role of the Navigator as needs assessment, to identify and intervene with students at higher risk of dropping out or falling behind due to academic, personal, or family struggles. Members selected a Noel Levitz risk stratification assessment for each AMID student to take when entering the program. Students gave informed consent to participate in the risk stratification assessment. The assessment provided information students their learning styles, strengths and weaknesses. It also identified "high risk" responses. The Work Group defined intervention criteria and thresholds for students based on Noel Levitz scores. Eventually, staff developed a protocol to run certain Banner reports on students flagged as "high risk" to inform Navigators of specific warning signs like midterm warning grade reports, drop reports, accepted reports (if students are accepted but do not register), academic probation reports, and current students who had not registered for the following semester. This protocol was intended to use data to identify students at risk of falling behind and dropping out of the program quickly, and prevent this from happening whenever possible.

The Success Navigators were originally called Student Navigators; however, this title created internal confusion. Different departments within the college asked if these personnel we, in fact, students. Because the navigator role was a new concept to NCC, staff believed a job title change to "Success Navigator" would more accurately convey the true function of the role.

When the first Success Navigator was hired just prior to the Fall 2015 semester and began working with students, it became apparent that student needs were in greatest in the areas of academic assistance (e.g., tutoring) and coaching, navigating administrative systems at NCC (e.g., financial aid and the

registrar's office), and career preparation assistance, as opposed to social and community services. Therefore, an evolved understanding of AMID students' needs shaped the nature of the Success Navigators' work, placing emphasis on academic and career support and student advocacy with NCC staff and instructors, and diverting it away from social services.

Figure 3. Student Navigator Logic Model



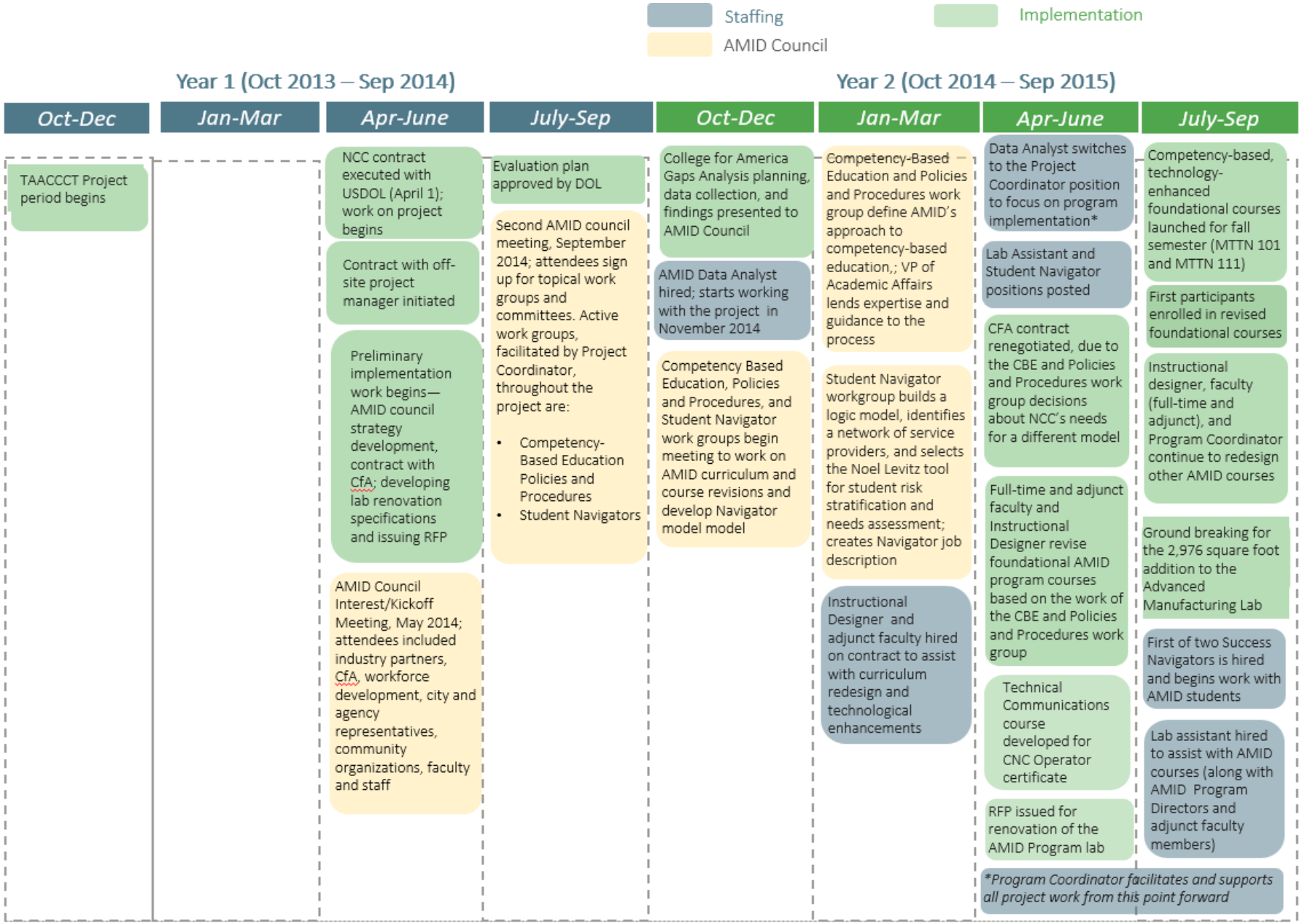
Source: Student Navigator Work Group, July 2015

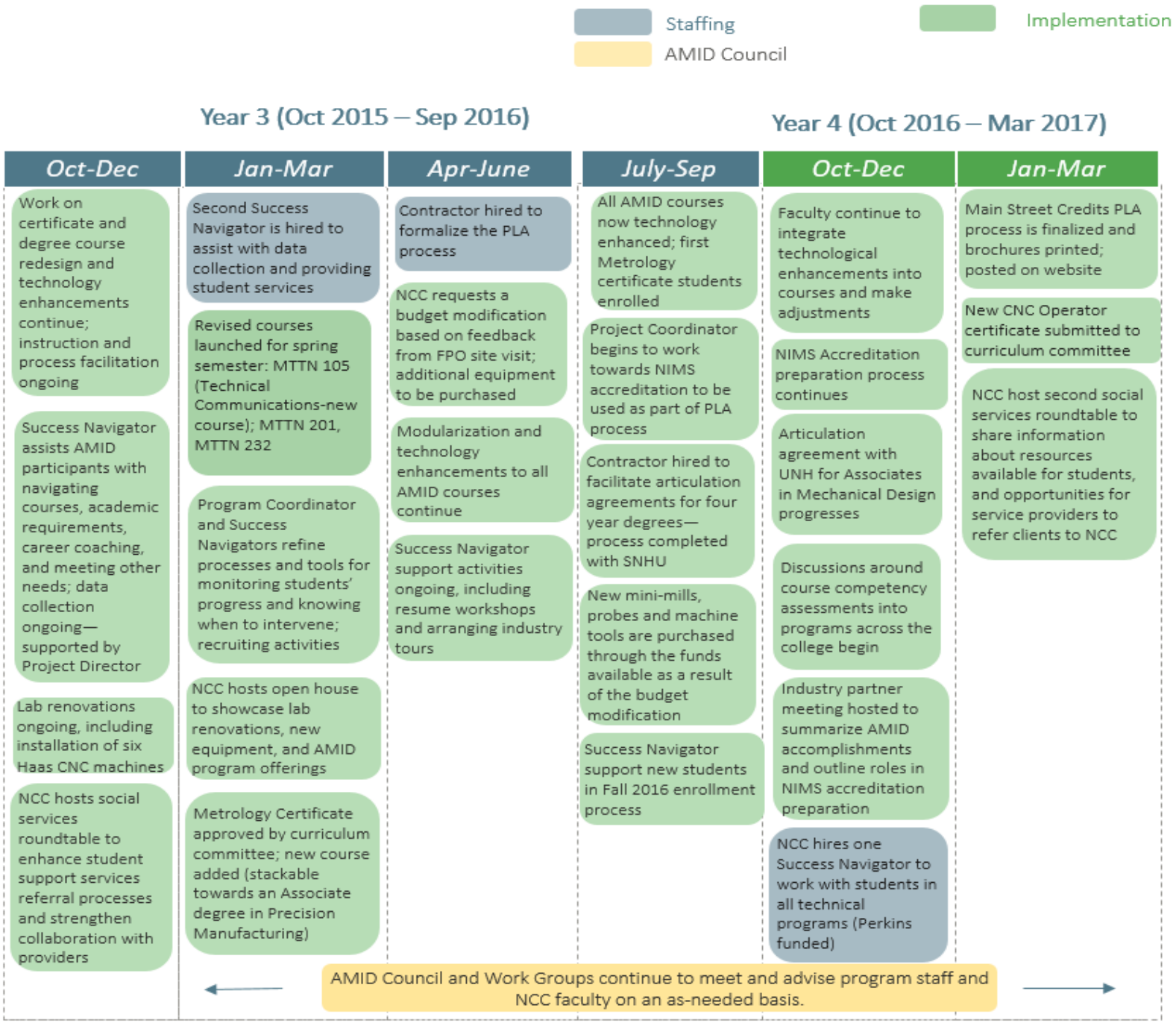
Major Implementation Milestones

The timeline on the next page outlines major implementation milestones for key components of the AMID program between October 2013 and March 2017. Categories of program activities, accomplishments, and deliverables represented include:

- Governance, leadership and staffing dynamics;
- AMID Council and Work Group deliverables;
- Key program deliverables completed, including:
    - Curriculum redesign and technology enhancements; new courses and certificate
    - Lab renovations and equipment purchases
    - Success Navigators' work
    - Prior Learning Assessments and articulation agreements with four-year institutions, including with SNHU to pursue a BS in Technical Management. An articulation agreement with the University of New Hampshire-Manchester is still pending at the time of this report.
- Major community and employer engagement efforts.

Figure 4. AMID Implementation Timeline




Staffing
Implementation
AMID Council
Year 3 (Oct 2015 – Sep 2016)
Year 4 (Oct 2016 – Mar 2017)
Oct-Dec
Jan-Mar
Apr-June
July-Sep
Oct-Dec
Jan-Mar
Work on certificate and degree course redesign and technology enhancements continue; instruction and process facilitation ongoing
Success Navigator assists AMID participants with navigating courses, academic requirements, career coaching, and meeting other needs; data collection ongoing—supported by Project Director
Lab renovations ongoing, including installation of six Haas CNC machines
NCC hosts social services roundtable to enhance student support services referral processes and strengthen collaboration with providers
Second Success Navigator is hired to assist with data collection and providing student services
Revised courses launched for spring semester: MTTN 105 (Technical Communications-new course); MTTN 201, MTTN 232
Program Coordinator and Success Navigators refine processes and tools for monitoring students' progress and knowing when to intervene; recruiting activities
NCC hosts open house to showcase lab renovations, new equipment, and AMID program offerings
Metrology Certificate approved by curriculum committee; new course added (stackable towards an Associate degree in Precision Manufacturing)
Contractor hired to formalize the PLA process
NCC requests a budget modification based on feedback from FPO site visit; additional equipment to be purchased
Modularization and technology enhancements to all AMID courses continue
Success Navigator support activities ongoing, including resume workshops and arranging industry tours
All AMID courses now technology enhanced; first Metrology certificate students enrolled
Project Coordinator begins to work towards NIMS accreditation to be used as part of PLA process
Contractor hired to facilitate articulation agreements for four year degrees—process completed with SNHU
New mini-mills, probes and machine tools are purchased through the funds available as a result of the budget modification
Success Navigator support new students in Fall 2016 enrollment process
Faculty continue to integrate technological enhancements into courses and make adjustments
NIMS Accreditation preparation process continues
Articulation agreement with UNH for Associates in Mechanical Design progresses
Discussions around course competency assessments into programs across the college begin
Industry partner meeting hosted to summarize AMID accomplishments and outline roles in NIMS accreditation preparation
NCC hires one Success Navigator to work with students in all technical programs (Perkins funded)
Main Street Credits PLA process is finalized and brochures printed; posted on website
New CNC Operator certificate submitted to curriculum committee
NCC host second social services roundtable to share information about resources available for students, and opportunities for service providers to refer clients to NCC
AMID Council and Work Groups continue to meet and advise program staff and NCC faculty on an as-needed basis.

Implementation Evaluation Study

Implementation Evaluation Study Design

Design Summary

The implementation evaluation began in July 2014 and continued through March 2017 (the end of the project period) to document AMID's progress, monitor program outcomes, and provide recommendations for continuous improvement of program operations. The implementation evaluation was primarily focused on the development of various elements of the AMID program. In this report, the implementation evaluation assesses the operational strengths and challenges the program experience, seeking to understand the effectiveness of core strategies from the faculty, student, and employer partner perspectives. Additionally, it documents context surrounding the project that may have contributed to participant outcomes as well as institutional capacity-building. The evaluation team used the research questions in Table 3 as a guide throughout the evaluation, framing specific questions to assess program processes and outcomes.

The objective of the formative implementation evaluation was to improve the effectiveness of program activities by monitoring progress throughout the life of the program, engaging stakeholders and ensuring their insight was incorporated into program decisions, documenting the extent to which the program was implemented with fidelity to the model, and providing context for why program elements were or were not producing expected outcomes. Monthly progress calls and quarterly implementation evaluation calls with program leadership and other relevant stakeholders (such as AMID Council members and employer partners) allowed the evaluators to understand progress as it occurred and provide timely, objective feedback throughout the implementation of the program that could be incorporated without interfering with the analysis.

Progress toward achieving targets was also evaluated on-site at two points in the program (spring of 2016 and winter of 2017) and was detailed in quarterly implementation evaluation summaries as well as within this Comprehensive Final Program Report. Through interviews with leadership, staff, partners, and employers and using the lens of the research questions in Table 3, the evaluators examined how the program was implemented at each stage – program challenges, successes, unintended consequences (both positive and negative), and reasons for accelerated or delayed program progress – and to what extent AMID implementation aligned with the original plan.

Research Questions

The following set of research questions guided the implementation evaluation and provided a normative basis for the evaluation.

Table 3: Implementation Evaluation Research Questions

Curricula Development and Modifications
1. How was the particular curriculum selected, used, and/or created?
Program Delivery and Modifications

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?

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?

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?

Understand Successes and Challenges to Implementation

5. What program outputs have been generated to date, and how do they align with the originally proposed project schedule? What barriers hindered output achievement? What factors unexpectedly improved output achievement? Why?

6. What program outputs have been generated to date, and how do they align with the originally proposed project schedule? What barriers hindered output achievement? What factors unexpectedly improved output achievement? Why?

7. What have been accelerators and obstacles to program performance?

8. How can program processes, tools, and/or systems be modified to improve performance?

9. Has faculty satisfaction with the advanced manufacturing course of study increased since AMID program implementation? If so, in what ways?

10. What factors contribute to and hinder students' success in completing an advanced manufacturing credential through the AMID program?

11. What specific benefits, if any, do students expect to receive by completing an advanced manufacturing credential through the AMID program?

Factors Affecting Partnerships

12. What specific benefits have AMID Council members (employers and community stakeholders) received (or, what specific benefits do they anticipate receiving) as a result of their involvement with the program?

13. In what ways, if any, has the program helped employers fulfill their needs for workers with advanced manufacturing skills?

Examine Institutional Capacity-Building.
14. What are the most promising programmatic components to expand institution–wide? Why?

Data Sources

To answer the research questions, the Evaluation Team utilized the following data collection sources.

Monthly Progress Update Calls. Monthly update calls served primarily as an administrative function by providing an opportunity for TPMA and the AMID staff to schedule evaluation-related activities, exchange key contact information for employers and grant partners, and discuss progress toward evaluation reports. The monthly calls also served as the venue for discussing data updates including participant counts and data tracking challenges.

Quarterly Implementation Calls. Quarterly implementation calls allowed key institution leadership, faculty, and program staff to provide the Evaluation Team with timely information regarding program process, progress, obstacles, and successes. Quarterly calls afforded NCC leadership an opportunity to recall events and challenges more frequently than on an annual basis. This information was expanded upon and clarified during annual onsite interviews and focus groups.

Document Review. Where applicable, the Evaluation Team reviewed program documents and artifacts to triangulate sources of information.

On-Site Interviews and Focus Groups. The Evaluation Team conducted two comprehensive on-site assessments of program implementation with scheduling support from the AMID project manager. TPMA met with program leadership, faculty, staff, students, employer partners, and other stakeholders to more fully evaluate program successes and challenges. Activities included interviews with leadership, instructors, Success Navigators, AMID council members, and employers, and focus groups with AMID students. Interview and focus group discussion guides were developed prior to onsite activities.

Capacity Building Indicators Data. When addressing how the program enhanced or expanded institutional capacity, TPMA collected qualitative data on the following capacity indicators:

- Identification of specific TAACCCT Round 3 program elements that expanded institutional capacity to deliver high-quality academic pathways, support students, and fulfill workforce needs of local businesses;
- Diffusion of lessons learned of TAACCCT Round 3 program elements throughout the institution;
- Institutional arrangements for technology and knowledge transfer;
- Level of AMID program leadership and staff commitment, and
- Level of employer and community partner (AMID council) response and commitment.

Analysis Methods

A general inductive thematic approach,[7] with influences of applied phenomenology,[8] was used to analyze the qualitative data generated from the focus groups and interviews. This approach was selected because of its usefulness in drawing clear links between research questions or objectives and data collection results, and because it provided a theoretical foundation for subjective meaning to be interpreted and extrapolated from discourse.[9] The analytical framework used for the analysis included a time-dependent gradient (changes occurring in each year of program implementation) and a program-dependent gradient (analyzing the program components). Units of analysis included the program, AMID staff, NCC administrators, program faculty, partners, and participants.

Emerging themes were then developed according to the analytical framework and through a review of (1) notes taken during monthly and quarterly update calls; (2) detailed notes taken during the site visits; (3) AMID documents; and (4) the Evaluation Team's extensive experience with technical training programs and the body of evaluation knowledge built through their work. Guidance about what was important came from the grant narrative, research questions, and calls that had occurred throughout the grant period. Following this initial theme development, additional Evaluation Team members reviewed the results, adding contextual details and examples. The themes were divided into the following categories:

- Program successes – major program accomplishments as perceived by college and grant faculty and staff, partners, and participants;
- Challenges and barriers – persistent difficulties staff faced in accomplishing grant initiatives;
- Lessons learned – opportunities the Evaluation Team identified for improving progress toward grant outcomes (in Interim Reports) and lessons learned for other educational institutions looking to start similar programs;
- Expanded institutional capacity – ways in which the Evaluation Team identified that the grant expanded the capacity of the institution.

The results were again compared to the analytic framework and anticipated reporting elements. The final step in the analysis was to send the summarized results to AMID staff at NCC for clarification and additional contextual details.

To strengthen the accuracy and credibility of implementation study findings, the Evaluation Team relied on triangulation and collaborative inquiry. By comparing findings based on different data sources and using approaches that incorporated both evidence and negative evidence, the Evaluation Team created a robust and dynamic depiction of implementation.[10] By presenting findings to NCC staff for elaboration, corroboration, and modification, the Evaluation Team confirmed and updated analyses. Additionally, by sharing findings with intended users as they emerged, the Evaluation Team built a collaborative

[7] Thomas, D.R. (2006). *A general inductive approach for analyzing qualitative evaluation data.* American Journal of Evaluation, 27, 237-245.
[8] Guest, Greg, MacQueen, K.M., and Namey, E.E. *Applied Thematic Analysis*. Thousand Oaks, CA. SAGE Publications, Inc., 2011.
[9] Ibid.
[10] Brewer, J. and A. Hunter. *Foundations of Multimethod Research: Synthesizing Styles*. Thousand Oaks, CA. SAGE Publications, Inc., 2006.

relationship with stakeholders that encouraged higher quality first-person data and increased the likelihood the evaluation could produce timely, user-relevant findings. [11]

Limitations

Limitations for the Implementation Evaluation included the following main elements:

Limited Data Sources – When possible, the Evaluation Team used data triangulation to verify narratives and other information shared by key stakeholders. Triangulating data from multiple sources, such as comparing findings among stakeholder interviews and with documents reviewed, creates more credible evaluation results and is considered critical to the validity and reliability of findings.[12] However, the Evaluation Team sometimes was faced with a limited number of data sources due to inability to speak with all stakeholders involved in an effort.

Effort Justification Bias – Stakeholders connected to the grant may have exaggerated progress related to AMID to justify the significant investment made by USDOL into the program. Due to the lack of data (quantitative and qualitative) available to the Evaluation Team, interviews with these stakeholders were an especially important source of information. However, without a strong ability to triangulate data using multiple sources, it was more challenging for the Evaluation Team to verify statements made by NCC stakeholders. As best as possible, the Evaluation Team documented the data sources for the Implementation Evaluation and noted when information was received primarily from one source.

Partial and Biased Findings – Qualitative and perceptual research methods offer good insights, but are, by nature, partial and biased. For this study, perceptual information (data gathered through focus groups and interviews with staff, stakeholders, and participants) was the primary mechanism by which information was obtained to gauge successes and challenges of the project. The Evaluation Team was faced with a limited number of additional data sources (quantitative and qualitative) to support these findings. To attempt to address this limitation, the Evaluation Team used data triangulation whenever possible, including interviewing multiple stakeholders.

Respondent Order Effect – During each site visit, the Evaluation Team conducted a group interview for students in the AMID program. At these group interviews, participants more interested in sharing their opinions of the program may have spoken up at a greater rate than other students. This may have created a pecking order bias by participants self-selecting their response order (i.e. certain participants go first and others go last). Receiving a range of feedback from participants, from positive to critical, supports the notion that a spectrum of student experiences was captured; however, it is possible that bias related to the participant response ordering was introduced into the evaluation.

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[11] Cousins, J.B. and Earl, L. M. (1992) *The Case for Participatory Evaluation*. Educational Evaluation and Policy Analysis, 14(4), 397-418.
Cousins, J.B. and Whitmore, E. (1998) *Framing participatory evaluation*. New Directors for Evaluation, 80. 5-23.
Greene, J. G. (1998) *Stakeholder participation and utilization in program evaluation*. Evaluation Review, 12. 91-116.
Reineke, R. A. (1991). *Stakeholder involvement in evaluation: Suggestions for practice*. American Journal of Evaluation, 12, 39-44.
[12] Denzin, N.K. *The research act: A theoretical introduction to sociological methods* (2nd edition). New York, NY. McGraw-Hill. 1978.
Patton, M.Q. (2001). *Evaluation, Knowledge Management, Best Practices, and High Quality Lessons Learned*. American Journal of Evaluation. 22(3). 329-336
Patton, M.Q. *Qualitative Research & Evaluation Methods* (4th edition). Thousand Oaks, CA. SAGE Publications, Inc., 2015.

Researcher Extrapolation – Analysis conducted with an interpretive analytical framework, influenced by phenomenology, suffers from the threat that researcher extrapolation and interpretation may go too far beyond what is present in, and supported by, data.[13] Indeed, the recommendations provided in this report are based on a combination of what was learned and supported by data and the experiences and findings of the evaluators' previous experience designing, implementing, and evaluating various workforce development programs.

[13] Guest, Greg, MacQueen, K.M., and Namey, E.E. *Applied Thematic Analysis*. Thousand Oaks, CA. SAGE Publications, Inc., 2011.

Findings

Program Successes

Despite facing initial delays in implementation due to the federal government shutdown and inability to execute a contract with USDOL, as well as changes in approach to the competency-based curriculum modifications, the AMID program has achieved many successes.

Created and implemented a competency based education (CBE) model incorporating technology-enhanced courses in alignment with institutional context and employer needs.

After receiving feedback from employer partners, the financial aid office, and others, which indicated difficulties in implementing a CfA's CBE model, the Competency-Based Education and Policies and Procedures Work Groups undertook a process of developing a unique model (see the Competency-Based Curriculum Redesign Process section for more details on this process and the results.) One NCC administrator noted, "when we were first putting the curriculum together with the CfA CBE model, it was a big surprise when the partners were so vocal about 'that is not going to work.'" According to AMID staff, "initially we thought we'd work with CfA and they would help us change our delivery to completely competency-based. We realized early on [though] that this wouldn't be the match made in heaven, so we reduced their role."

After the CBE Work Group's report, NCC hired an Instructional Designer to work with adjunct and full-time faculty to translate course objectives to competencies, and modularize the curriculum with activities and assessments for each module. NCC and the AMID Council modified elements of competency-based education approaches to create a customized model that fits well within the college's institutional practices and operations. Per AMID staff, "CBE has its own interpretations, and we came up with our own. The NCC AMID model has a 'what competency-based education looks like' between more conventional and less conventional." According to one instructor, "the emphasis [of the grant] was curriculum and tech improvement, delivery and access. We've made huge progress in that respect."

Developed and Implemented Technology-Enhanced Learning Models

AMID leadership particularly mentioned the importance of making courses technology-advanced. "Manufacturing in some people's minds is old and dirty, but in real life, it's highly mechanized. A person working in these shops will spend as much time programming the machine as they do running parts."

By the end of summer 2016, all technical AMID courses had incorporated technology enhancements, with at least some portion of the course being available online through Blackboard. Two full-time faculty Program Directors and 15 adjunct instructors underwent Blackboard training to attain proficiency in teaching through this modality. Additional technological resources, such as Tooling U modules, were identified in alignment with course competencies defined in the objective/competency working sessions with the full-time faculty, adjunct instructors, and Instructional Designer. One faculty member indicated, "we have three fully accessible courses on Blackboard, whereas a year ago we had none." Throughout the course of the grant, faculty continued to refine their use of technology based on student feedback. As instructors became more familiar with these tools, they identified the best ways technology could be

used to strengthen their courses. As one faculty member noted, "we've learned that a certain age group doesn't take to [technology enhancements] as well, but most everyone appreciates the value it has added to their learning." To addresses differences across courses within the program, faculty indicated they have adjusted the ratio of online vs. hands-on learning in certain courses, but each revised course still includes some element of technology-enhanced learning.

Staff worked with the NCC Media Coordinator at the college to shoot and edit videos for their courses. This allows staff to create instructional materials that cover precisely the material they find relevant rather than depend on what they can find online. Additionally, AMID staff and faculty see an advantage in students being able to access these videos and watch them as many times as they need via Blackboard. Now, the instructor demonstrates the certain activities only once, and students can access the videos to reinforce what they learned in the demonstration. According to one NCC administrator, "repetitive activities are now captured on video. So that time to go over it repeatedly in the classroom is no longer needed." In addition, faculty indicated that having elements of the courses captured on Blackboard could assist when students missed class or in the event of bad weather. "It [has proven] to be very valuable. We can make assignments, [tell students to] watch this video, answer questions—whether [the faculty] is there as part of it or not." Faculty have also been able to use technology-enhanced learning to engage more students, such as using a video camera to show the inside workings of a CNC machine. AMID staff explained, "[with the] GoPro Camera, they put it in the machines and we have a big monitor on wheels. If you have a group of students standing around and you want to show them what's in the machine, filming it and putting it on the monitor, they can all see."

AMID staff reported that a key aspect in successfully implementing the technology enhancements in the AMID program was the buy-in from program faculty. Staff report that after one faculty member observed and experience the value of the technology in the classroom, he served as a key advocate for using the new tools, leading to other faculty getting on board with making changes and improvements using technology. "We have two full-time instructors who have definitely gotten on board."

Faculty reported that the move to competency based education and the process of technologically enhancing their courses has resulted in professors rethinking their curricula, being intentional about the specific competencies that lessons address, and creating valuable resources for students. "As we laid each course out, it helped us to be mindful of [course design]. [It helped us] close the loop on how we will measure if students can complete each competency-based task."

Formalized the Prior Learning Assessment Process

AS part of its work in implementing a competency-based education model, the AMID program has formalized the Prior Learning Assessment (PLA) process and has assembled the college's "Main Street Credits" brochure, which provides guidance to students seeking credit for prior learning. This process is the first formal process for assessing prior learning in place at the school. Per one NCC administrator, "we have always done some sort of PLA, but [before now] there has never been an attempt to centralize it and put it in a format for internal staff and those outside to identify as an opportunity. The process hasn't changed too much, but it is more identifiable now."

According to AMID staff, the process of aligning courses to competencies assisted in the formalization of the PLA process. "We changed all of our objectives to competencies; they're all broken down like that, and when people want to do a PLA, they use the competencies." Staff report that having this information in written format makes the process easier to communicate to students, and it is also useful in speaking with prospective students. "Main Street Credits can be marketed as something a worker could take advantage of." AMID staff and NCC administrators hope that the process developed through the AMID program will be standardized across the school in the future. "[We are] anticipating that once the TAACCCT project is completed, [formalized PLA] will be expanded for all programs."

Enhanced laboratory space, equipment and materials

Through TAACCCT funding, the AMID Program was able make significant upgrades to equipment, materials, and the lab space. Per one faculty member, "it's really transformed our program and it's really helped the constituency, both students and companies on our advisory board." "We've hit the nail on the head with purchasing the machinery that was most important. The machinery has been appropriate, the layout amazes people, it's modeled after the factory floor."

NCC has engaged industry partners in identifying equipment purchases, helping to ensure that the equipment students are being trained in are relevant and in-demand. Faculty and industry partners reported that the equipment purchased through the grant is the same equipment found in many local employers' shops. Being trained on these same tools increases students' preparation for employment.

Mini Mill purchased with DOL funds through the AMID grant

One staff member described the lab as having the "premier lab tool machines in the state." The grant funding enabled the program to purchase equipment that is frequently used on shop floors, helping to better prepare students. Per AMID staff, "once the students are trained on [innovations like probes], they are job-ready." According to one faculty member, "the equipment is being put to good use. [We have] acquired new pieces and updated probes. Instead of doing things the old-fashioned way, the probe is an electronic device with a sender and receiver. This is pretty much state of the art." Using actual tools rather than simulators or tabletop equipment increases proficiency and reduces the amount of time employers must spend training on the job. Hands-on practice with current equipment is critical for effective learning. According to one faculty member, "the grant has been instrumental in helping us have the capacity to get everyone on the machines." One student noted, "I was surprised how quickly you get hands-on with the machine."

Faculty identified several purchases that were particularly consequential to the program. The new coordinate measuring machine allows students to gain experience with measuring and enabled the creation of a new certificate in Metrology and Quality Control. "This program is something we did not previously have. It's really popular for inspection of parts in the industry. The coordinating machine helps

us enable that. According to one Metrology and Quality Control student, "it's about time. Thank God that it is here." Additional mini-mills and a lathe were also purchased through the grant, increasing their equipment capacity and allowing more students to get hands-on training at one time. A screw machine purchased through another funding stream allowed additional classes to be taught. Faculty are exploring the addition of two certificates specific to the machine, one for programming and one for operation. "Our Swiss style screw machine represents a big need in Southern New Hampshire."

Implemented the Success Navigator Model to assist students in academic and career success

Success Navigator roles evolved from the original vision, because students ended up needing less assistance with access to outside resources to address basic needs and more assistance with academics, industry connections, and getting on a career path. (The Success Navigator section in the Project Implementation Narrative contains more detail on this evolution.) According to one Navigator, "initially the role was conceived of having more of the function of outsourcing [students] to outside community services. While we do that, it's a minor part of what we do." Instead, Success Navigators have adapted to meet the needs that students bring forth, which turned out to be more along the lines of academic support and career preparation. "We were able to be active support for the students—struggles they faced in class, getting a schedule changed, getting work experience, or helping them move through coursework."

When students enter the AMID program, they complete a Noel Levitz risk stratification assessment that helps to identify students that are "high risk" and may need additional supports to be successful. While the Navigators found the assessment to be a useful tool, they augmented it with direct contact with students. "We still use Noel Levitz—it is helpful to have the data, but it doesn't always align. It's been helpful to have the data but not always applicable. Being hands on, that's sometimes the best way to assess." The Success Navigators reported working very closely with students, developing strong relationships and acting as a support system. "When a student knows that they have a place to go check in or vent, that's been really helpful. They do use that, the Navigators for support." Another Navigator added, "they come see us all the time, even for anxiety or excitement. It's very sweet." With the combination of hands-on interaction and data, the Success Navigator position has enabled the program to be proactive and begin offering services and supports to students early on, prior to the student reaching a critical point where they may leave the program. The Navigators worked to create relationships with program faculty so that information about students could be shared easily, although Navigators indicated that building strong relationships with full-time faculty was less difficult than with adjunct faculty. "We've tried, but with the adjunct faculty, because a lot are here only part time, it's more fragmented." When Navigators were able to build relationships with faculty, they found it valuable. "We try to reach out to individual instructors and let them know what we're doing and create relationships, so when [our] students are in with those professors, we get voluntary reports, and that's just great because then you know [how they are doing.]" Students expressed that they appreciated their Navigators' level of involvement educational progress. "[The Navigator] talked to my professors to see how I was doing and followed up when I missed classes. It's cool to see the interest they take in the program."

Consistently, NCC administrators, faculty, staff, and AMID students reported that the Success Navigators had played a crucial role in facilitating academic and career success for students. Success Navigator contributions included walking students through the job search and application/interview process; linking them with resources for academic help; and assistance with using classroom technology. Program faculty noted, "the Navigators have been a critical success and a strong point of the whole program. They really help students when they have various problems and steer them toward the right resources." Several students reported that the Success Navigators contributed to their staying in the program. "If it weren't for [the Navigators], I probably would have dropped out of the program. I would not have been able to make it through without them. [They were somebody] in my corner to help me navigate the school." "I can't praise them enough." According to one Success Navigator, "there are so many individual successes that you can think of. You can think, that person found a career path that he's going to be successful at. That person looks more confident. Cumulatively we're really proud of those individuals, that we could create rapport and trust." AMID staff noted, "our retention is really good. The Success Navigator has helped. If you don't show up for class for a few days, the instructor gets in touch with [the Navigators]. There's that follow through."

Seeing the value of the Success Navigator model, NCC has hired one of the Navigators through Perkins funding to provide similar services to students across all technical programs in the school. While not exactly the same role, the concept behind the position is being sustained and expanded to increase persistence, retention, and completion among a broader technical student population.

Strengthened student employability and soft skills through coursework and external support

The Technical Communications course created with input from industry partners, as well as efforts by program faculty and the Success Navigators, were designed to help students develop the employability and soft skills they need to obtain and maintain employment after completing the program. Industry partners indicated that they had seen success from these efforts. According to one partner, "Nashua has really, really helped [with] soft skills. In the beginning of the journey, we did interviews with students and gave feedback. [Now, Nashua] has added resume writing. It is night and day from the past three years." Another partner noted, "I would rate the soft skills as excellent. They cover the bases pretty well from what I can see."

According to one instructor, "we have tried to cover more soft skills [as part of our courses]. We're training students that they need to keep a clean area, as well as other soft skills and skills they might lack." Success Navigators provided one-on-one assistance to students helping them develop resumes and prepare for interviews. "We've noticed soft skills and resume work has been an area where [the students] needed a lot of support. Sometimes they're not familiar with the formalities of going through an HR, a whole interview, or even a panel. That's been a success for us that continues to develop." "We [the Navigators] interact with the students just like a real interview." Students indicated that support from Navigators and faculty in resume design and preparing for interviews was helpful. "I credit [the Navigator] exclusively with getting my job. The [Navigators] did mock interviews and emailed me about updating my resume."

The Technical Communications course was designed to strengthen the written and oral communication skills that students will need to be effective in the work place upon graduation. It also encompasses

problem solving through communication, which employer partners indicated was a critical skill in the workplace. According to faculty, the course demonstrated success in building students' skills and confidence in these areas. "I think [the students] see it is going to benefit [them] in the workplace." Another faculty member noted, "it provides students with [the skills] to communicate in business and make business decisions."

Developed and enhancing industry relationships

AMID has engaged industry partners throughout the program's implementation and specifically at crucial moments related to the program format and competency-based model, tools and equipment to purchase, and the development of courses and certificates. Per faculty, "[industry partners] have been very impressed by how we've been able to implement this. We've developed two certificates and have another in the works based on their input. We work very well together." In addition to the advisory council, the AMID program leveraged program faculty's backgrounds in the field, as well as their connections with local industries. One instructor noted, "a lot of these folks, we know on a first name basis. We come out of industry. That's the key to our success, knowing these people." Another instructor added, "it's been helpful to have a mix of people to act as a sounding board, and think about new ideas to get involved in the industry. [We have] picked up a number of partners that we did not have, and it's helped get partners that we already had excited again."

CNC Lathe purchased with DOL funds through the AMID grant

The Precision Manufacturing and Mechanical Design Technology Program Directors and Instructional Designer responded to industry feedback during the curriculum development process, resulting in the move away from the CfA model of all online courses and the ability to repeat assessments multiple times to demonstrate achievement of competencies. Input from employer partners helped NCC administrators and AMID staff determine that the CfA model was not the most appropriate for hands-on courses. "Once the project started and we started interacting with industry partners, we realized CfA wouldn't work with technical projects and industry. Industries were ready to walk out when they thought we would be training candidates online." Added another administrator, "we realized that there was no way to shorten the length of time needed to get the education necessary to be productive and skilled."

New equipment, programs, and courses also were created as a direct result of industry input. The Technical Communication course was created as a direct result of employer input. According to faculty, "in meeting with industry partners, it was suggested that people who graduate are prepared for technical parts of the job but not for the speaking and writing parts." Further, equipment purchases were frequently a result of input from industry partners. Faculty noted that while they ultimately make purchasing decisions based on suitability for the program, decisions were based heavily on the needs of constituent companies. "For example, [our constituent companies], you'll see they have the same

machines we have. That's how we base our decisions." According to faculty, "certainly our industry partners are happy. With the additions of the probes, one of the local manufacturers [specifically mentioned] they were delighted with our students."

NCC administrators, AMID staff, and faculty feel that strong industry relationships will open pathways to internships and jobs, as well as ensuring students have the training they need to be effective in the workplace. One example of this already occurring is General Electric's participation in the AMID advisory council, which leading to strengthening and enhancing an existing internship program collaboration. According to NCC administrators, "students are coming out with marketable skills. Industry partners consistently attend the partner meetings on campus, to learn what's going on and get updates on the curriculum. They have a high turnout."

Enhanced students' learning experiences through experienced faculty and lab assistants

Students indicated that AMID faculty bring strong knowledge of industry practices and trends to the classroom. "The combined experience of the professors and adjuncts is well over 100 years. They are great resources and connections." Students also noted that faculty offered personalized attention. "[The faculty] take special interest in students and revel in their success. [They] meet us where we are and go above and beyond." Another student noted, "they know how much to coddle you and when to push you to do things on your own. They push you in the right direction and leave you to figure it out." According to AMID staff, "the faculty is really quality. They are dedicated and open to new ideas and making things more efficient."

Grant funding was used to bring on two Lab Assistants. The Lab Assistants have provided additional capacity to provide guidance for students for hands-on learning. AMID staff reported that the presence of Lab Assistants has helped to keep classes small and increased the amount of one-one-one attention that students receive. "The Lab Assistants really help with the student ratio kinds of things. For our students, the ratio isn't bigger than 10:1." With the additional lab space and purchases made through the grant allowing for more students in the lab, the Lab Assistant positions have provided the needed capacity to ensure students get the attention and instruction they need. According to one instructor, "we've enjoyed [the lab assistants] throughout the grant. The more students we have, the greater risk, and we need the extra staff to ensure safety. [They also] create a mentoring relationship which will be critical to our success."

Challenges and Barriers

In creating any new program, challenges and delays are inevitable. NCC encountered a number of challenges, both internal and external, that they had to address in order to successfully implement the AMID program:

External Factors Delayed Program Implementation

Staff faced a shortened timeline and a later start to the program due to the government shutdown and subsequent delay in executing NCC's contract with USDOL. The shutdown occurred right at the start of the project period (October 2013), resulting in a delay in hiring an internal Project Coordinator, making purchases, and the curriculum redesign process. According to AMID staff, "we got the whole thing started, kicked off—and then the government shut down and everything paused for six months."

Another delay in program implementation occurred when it became clear that the initial proposed model of online courses through College for America would not meet the needs of industry partners, nor align with NCC's needs, as discussed in the Competency-Based Curriculum Redesign Process section. Necessarily, it took additional time for the instructional designer and faculty to customize the CBE for each course. According to one NCC administrator, "defining the program took longer than we thought." However, as indicated in the Program Successes section, NCC administrators, AMID staff, faculty, and industry partners ultimately feel that the customized CBE developed through this process was a better fit for the college.

Federal Grant Requirements Compliance Required Significant Time and Effort

AMID staff reported that having never implemented a DOL single institution grant before, there was a significant learning curve for the paperwork and requirements for its administration. Staff reported that it took significant time to learn the requirements for using funds and the reporting. Staff also shared that spending down grant dollars required a different frame of thinking than the typical process they have used as a community college in terms of efficiency. As a rule, NCC tries to be as efficient as possible. However, this practice resulted in their leaving some funding unspent. The program purchased some equipment for less than they had budgeted, but then they were unable to shift the balance of those funds to other cost categories.

AMID staff and NCC administrators also reported that data collection and management requirements for performance reporting and evaluation consumed a significant amount of time. The Community College System of New Hampshire's efforts to consolidate under the student management system Banner has been a challenge, and the data warehouse that was being designed for data extraction and reporting is still not usable. As such, obtaining and reporting data on program enrollments and outcomes has been a time-consuming manual process.

Students Experienced a Learning Curve with Online Course Work

The AMID program served students of a variety of backgrounds and age groups during the implementation period. According to AMID staff and faculty, many students in the program had never taken an online course before this program, and some students do not have home computers. This made adapting to the technology being utilized in courses difficult for some students. For example, faculty reported that students without computers were trying to complete the online component of courses on their smartphones, and the Blackboard site is not mobile optimized, making this very difficult.

Faculty reported that students that were further along in the program reported more negative feedback towards classes with online components, as they had come to expect fully in-class learning. However, students who began the program with technology enabled features then expected these same features in later courses. "One of the early classes, we used the hybrid approach, but that particular group didn't feel comfortable with the online tools. We've learned now that as we implement things in earlier classes, as we introduce in their first classes, the students seem to pick up on it a lot quicker and are engaged." Faculty reported that they have been working to learn from feedback and engage students at all levels in the technology-enhanced models. According to one faculty member, "we kind of learned the hard way,

but sometimes you don't know until you try something." However, in part due to feedback from students, faculty have moved away from implementing fully online curriculum for most courses.

Staffing Dynamics Caused Delays in Program Startup

The interim AMID Program Director was an external consultant, located out of state and worked remotely most of the time from April 2014-March 2015. Staff reported that this arrangement impeded progress, since there was no one onsite to coordinate tasks involved with the day-to-day implementation of the project and communicate with faculty, staff, partners and stakeholders on the ground. "We had assumed that [the Interim Program Director] would be more involved onsite, but it ended up she would do conference calls with action items, but no one was here to do the follow up." According to NCC administrators, "we realized pretty quickly that a remote project director was not going to work." Over time, the AMID Project Coordinator assumed responsibility for most day-to-day functions in early 2015 which greatly improved the processes. NCC administrators and faculty particularly indicated that having the onsite Project Coordinator was very helpful. "[She] has been great, she's very detail-oriented and she's great at keeping us up to speed on things. That has been a key component of the project's success."

In addition to planned staffing changes, the project has experienced turnover in data management functions, with the person who was brought in to oversee the Banner consolidation leaving NCC for another position. As a result, the responsibilities for data management fell to the Associate Vice President of Institutional Research and Academic Affairs, which added burden due to the position having many other administrative and functional responsibilities.

The Precision Manufacturing and Mechanical Design Technology programs rely on several adjunct instructors. Since these instructors are not full-time faculty, contracts had to be developed individually to cover additional hours the adjuncts needed for training on new technology and for the work of modularizing their courses in a competency-based format. Staff report that the process of developing individual contracts was time consuming, and it may have been better to hire more full-time staff through grant funds. However, staff did note that having full time faculty to assist in the development and implementation of the program could provide needed manpower and flexibility, but also could make sustainability more difficult as grant funding ends.

Sustainability Plans and Expanded Institutional Capacity

NCC has developed sustainability plans for a number of AMID program components. Further, implementation of the AMID program has resulted in expanded institutional capacity and efficacy in some areas.

Sustainability Planning

Funds have been set aside in the NCC's operating budget to maintain and keep the equipment in the AMID program up to date, and the Lab Assistants positions will also be absorbed under the Operations budget. The Academic Affairs Division has absorbed one Success Navigator position, supported through Perkins funding, to provide similar students to all NCC technical education programs with the goal of increasing retention, completion, and post-completion employment rates. The AMID program has also begun the process of becoming NIMS (National Institute for Metalworking Skills) accredited as a testing facility. If this materializes, NCC will be the only institution New Hampshire to be NIMS-accredited, which

staff believe will open the door for more potential funding opportunities, as well as serve as a recruitment tool for the program.

Expanded Capacity to Implement PLA Model across the College

Formalization of the PLA process has been beneficial for AMID, allowing faculty and staff to give prospective students concrete information about how their prior learning can be applied toward their certificates or degrees of interest. The development of the "Main Street Credits" brochure is the first time the PLA process has been centralized and put in a format that can be easily communicated to both internal staff and prospective students. NCC administrators and AMID staff report that this process will likely be adopted by other programs and used across the school once the AMID grant has ended.

Expanded Institutional Knowledge around Federal Grants

Several staff described the learning curve they experienced when implementing this first large federal grant in the program. The lessons learned through implementation of the AMID program positions the school well to pursue and successfully implement future federal funding. Staff have gained experience with the administrative and implementation of federally funded projects regarding budgeting, procurement, and requests for budget modifications process that will enable the school to more efficiently use funds in the future.

Increased Capacity for Utilization of Instructional Technology and a Competency-Based Approach

The AMID program was successful in implementing the competency-based model within its degree and certificate programs. Staff are considering how this model can be applied to other programs of study at the college and in the development of new courses. The AMID program also serves as a model for using technology to enhance courses. Through the process of technology enhancement and getting feedback from students, staff have gained valuable insight into how to approach the enhancements, and what formats work the best for their students. This knowledge will serve the school well as they seek to offer other courses with an online component.

Considerations for Program Replication

The AMID program implementation provides a number of valuable lessons and considerations for other institutions of higher education looking to implement a similar program or approach, or for future grants the school receives.

Allow for flexibility in student support roles.

When developing the Success Navigator position, AMID staff and the Advisory Council expected Navigators would spend significant time connecting students to public assistance and other community resources to meet basic needs. However, program staff discovered that rather than basic needs services, students more frequently requested assistance in academic-related areas and in developing soft skills, as well as assistance with the process of finding employment and using technology in the classroom. While some AMID students do face challenges around financial stability, transportation, and housing, the Navigators only provided these connections infrequently. AMID staff and Navigators indicated the value of having built in flexibility to the Navigator role so that student needs could be met, even if those needs differed from what was originally anticipated.

Develop familiarity with federal grant requirements and processes to optimize resources.

One lesson learned in spending federal grant money was the need become familiar with approval requirements at the federal level for budget changes, and to navigate how these processes may differ from those traditionally used at the college. For example, AMID staff shared that bids for some machines came in lower than what had been budgeted in the grant application. In trying to be as efficient with the funding as possible, AMID staff purchased these machines at the lower price, which resulted in money left over in that budget line item. However, since AMID staff had not obtained prior approval from the federal government to move the leftover funds between budget categories, NCC was unable to repurpose the balance of the budget for other program needs.

Assess the costs and benefits of different instruction models.

According to NCC administrators, one challenge in implementing the curriculum redesign was that some AMID programs (in particular, the Mechanical Design Technology AS degree) are primarily taught by adjunct professors. As such, tasks that involved adjunct instructors like course redesign outside of the scope of contract required additional dedicated resources. These resources came in the form of individual contracts with each adjunct instructor, increasing administrative time spent on facilitating the work.

When implementing a program that requires significant faculty involvement in a revisions process, it is important to assess the capacity of current faculty and determine early on what the best route is for ensuring adequate capacity. Options include hiring full time, bringing in consultants, or contracting with adjuncts for additional time. While the overall process for hiring new full-time faculty for new program implementation may be more burdensome than relying on adjunct staff, the use of full-time faculty may allow for greater input, buy-in, and involvement in the process. At the same time, NCC administrators indicated that it would be important to weigh the potential benefits of bringing on full-time staff against sustainability issues. In other words, if an institution brings on full-time faculty for program implementation, it must identify a strategy for funding those faculty members when grant funds have ended.

Immerse students in technology-enhanced instruction early in their programs.

Faculty indicated that students exposed from the beginning of their programs to the technology enhancements in courses adjusted more easily than those who experienced the enhancements midway or more through their coursework. They also experienced more benefits of these new tools. Faculty also noted that older students experienced greater difficulty in adapting to technology enhancements than younger students.

As such, colleges may want to consider slowly adapting to technology-enhanced courses with new cohorts of students, rather than rolling out these changes to students who are already midway through their programs. When making the shift to online course material, it is important to consider how students will access the content. If possible, making the content optimized for mobile devices could increase student access. For content that will require computer access, colleges should communicate this to students when they enter the program, so they can make plans to purchase a computer or to access one at the school or another location on a consistent basis.

Develop mechanisms to build faculty buy-in.

AMID staff stressed the value of developing early buy-in from faculty when attempting to implement widespread curriculum redesign, particularly technology enhancements. Staff described a key moment in the implementation of the project as when one of the faculty members bought into the value of using technology in the classroom. Having early buy-in from a faculty member was vital to getting others on-board with the project and ensuring its success. In re-designing curriculum for a program, providing opportunities input from faculty on the process can help to increase buy-in and ensure that faculty will be committed to making the changes work.

Outcomes and Impact Evaluation Study

Outcomes and Impact Evaluation Study Design

Design Summary

The AMID program represented an innovative approach to technical education in the field of advanced manufacturing, incorporating a competency-based, technology enabled and enhanced curriculum model and support services to students. Results relating to nine educational program outcomes defined by USDOL were generated to produce a snapshot of how well program participants performed in terms of factors like completion, retention, employment, and increased wages.

In addition to the outcomes analysis, the Evaluation Team initially proposed conducting a quasi-experimental design (QED) using propensity score matching to demonstrate the impact of the AMID program on participants. In this design, students pursuing three AMID majors (AS Degree in Precision Manufacturing, AS Degree in Mechanical Design Technology, and a certificate in Machine Tool Technology CNC Programming were to be matched to another technical program major (Electrical Engineering Technology, EET) that is similar but adhered to a more traditional learning model. Groups were to be compared to each other in terms of relevant outcome measures and models of selection bias were to be developed to facilitate assessment of AMID's impact on these measures. However, as discussed in the Impact Methodology section on the next page, due to the small sample size of the EET group, as well as potential cross-contamination that was identified (some EET students in the control group were found to have taken AMID courses), the QED impact analysis was not conducted.

Research Questions

The following set of research questions guided the outcomes and impact evaluation.

Outcomes:

1. What were the outputs associated with the program (number of unique participants)?
2. To what extent did participants progress during their program, as measured by completing credit hours, or earning a credential?
3. To what extent were participants successful during their time in the program, as measured by completing the program or staying retained in the program?
4. To what extent were participants successful after program completion, as measured by pursuing further education, obtaining and maintaining employment, and/or earning a higher wage?

Impact:

5. Do AMID students demonstrate increased probability of persistence outcomes (e.g., credits earned and retention) than equivalent comparison group members in a technical academic program with similar labor market outcomes?
6. Do AMID students demonstrate increased probability of program completion outcomes (e.g., graduation and course completion) than equivalent comparison group members in a technical academic program with similar labor market outcomes?

7. Do AMID students demonstrate improved employment outcomes (e.g., employment at post-program interval; working in target industry post-program; and changes in earnings from pre- to post-program) over equivalent comparison group members in a technical academic program with similar projected labor market outcomes?

Data Sources

To address the outcomes research questions, data was extracted from a variety of sources, including:

- NCC's Student Information System — source of student demographics, enrollment, and completion outcomes.
- The Community College System of New Hampshire's (CCSNH) data warehouse -- source of student demographics, enrollment, and completion outcomes.
- National Student Clearinghouse (NSCH)—source for enrollment in further education outcomes.
- New Hampshire Employment Security (NHES)—state Unemployment Insurance database; source for participant employment information
- Intake and Exit Surveys[14] –source of student demographics, incumbent and post-completion employment status, and student perception/program feedback.
- Post-graduation social media search analysis—source of post-graduation employment status

Analysis Methods

Outcomes Methodology

The overarching goal of the AMID program was to provide relevant training and increase workforce skills in advanced manufacturing occupations for individuals negatively affected by changes in the economy. To achieve this goal, Nashua Community College offered three AMID programs beginning in the fall of 2015: a two-year Associate of Science degree in Precision Manufacturing (71 credits); a two-year Associate of Science in Mechanical Design Technology (66 credits); and a two-year Machine Tool Technology CNC Programming Certificate (48 credits).[15] During the project period, NCC also created a new certificate program (Metrology and Quality Control, 27 credits). In addition, some students participated in AMID courses though they may not have been seeking AMID degrees or certificates. The outcomes evaluation tracked data on all students enrolled in any AMID courses, regardless of whether they were pursuing a degree or certificate in the program.

Impact Methodology

As of September 2017, there were only 24 individuals in the Electrical Engineering Technology program who met the criteria for inclusion in the control group. Although the sample size was small, the Evaluation Team decided to move forward and attempt to conduct the QED, as conceived in the original evaluation

[14] These surveys were designed to assess participants' employment experience and income status at enrollment (Intake Survey), as well as income and employment status at exit (Exit Survey). Combined across Fall 2015 and Fall 2016, 243 students completed the Intake Survey. The Exit Survey was also designed to obtain information on students' perception of the extent to which the program had helped prepare them for career success. In 2016, n=32 participants completed the Exit Survey, and in 2017, n=30 participants completed. See Appendices A and B for Intake Survey and Exit Survey questions. Questions on the 2016 and 2017 Exit Surveys differed somewhat; as such, survey results provided in the report are noted as 2016 only, 2017 only, or 2016 and 2017 combined.

[15] Prior to AMID, NCC offered a Computer Numerical Control Programming certificate. The prior certificate was replaced by the Machine Tool Technology CNC Programming certificate, but some students that received the prior certificate took courses that were transformed through AMID.

design. However, upon further review of the data, the Evaluation Team determined that additional individuals in the Electric Engineering Technology program had participated in one or more AMID courses. As such, the Team, after discussion with NCC staff, determined that the comparison group was too small to move forward with the QED. Therefore, this evaluation section focuses only on outcomes analyses.

Outcomes Study Findings

Enrollment by Program Type

The outcomes study focused on 269 unique participants[16] enrolled in AMID programs or courses during the fall 2015 through spring 2017. 71% of the participants were enrolled in AMID degree or certificate programs, with 29% enrolled in AMID-related courses but not seeking AMID credentials.

The largest number of participants in AMID credential programs was in the AS in Precision Manufacturing (35%), followed by the AS in Mechanical Design Technology (19%). According to NCC's website, Precision Manufacturing is the most popular AS program in the Advance Manufacturing area, and Machine Tool CNC Programming is the most popular certificate program.[17]

Table 4 shows AMID enrollment by program, as well as enrollment for those students taking AMID courses only. While 15% of students taking AMID courses only were seeking a degree of some type, 14% were non-degree seeking.

Table 4: Enrollment by Program Type

AMID Program	# of Participants	Percent of Total
AS in Precision Manufacturing	94	34.9%
AS in Mechanical Design Technology	52	19.3%
Machine Tool Technology CNC Programming Certificate	37	13.8%
Metrology and Quality Control Certificate	1	0.4%
Phased Out Advanced Manufacturing Programs[18]	6	2.2%
AMID Courses Only (Degree-seeking)[19]	41	15.2%
AMID Courses Only (Non-degree seeking)	38	14.1%
TOTAL	**269**	**100.0%**

Demographic Information[20]

Just under three-quarters of the AMID students were White, with Hispanic as the next most common race/ethnicity. The demographics of AMID program enrollees are about the same as those of NCC's general student population (75% white and 9% Hispanic).[21] The majority of students were male, which is common for Advanced Manufacturing programs.

[16] 10 students elected not to sign consent forms and therefore are not included in the analyses.
[17] www.nashuacc.edu/about/snap-facts
[18] Three degrees and certificates were phased out over the course of the AMID project—a Certificate in CNC Programming (4 students enrolled); a Certificate in Advanced Manufacturing Processes (1 student enrolled); and the AS in Advanced Manufacturing Processes (1 student enrolled), which was the previous version of the AS in Precision Manufacturing.
[19] Includes students enrolled in the following majors: Aviation, Computer Networking, Electronic Engineering Technology, Applied Career Fund Adv. Mfg., and Liberal Arts.
[20] Demographic information was available for 237 of 269 students (88%).
[21] NCC demographic data is sourced from NCC's website: www.nashuacc.edu/about/snap-facts

In contrast to the age demographic makeup of NCC's student body, with 72% of students under the age of 25, AMID program participants skewed older. About half were under 25, with 31% between the ages of 18-21. However, half were over 25, with 22% falling in the age ranges of 26-34 and 28% 35 or over.

Table 5: Student Demographics

Race/Ethnicity	
White	73.0%
Hispanic	10.5%
Two or More Races	6.3%
Asian	5.1%
Other[22]	1.3%
Unknown	3.8%
Gender	
Male	89.5%
Female	10.5%
Incumbent Worker	
Yes	65.4%
No	21.9%
Unknown	12.7%
Age	
18-21	31.2%
22-25	18.6%
26-34	22.4%
35-44	12.2%
45 or older	15.6%

Student Characteristics at Entry

This information is sourced from the Intake Survey, which was completed by 243 participants from Fall 2015 through Spring 2017. As indicated in the demographics section, over 65% of students reported being employed at the time of enrollment. Interestingly, 42% reported expecting to work full-time jobs (40+ hours) while in school, with another 13% indicating that they expected to work 31-40 hours.

In focus groups conducted as part of the Implementation Evaluation, many students noted that they had enrolled in the programming looking for a career change, which is supported by the Intake and Exit Survey data. 61% of participants indicated having less than five years of experience in Advanced Manufacturing at intake, with about 38% indicating no experience at all. During focus groups with students, as well as on the Exit Survey, students indicated that they particularly enjoyed the hands-on aspects of the courses that they took through the AMID program. The hands-on nature of the courses may have been particularly helpful due to most of the students having little to no experience in the field.

In terms of educational attainment, 79% of the participants did not have a college degree (Associate or higher). This is reflective of the goal of AMID (and TAACCCT programs) to help individuals gain skills and education to assist them in either obtaining employment or obtaining higher wages. Forty-three percent

[22] Includes American Indian or Alaskan Native and Native Hawaiian/Pacific Islander

of the participants reported having some college, while 37% had never attended college and held a high school diploma or GED.

Table 6: Student Characteristics at Intake

Avg. Work Hours Weekly	
0-10	12.8%
11-20	10.7%
21-30	11.5%
31-40	13.2%
40+	41.6%
No Response	10.3%
Experience in Advanced Manufacturing	
None	38.3%
Less than 5 years	22.6%
5-10 years	6.6%
11-15 years	2.9%
More than 15 years	6.2%
No response	23.5%
Educational Attainment	
High School or GED	36.6%
Some College, No Degree	42.8%
Associate Degree	7.4%
Bachelor's Degree	2.5%
Post-Graduate Degree	1.2%
No Response	9.5%

Progress by Program Type[23]

All but three of the 269 students in the AMID program completed credit hours. On average, participants earned 40.1 credits, with a standard deviation of 29.6 credits.

Table 7: Progress by Program Type

AMID Program	# of Participants	% Completed Credit Hours
AS in Precision Manufacturing	94	97.9%
AS in Mechanical Design Technology	52	100.0%
Machine Tool Technology CNC Programming Certificate	37	100.0%
Phased Out AMID Programs	6	100.0%
AMID Courses Only (Degree-seeking)	41	100.0%
AMID Courses Only (Non-degree seeking)	38	97.4%
TOTAL	**269**	**98.9%**

[23] Please note that for the remaining analyses in this report that discuss progress and completion by program type, phased out Advanced Manufacturing programs replaced through the AMID programs (e.g., the prior AS in Advanced Machine Tool Technology and CNC Programming Certificate) and the Metrology and Quality Control Certificate are not include in tables to protect student privacy, due to having fewer than ten combined students enrolled in these programs.

For students enrolled in AMID degree programs, on average, those in Precision Manufacturing earned the most credit hours (56.6). Although Precision Manufacturing requires the most credit hours (71), students in this AMID program were, on average, the closest to completion (nearly 80% complete). Students in the Precision Manufacturing group were also the most likely to complete their degrees, which reflects their strong progress toward completion in terms of earning credits. Overall, AMID credential-seekers were, on average, nearly 70% toward completion by the end of the grant period.

Table 8: Credit Hours Earned for AMID Credential-Seekers

AMID Program	Avg. Credit Hours Earned	Avg. % of Credits toward Completion
AS in Precision Manufacturing	56.6	79.7%
AS in Mechanical Design Technology	44.1	66.8%
Machine Tool Technology CNC Programming Certificate	22.5	46.9%
Total	**40.6**	**68.5%**

Retention and Completion Outcomes by Program Type

Of the 231 AMID-served students who were degree-seeking, 58% had either completed (22%) or were still enrolled (37%) as of August 2017. In looking at AMID majors only, just over one-quarter had completed, and 34% were still enrolled. Compared to NCC's overall on-time graduation rate of 13.4%,[24] the completion rate of AMID majors was nearly 12 percentage points higher. As the Implementation Evaluation demonstrates, grant staff, faculty, and students indicated that the Success Navigators were critical to student success. The higher on-time graduation rate may in part be associated with the support the Success Navigators provided.

Students enrolled in the AS in Precision Manufacturing had the highest completion rate (37%) of all AMID students. While only 3% of students enrolled in the Machine Tool Technology CNC Programming certificate had completed by program end, nearly one-third were still enrolled as of August 2017. However, the certificate program had the highest non-completion rate, with 65% leaving the program.

Table 9: Retention and Completion by Program Type[25]

AMID Program	# of Participants	% Completed Program	% Retained in Program	% Stopped Out of Program
AS in Precision Manufacturing	94	37.2%	31.9%	30.9%
AS in Mechanical Design Technology	52	21.2%	21.2%	38.5%
Machine Tool Technology CNC Programming Certificate	37	2.7%	32.4%	64.9%
AMID Courses Only (Degree-seeking)	41	4.9%	51.2%	43.9%
TOTAL	**231**[26]	**21.6%**	**36.8%**	**41.6%**

[24] Source: Integrated Postsecondary Education Data System (IPEDS), number completed a degree/certificate within 100% of normal time, 2015 reporting year (most recent available).

[25] Note that this table excludes non-degree seeking AMID students, as they would not have been expected to complete a program. Students are included in only one category.

[26] Total includes students in phased out AMID programs and Metrology and Quality Control certificate, which are not reported individually due to small size, to protect student privacy.

A chi-square test (χ^2) was performed to compare the frequency of program completion, program retention, and program stop-out among the four groups of students and to test if group membership and completion were related (i.e. not independent). A chi-square test is a useful exploratory analysis to examine if there is a statistically significant relationship between group membership and completion. Effect sizes (Cramer's *v*) were also computed, which helped substantiate any statistically significant results and for understanding if the statistically significant results were practically relevant. They also served as an additional safeguard to fallacious *p*-values insofar as they are indifferent to significances that may result from sample size.

Results of the chi-square test reveal that there was a statistically significant association between group membership (i.e., the program in which the student was enrolled) and completion (χ^2=27.88, df=3, p<0.05), as shown in Table 10 below. Furthermore, the effect size (Cramer's *v*) that accompanies this test is of a medium (0.35) size. This means that there was a statistically significant relationship between group membership and completion, though the likelihood of completion cannot be purely attributed to group membership, since the chi-square test does not control for background characteristics. However, the findings do indicate that some sort of association exists between specific program enrollment and completion rates.

Table 10: Cross Tabulations of Group Membership and Completion (N=224)

AMID Program	Completion		χ^2	Cramer's *v* (Effect Size)
	Yes	No		
AS in Precision Manufacturing (n=94)	35 (37.2%)	59 (62.8%)	27.88*	0.35
AS in Mechanical Design Technology (n=52)	11 (21.2%)	41 (78.8%)		
Machine Tool Technology CNC Programming Certification (n=37)	1 (2.7%)	36 (97.3%)		
AMID Courses Only (Degree seeking) (n=41)	2 (4.9%)	39 (95.1%)		

Note. Effect size: Small=0.10; Medium=0.30; Large=0.50, see Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed) . Hillsdale. NJ: Lawrence Earlbaum Associates.
*p<.05.

Additionally, results of the chi-square test reveal that there was a statistically significant association between group membership (i.e., the program in which the student was enrolled) and stopping out of the program during the study (χ^2=13.02, df=3, p<0.05), as shown below. The effect size (Cramer's *v*) that accompanies this test is between small and medium (0.24). This means that there was a somewhat noticeable relationship between group membership and dropping out, though the likelihood of completion cannot be purely attributed to the likelihood of dropping out purely to group membership, since the chi-square test does not control for background characteristics. However, the findings do indicate that some sort of association might be occurring between the AMID program and whether the student dropped out.

Table 11: Cross Tabulations of Group Membership and Dropout (N=224)

AMID Program	Dropout		χ^2	Cramer's *v* (Effect Size)
	Yes	No		
AS in Precision Manufacturing (n=94)	29 (30.9%)	65 (69.1%)	13.02*	0.24
AS in Mechanical Design Technology (n=52)	20 (38.5%)	32 (61.5%)		

Machine Tool Technology CNC Programming Certification (n=37)	24 (64.9%)	13 (35.1%)		
AMID Courses Only (Non-degree seeking) (n=41)	18 (43.9%)	23 (56.1%)		

Note. Effect size: Small=0.10; Medium=0.30; Large=0.50, see Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed) . Hillsdale. NJ: Lawrence Earlbaum Associates.
*p<.05

However, findings from the chi-square test reveal that there was not a statistically significant association between group membership (i.e., the program in which the student was enrolled) and retention (χ^2=5.13, df=3, p>0.05), as shown below. Furthermore, the effect size (Cramer's *v*) that accompanies this test is small (0.15). This means that there was not a substantial association between program and retention.

Table 12: Cross Tabulations of Group Membership and Retention (N=224)

AMID Program	Retained		χ^2	Cramer's *v* (Effect Size)
	Yes	No		
AS in Precision Manufacturing (n=94)	30 (31.9%)	64 (68.1%)	5.13*	0.15
AS in Mechanical Design Technology (n=52)	21 (40.4%)	31 (59.6%)		
Machine Tool Technology CNC Programming Certification (n=37)	12 (32.4%)	25 (67.6%)		
AMID Courses Only (Non-degree seeking) (n=41)	21 (51.2%)	20 (48.8%)		

Note. Effect size: Small=0.10; Medium=0.30; Large=0.50, see Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed) . Hillsdale. NJ: Lawrence Earlbaum Associates.
*p<.05

As noted in the Implementation Evaluation, the AMID program had a delayed start due to contract delays and program revisions, which delayed the program elements' rollout until fall semester of 2015. As such, the majority of the AMID program graduates did not complete their programs until 2016 or 2017. To illustrate, over half of the AMID program graduates (54%) completed in spring 2017, with another 36% completing in spring of 2016. The majority (88%) of participants that graduated completed Associate degrees. Of the six students who completed certificates, four had originally enrolled pursuing Associate degrees.

Table 10: Date of Graduation for AMID Completers

Graduation Date	# of Completers	Associate Degree	Certificate
December 2015	1	1	0
Spring 2016[27]	18	16	2
December 2016	4	3	1
Spring 2017[28]	27	24	3
TOTAL	**50**	**44**	**6**

[27] Includes one student whose date of graduation is listed as August 2016.
[28] Includes one student whose date of graduation is listed as August 2017.

Post-Program Completion Outcomes by Program Type

According to the Exit Survey administered in 2016 (n=32 respondents), 81% of respondents indicated that the AMID program helped them accomplish their educational and career goals. While the majority of AMID completers did not elect to pursue further education, most had found or were retained in employment and were still employed one quarter after graduation.

Of the 50 degree - or certificate-seeking students who completed their programs of study, only 4% elected to pursue further education. However, this may be in part because 27 of the 50 completed in May of 2017; therefore, due to lag, further education data was not yet available as of the time of this report. For the remaining 23 that completed prior to 2017, one student had elected to continue education.

In looking at employment one quarter after graduation, the analysis focuses only on those individuals who completed prior to 2017, because all individuals who completed in 2017 were May graduates, meaning quarter one after graduation data (July-September 2017) was not available as of this report. Of the 23 AMID graduates who completed prior to 2017, nearly three-quarters were employed as of the first quarter after graduation. All Mechanical Design Technology program students were employed, and 77% of the Precision Manufacturing graduates were employed.

The number of AMID graduates (non-incumbent workers) who were retained in employment three quarters after graduation is not available. The most recent employment data available from NHES was quarter three of 2016. As such, this data would only be applicable for students who graduated in December of 2015. There was only one individual who graduated in December of 2015 and, to protect privacy, the information cannot be reported.

Table 11: Post-Program Completion Outcomes by Program Type

AMID Program	# of Completers	% Enrolled in Further Ed	# of Completers (prior to 2017)	% Employed
AS in Precision Manufacturing	35	0.0%	13	76.9%
AS in Mechanical Design	11	9.1%	6	100%
Machine Tool Technology CNC Programming Certificate	1	*	1	*
Phased Out AMID Programs	1	*	1	*
AMID Courses Only (Degree-seeking)	2	*	2	*
TOTAL	**50**	**4.0%**	**23**	**73.9%**

*Number not reported to protect privacy

According to the 2016 Exit Survey, 87.5% agreed or strongly agreed that completing the program of study improved their career prospects. Of combined respondents on both the 2016 and 2017 surveys, (64.5%) indicated that they had acquired a new job in their field of study as a result of completing a program of study at NCC. Just over one-quarter indicated they were still looking for employment.

Figure 5: Improved Career Prospects

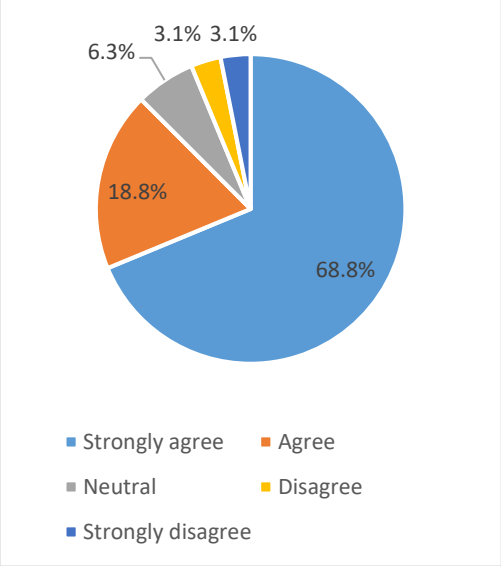
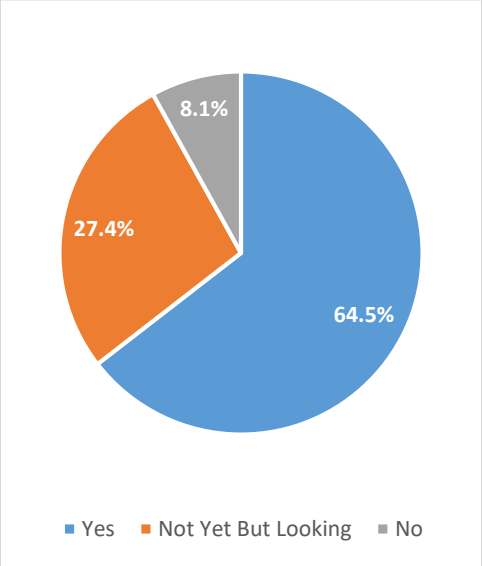


Figure 6: Acquired New Job



Of the 62 respondents, 47% indicated that they had gotten a new job as a result of school events (8%), school referrals (18%), or internships (19%). As indicated in the Implementation Evaluation, grant staff, faculty, and students indicated that Success Navigators had played a strong role in assisting them to be prepared for career success and soft skills. Further, a major success of the AMID program was NCC's ability to enhance employer partnerships, including strengthening existing internship opportunities. That nearly half of the Exit Survey respondents indicated they had gotten a new job through activities directly related to NCC suggests that these endeavors demonstrated success.

Table 12: Methods through which Job Was Obtained

I obtained my degree-related position through:	Response
Internship	19.4%
School Referral	19.4%
Have Not Yet Gotten a Program-Related Job	11.3%
School Event/Networking	8.1%
Other	25.8%
No Response	16.1%

Conclusion

AMID Program Impact

It is beyond the scope of this evaluation to make value judgments about whether the degree of tangible and intangible successes the AMID program experienced was sufficient to warrant the amount of public investment made. Qualitative evidence suggests, however, that the AMID program generated significant benefits for a range of stakeholders, including the institution and its faculty, staff, and administrators, student participants, and partners. AMID's activities accomplishments have substantially increased NCC's ability to deliver technical education programs in a competency-based format designed specifically to align with institutional context; support student persistence and retention through the Navigator model; provide state-of-the art facilities for hands-on instruction, and align programs with employer feedback and needs.

Competency-Based and Technology-Enhanced Curriculum Redesign Process--At the core of NCC's plan for the AMID program was a curricular redesign for the Precision Manufacturing and Mechanical Design Technology programs. The intention of the redesign was to create a new, more flexible model of education that emphasized hands-on demonstration and practice of technical skills and competencies, allowing students to progress through the material at their own pace. After undergoing a learning process about the different models of competency-based education, the AMID Council, NCC administrators, faculty and staff, and partners agreed upon an approach that fit within the constraints of institutional operations and fulfilled employer needs. They successfully implemented this unique approach to competency-based education, and observed early evidence of student, faculty, and partner satisfaction. Lab renovations and new equipment purchases transformed NCC's facility into a state-of-the-art learning resource. The AMID program has influenced the way that administrators, faculty and staff think about technical education, and some of the lessons learned throughout AMID's implementation can be applied to other technical programs at the college.

Success Navigator Model-- NCC based its plan for Success Navigators as part of the AMID program on the premise that non-traditional, working age students tend to experience barriers to academic program persistence and completion due to their multiple responsibilities and subsequent support needs. The Navigators were intended to coordinate academic and social support services internal and external to NCC, and to coach and guide AMID students throughout their programs, serving as advocates to improve the probability of persistence and retention. Although the nature of the services the Navigators provided to the students evolved from the original plan due to responding to different needs, they played an essential role in student success, from the perspective of students, staff and faculty, and partners.

Recommendations for Further Research

The AMID program's start was delayed due to contracting issues and program revisions, which in turn delayed the program elements' rollout until the fall semester of 2015. As such, the majority of the AMID program graduates did not complete their programs until 2016 or 2017, and therefore, for this study, there was insufficient outcome data to assess AMID's comprehensive impact on participant program completion and labor market outcomes. Future research into competency-based technical education program models in a community college setting should investigate the degree to which competency-based technical education programs facilitate participant success in higher education and in the labor

market. In addition, future research could examine the extent to which competency-based models accelerate students' ability to complete their degree programs.

The AMID program served a relatively homogenous student population. The majority of AMID students were incumbent workers and white males. Additional research should explore the dynamics and outcomes of competency-based technical education programs that serve populations with different demographic characteristics and in different geographic areas and labor markets. For this project, industry partners strongly supported the concept of competency-based education, and future research could explore managers' perceptions of the performance of workers educated in a competency-based framework.

Like many TAACCCT programs, the AMID program integrated student support services, in the form of Success Navigators. While qualitatively the Success Navigators assisted in ensuring that students persisted through their programs and remained on track to complete, additional research could explore the degree to which students with access to this resource are successful and persist in programs compared to similar students who do not have this resource. As these types of student support services have been identified as a potential promising practice, especially in working with non-traditional students, research could examine the ways in which additional student supports have an impact on student persistence and completion, particularly for students who are older or working while in their college programs.

For this project, industry partners strongly supported the concept of competency-based education, and future research could explore managers' perceptions of the performance of workers educated in a competency-based framework. Ideally, this type of research could be analyzed through a quasi-experimental design (QED), in which a comparison group of similar students who did not participate in competency-based education is analyzed alongside a group of students who participated in competency-based education.

A topic of significant policy importance is the exploration of the impact of different models and types of competency-based education programs on student outcomes, as well as the settings in which they are implemented. Policymakers and higher education administrators can learn from the process NCC underwent to design a model that incorporated some key tenets of more traditional models, but did not incorporate the open entry/open exit characteristic because it was incompatible with its institutional structure and rendered the program ineligible for Title IV financial aid. Other institutions of higher education likely face similar barriers in implementing a traditional competency-based model. Strong evidence about the impact of different types of competency-based education programs on student outcomes will equip policymakers and administrators to make effective decisions on whether to incentivize or facilitate these models through adaptation of institutional operations and federal financial aid policy.

Appendix A: Intake Survey

The Intake Survey was administered electronically to all students who enrolled in one of the foundational AMID courses. All students whose information was included in the analysis signed a consent form which gave explicit permission to use their responses in aggregate format for the study. Text of the survey is as follows.

1. Student ID

2. Contact Information
    a. First name
    b. Last name
    c. Street Address, Apt. #
    d. City, State, Zip
    e. Country
    f. Email Address
    g. Best contact phone number
    h. Mobile phone

3. Are you a veteran?
    a. Yes
    b. No

4. Are you currently employed?
    a. Yes
    b. No

5. Average work hours weekly (while in school)?
    a. 0-10
    b. 11-20
    c. 21-30
    d. 31-40
    e. 40+

6. Name of Employer

7. Address of Employer

8. Job Classification/Title

9. Number of years of experience in the following industries (check all boxes that apply)

	None	Less than 5 years	5-10 years	11-15 years	More than 15 years
Advanced Manufacturing					
Mechanical Design					
Electronic Engineering Technology					
Other					

10. Your current total estimated annual household income (the sum of all household members' income):
    a. <$10,000
    b. $10,000-$19,999
    c. $20,000-$29,999
    d. $30,000-$39,000
    e. $40,000-$49,999
    f. $50,000-$59,999
    g. $60,000-$69,999
    h. $70,000 or more
    i. Don't know
    j. Refused to answer

11. What is your (the student's) current total estimated annual income?
    a. <$10,000
    b. $10,000-$19,999
    c. $20,000-$29,999
    d. $30,000-$39,000
    e. $40,000-$49,999
    f. $50,000-$59,999
    g. $60,000-$69,999
    h. $70,000 or more
    i. Don't know
    j. Refused to answer

12. What is the source of your income (check all that apply?)
    a. Salary or wages
    b. Investment income
    c. Student loans
    d. Alimony
    e. Child support
    f. Pension/Retirement Savings
    g. SSI

h. SSDI
i. Other
j. Refused to answer

13. Do you have dependents in your household?
    a. Yes
    b. No (Skip to #17)

14. If yes, how many dependents?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5 or more

15. Please check the option that best describes your family situation
    a. Married (or living with significant other)
    b. Single
    c. Separated or divorced
    d. Widow(er)
    e. Other

16. Tax Status
    a. Married (filing jointly)
    b. Married (filing separately)
    c. Single
    d. Head of Household
    e. Qualifying Widow(er)

17. Highest Level of Academic Attainment?
    a. High School or GED
    b. Some College
    c. Associate Degree
    d. Bachelor Degree
    e. Post Graduate

18. GPA at highest level of education?

19. Would you use these Academic Resources?

	Yes	No	Maybe Sometimes
Financial Counseling			
Applying for Financial Aid			
Career Counseling			
Study Skills			
Peer-to-Peer Tutoring			
Academic Advising			
I.D. Services			
Tutoring			

20. Would any of these social stressors affect your ability to do school work?

	Yes	No	Maybe Sometimes
Lack of Academic Preparation			
Study Skills			
Lack of Academic Support			
Work Commitments			
Transportation Issues			
Scheduling			
Personal Health Issues			
Family Health Issues			
Dependent Care Issues			
Financial Issues			

21. Do you need help with these support services?

	Yes	No	Maybe in Future
Transportation to Campus			
Acquiring Housing			
Acquiring food assistance			
Dependent Care			
Medical Care			
Acquiring Utility Assistance			
General Counseling			
Acquiring Legal Assistance			
Financial Counseling			
Eligibility Specialist Assistance			

Appendix B: Exit Survey

The Exit Survey was administered electronically to all graduates in of AMID and Electronic Engineering Technology programs. Text of the survey is as follows.

Congratulations on your upcoming graduation from Nashua Community College.

We would like to know if you believe your program of study is contributing to your ongoing success as you move forward in your career,

Note: We want to assure you that your responses are completely anonymous. Additionally, your responses are combined with those of others and only used in a summarized format to protect your security.

22. My major at NCC is:
    a. Precision Manufacturing-AS Degree
    b. Mechanical Design Technology-AS Degree
    c. Electronic Engineering Technology—AS Degree
    d. Machine Tool CNC Programming—Certificate
    e. Metrology & Quality Control in Precision Manufacturing—Certificate

23. I have a job related to my major
    a. Yes –where (please provide name of employer)
    b. No
    c. Not yet but looking

24. In what city or state do you work?

25. My title/position at work is?

26. I have worked at this job:
    a. Before I started at NCC
    b. I started while I was in school at NCC
    c. Since graduation

27. I have received a promotion in my current job because of my degree/certificate.
    a. Yes—please provide new title
    b. No

28. I have received a raise in my current job because of my degree/certificate.
    a. Yes
    b. No

29. My program-related job search started:
    a. Before my time at NCC
    b. During my time at NCC

c. After my time at NCC
d. Haven't started yet

30. I obtained my degree-related position partly from:
    a. An internship
    b. A school event/networking
    c. A field trip
    d. A school referral
    e. I have not gotten a program-related job yet
    f. Other

31. My job pays me a salary of:
    a. Less than $19,999
    b. $20,000-$29,999
    c. $30,000-$39,999
    d. $40,000-$40,999
    e. $50,000 or greater

32. I am continuing my education?
    a. Yes—where (please tell us the school name)
    b. No
    c. Not at this time
    d. I have chosen a different field of study

33. Please provide us with your contact information. We would like to stay in touch with you occasionally to see how you are doing.
    a. First name
    b. Last name
    c. City, State, Zip
    d. Email address