2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
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ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #52144

Student Profile of Participants in a New "Technologist" Program to Upskill Technicians to a Technical Leadership Role in Manufacturing Shop-Floor

Cigdem Uz Bilgin, Massachusetts Institute of Technology
Dr. Meredith Thompson, Massachusetts Institute of Technology

Meredith Thompson is a STEM education researcher and program manager for MIT's Learning Engineering And Practice (LEAP) Group. She has conducted research in virtual reality, augmented reality for manufacturing, biology, and ecology education. In her current role she is a program manager for the Technologist Advanced Manufacturing Program, or TechAMP, which aims to bridge the gap between technicians and engineers to modernize the manufacturing workforce.

Dr. Marialice Mastronardi, Massachusetts Institute of Technology

Research Scientist at the Massachusetts Institute of Technology STEM Ph.D., University of Texas at Austin (2023) M.S. in Electronic Engineering, Polytechnic of Milan (Italy), 2006

Dr. John Liu, Massachusetts Institute of Technology

Dr. John Liu is the Director and Principal Investigator of the MIT Learning Engineering and Practice (LEAP) Group, which investigates the intersection of human-centered technologies, engineering workforce and education, and digital learning. He is a Principal Research Scientist in MIT's Mechanical Engineering department and a Scientist in the MIT Digital Learning Lab. He leads education and workforce development efforts for MIT's Initiative for New Manufacturing. He was the Director of the Principles of Manufacturing MicroMasters program, an online certificate program that has now enrolled over 200,000 learners across the globe. His work has received recognition from venues such as ASEE, IEEE DEMOCon, and ACM CHI. He has co-authored dozens of publications and currently serves as an executive guest editor for Manufacturing Letters. His research is supported by the Department of Commerce, Department of Defense, Massachusetts Technology Collaborative, Schmidt Futures, National Science Foundation, MIT, and industry partners.

Student Profile of Participants in a New "Technologist" Program to Upskill Technicians to a Technical Leadership Role on the Manufacturing Shopfloor

Abstract

Manufacturing companies struggle with a lack of technical leadership on the shop floor. They seek workers who can proactively initiate problem-solving and process improvement for more efficient and effective production. A new class of workers could fill this crucial role: "technologists", the technician-engineer workers who combine hands-on skills and an analytical mindset. The need for technologists has been created by the misalignment between the needs of industry and the current workforce development training in the United States. Traditional manufacturing training focused on industry-specific technology and equipment. Such trends become rapidly obsolete with the fast-paced advancements in technology, leaving workers unable to keep pace with new skill requirements. A deeper focus on training that allows workers to gain an understanding of the "why" behind manufacturing disciplines is necessary for them to engage in innovative problem-solving, and fosters lifelong learning of new skills as manufacturing processes evolve.

To address this need, the Massachusetts Institute of Technology, in collaboration with the University of Massachusetts at Lowell, Clemson University, Ohio State University, community colleges, and industry partners developed the one-year Technologist Advanced Manufacturing Program (TechAMP) to improve workforce development training for the Department of Defense's industrial base. Training new technologists requires not only the education programs for the technicians, but also an understanding of why technicians choose to participate in career development. Despite the need to develop manufacturing technician talent, there is little research about how work experience influences career development choices among technicians. To address this gap, this study uses Social Cognitive Career Theory (SCCT) to examine the processes involved in career exploration and decision-making in the first cohort of technicians enrolled in the TechAMP Program.

In the Fall of 2025, this program was launched in six sites, with an initial number of 82 students. In this paper, we present the results from the beginning-of-the-program survey and mid-semester interviews to examine the students' career motivations, reasons for enrolling in the program, and their content knowledge related to the program's curriculum. Due to attrition and one site starting in December, 64 students are included in this analysis. The data reveal a diverse range of professional experience among students, with educational backgrounds spanning vocational certificates to bachelor's degrees. While many students hold high school or associate-level credentials, their motivations for joining the program are rooted in aspirations for career advancement, personal enrichment, and intellectual curiosity. Early-career participants tend to draw on external sources of influence, including mentors and family support, when making career decisions, whereas more experienced professionals are guided by accumulated job experiences and place greater emphasis on autonomy and financial security. Despite these distinctions, job security consistently emerges as a central priority across all stages of professional experience. Additionally, the absence of a relationship between years of experience and baseline knowledge related to the program's curriculum highlights a significant skills gap, emphasizing the need for intentional, competency-based training to address this disconnect. Understanding who the students are will help us better support them during the program and inform assessments, future iterations of the curriculum, and interventions.

Introduction

Manufacturing has been an important segment of the US economy, providing employment, access to goods, and the impetus for continuing innovation [1]. The United States has prioritized a return to onshore manufacturing [2], supporting this aim through imposing tariffs on imports [3] and increasing investments in manufacturing infrastructure [4]. However, in the past 20 years, the manufacturing base in the US has been declining in total employment and in the percentage of the overall economy [5]. In 2000, manufacturing contributed 15.1% to the United States' economic output; in 2025, manufacturing only contributed 9.4%. Manufacturing employment has also declined from 17.2 million workers in 2000 to 12.7 million in 2025 [6]. Even as policymakers and businesses aim to increase manufacturing capacity, they are faced with a skills and labor shortage due to retirements, limited training capacity, unclear entry pathways, energy transition demands, and reshoring [7]. Rebuilding manufacturing in the United States requires recruiting for and preparing the next generation of workers through technical education and skill-building programs [8]. In order to achieve this goal, it is necessary to understand what motivates workers to participate in training programs [9], [10].

This paper reports on the background, motivation, and baseline knowledge of technicians enrolled in an upskilling program aimed at preparing technicians for career advancement that was designed by the Massachusetts Institute of Technology in partnership with the University of Massachusetts at Lowell, Clemson University, Ohio State University, Cape Cod Community College, Community College of Rhode Island, the Berkshire Innovation Center, Connecticut Center for Advanced Technology, and industry partners. This year-long, hybrid program that was launched in the Fall of 2025 across six sites in the USA is designed to provide career development for "star" technicians with a competency-based curriculum that includes online modules, hands-on labs, and a work-based capstone project coordinated with local employers. Star technicians are defined as individuals who have worked at a company for more than 3 years, have excelled in their work, and who seek career advancement. This mixed-method study explores what motivates individuals to enroll in the program at different stages of their professional experience. Additionally, this study evaluates how the program enables individual growth to fulfill the needs of a modernizing manufacturing workforce.

Background

Prior research demonstrates that stronger career motivation is associated with greater persistence, particularly in demanding fields such as STEM, where sustained commitment is required to overcome structural and academic barriers [11]. However, most studies of career motivation have focused on knowledge workers and traditional academic populations rather than incumbent technical workers in manufacturing environments [12], [13]. Furthermore, there is still very little engineering education research applied to workforce development [14]. As a result, relatively little is known about the specific motivational drivers, learning needs, and baseline competencies of technicians pursuing advancement through structured upskilling programs.

Studies of adult learners suggest that motivation plays an important role in encouraging adult participation in workforce training; motivation is impacted by internal and external factors [15]. In Spain, a study of 390 students seeking vocational training found that

employed individuals cite intrinsic motivation, such as interest in the material and developing their own problem-solving skills as motivations, while unemployed individuals reported extrinsic motivations such as job seeking or improving their family conditions [16]. In comparing manufacturing workers with different education levels, Killada found that while high school-educated workers had similar job satisfaction and similar self-efficacy in accomplishing complex tasks as their middle and college-educated peers, high school educated workers had less intention to participate [17]. When examining the factors influencing motivation to participate in training among manufacturing workers, Clochard & Westerman found that less-educated workers were less likely to participate because they often face psychological and structural barriers that reduce participation, including limited expectations of benefit and concerns about academic preparedness [18]. These findings suggest that decisions to engage in upskilling are influenced by subjective beliefs about competence and expected outcomes. Despite these insights, much of the existing literature examines training participation primarily through demographic variables such as educational attainment or employment status, while the relationship between work experience and motivation to pursue upskilling remains underexplored.

Understanding motivation in technician populations also requires attention to how workers conceptualize professional advancement. Research in engineering technology and technical career pathways suggests that many technicians define professional success in terms of demonstrated competence rather than academic credentials alone. Frady et al. found that engineering technology students often prioritize “technical/functional competence” and “security/stability” over managerial or entrepreneurial aspirations [19]. Similarly, studies of manufacturing technicians indicate that promotion decisions are frequently based on demonstrated skill, reliability, and workplace performance rather than formal degrees [20]. Research on perceptions of manufacturing careers further shows that exposure to industry experiences shapes how individuals value competencies and skill acquisition [21]. These findings suggest that competency-based programs may align well with technician career orientations. However, alignment alone does not explain why some technicians choose to enroll in advancement programs while others do not. Even when programs emphasize hands-on labs, work-based projects, and industry coordination, enrollment decisions still require individuals to invest time, effort, and often financial resources. Thus, while competency orientation helps explain what technicians value, it does not fully explain how beliefs about capability, anticipated outcomes, and contextual constraints influence participation decisions.

Socio-Cognitive Career Theory

This study is grounded in Socio-Cognitive Career Theory. Social Cognitive Career Theory (SCCT), developed by Lent et al., is a widely used framework that explains the processes involved in career exploration, decision-making, and success [22]. It has been applied across various professions, including nursing [12], engineering [13], and tutoring in English as a foreign language [23]. SCCT explains career motivation by emphasizing the interaction between an individual’s self-efficacy (belief in their ability to succeed), outcome expectations (anticipated results of career choices), and background contextual affordances (family support, socioeconomic status, and access to education) that influence career decisions and motivation [12]. According to SCCT, self-efficacy develops and strengthens through mastery experiences, meaning the successful completion of relevant tasks, which then motivates individuals to pursue and persist in their careers. For example, research shows that early

hands-on experiences and achievements in STEM fields significantly boost students' self-efficacy, leading to increased interest and persistence in those careers [11].

SCCT also highlights the importance of psychological factors (interests, abilities, values), social factors (e.g., socioeconomic status, gender, race), and economic factors (e.g., employment and training opportunities) in shaping career development [11].

Most SCCT applications focus on traditional academic populations rather than technical workers in industrial settings. Likewise, studies of technician advancement emphasize competency alignment and career orientation but rarely examine the underlying motivation that drives participation in upskilling programs. Specifically, how self-efficacy, outcome expectations, and contextual constraints interact with accumulated work experience to influence enrollment decisions among technicians pursuing career advancement is an underexplored area. Understanding these dynamics is critical for designing workforce programs that not only align with industry competency needs but also address the motivational factors that influence participation and persistence. By applying SCCT to a competency-based upskilling program for incumbent manufacturing technicians, this study seeks to clarify how motivational beliefs shape decisions to enroll and engage in workforce development pathways.

TechAMP Program

Engineers typically understand broad systems, while operators are usually trained to run specific machines, creating a skills gap on the factory floor. Companies increasingly need workers who combine practical technical abilities with systems-level understanding, yet individuals with this skill set are difficult to find [24]. The Technologist Advanced Manufacturing Program (TechAMP) is designed to train technicians to become shop floor leaders by giving them a combination of foundational engineering concepts and industry-selected technical skills. TechAMP is designed for an audience of incumbent workers with at least 3-5 years of experience. To train this new type of worker, the goal is to recruit star technicians to participate in the training then integrate what they have learned into their everyday work.

The TechAMP curriculum uses a Hub and Spoke model. The Hubs are four core topics that draw from engineering fundamentals that are a part of MIT's Principles of Manufacturing MicroMasters curriculum: Statistical Process Control, Manufacturing Systems, Technical Leadership, and Operations Management. These four Hubs include topics such as data analysis and experimentation (Statistical Process Control), systems thinking (Manufacturing Systems), interpersonal skills and leadership (Technical Leadership), and supply chain management (Operations Management). All TechAMP students take the four Hubs. In addition to four Hubs, TechAMP also has elective Spokes. These Spokes are technical topics like robotics, mechatronics, design and manufacturing fundamentals, automation programming, machining, and digital manufacturing. The curriculum itself is designed to give students the skills and knowledge to take on new responsibilities at work.

The curriculum was shaped with input from Industry Partners, who gave input on the competencies they felt technologists should have. Industry partners also informed the topics of the Spokes that were developed, and gave feedback on the overall curriculum outline. Each Hub and Spoke is 7 weeks in length. Participants take four Hubs in the fall, two concurrently for seven weeks and then the other two for seven weeks, four Spokes in the spring, and complete a 10-week capstone project in the summer. Each week, students are

expected to spend between 10-14 hours on TechAMP. They attend two 3-hour labs (one for each Hub or Spoke they are enrolled in), and spend between four and six hours watching online lectures and doing online simulations. As a certificate program, the program is not ABET-accredited by itself, however the certificate will be offered at UMass Lowell, which is an ABET-accredited institution, thus it will fall under that umbrella. Currently, the team is working on credit arrangements with the education sites that will enable students to earn credit towards an associate's degree at the education site or nearby community college, or at universities that offer engineering technology degrees, such as UMass Lowell. Transfer agreements with the university and education sites/ community colleges are in progress at the time of this study. Additionally, graduates of the program will be surveyed at the end of the program and six months after the end to document career progression as a result of the experience.

Method

Research Questions

This study aims to develop an in-depth understanding of individuals who enroll in TechAMP. It examines participants' demographic characteristics, career goals, motivations for enrolling in TechAMP, factors influencing their career decisions, long-term career goals, and baseline knowledge levels related to the program curriculum.
Research questions are:

- RQ1. What motivates people to enroll in [Education Program] based on their years of professional experience?
- RQ2. Which factors shape career decisions of technicians who enrolled in this program across different stages of professional experience?
- RQ3. What is the baseline knowledge level of [Education Program] students? How does baseline knowledge differ across different levels of professional experience?

Participants

The survey study sample (n = 64 of the 82 enrolled students) comprised participants who identified as male (59.4%, n = 38) and female (10.9%, n = 7), while 29.7% (n = 19) did not provide gender information. In terms of age, participants were predominantly between 20–29 (35.9%, n = 23) and 30–39 (35.9%, n = 23), followed by those aged 40 and older (25.0%, n = 16), a small group younger than 20 (1.6%, n = 1). In terms of race and ethnicity, the majority of the participants identified as White (75.0%, n = 48), followed by Hispanic or Latino/a (15.6%, n = 10), Asian (6.3%, n = 4), and other identities (1.6%, n = 1). The interview study sample was 9 individuals who had a range of educational backgrounds and represented each of the 5 sites that were running at the time the interviews were conducted.

Participants' professional experience that is relevant to their current job and educational backgrounds is presented in Table 1, highlighting that nearly one-third of the participants have over 10 years of experience. The majority of participants entered the program with a high school diploma or GED as their highest level of formal education (see Table 1).

Table 1. Professional Experience and Educational Backgrounds of Participants

Category	Sub-category	f	%
Professional Experience	Less than 1 year	4	6.3%
	1–3 years	14	21.9%
	3–5 years	12	18.8%
	5–10 years	12	18.8%
	Over 10 years	21	32.8%
Education	High school diploma or GED	24	37.5%
	Associate's degree	9	14.1%
	Vocational high school	8	12.5%
	Technical certificate	8	12.5%
	Bachelor's degree or higher	8	12.5%
	Other	6	9.4%

Data Collection

We developed a comprehensive pre- and post-program evaluation plan to collect data on students' backgrounds, interests, prior knowledge, and career goals. A mixed-methods approach was used to integrate quantitative and qualitative data, strengthening the interpretation of findings through triangulation. As part of this plan, students completed two surveys during the first week of the program at five of the six participating sites. The sixth site began the program at a later date; therefore, data from that site are not included in this paper. The two surveys served distinct purposes: a multiple-choice knowledge assessment administered during class time, and a survey administered outside of class time that focused on students' backgrounds, career interests, and motivations for program enrollment.

We adapted survey items from the PEARS (Pathways of Engineering Alumni Research Survey), which was developed as part of the NSF-funded Engineering Pathways Study [25] and applied to engineering graduates across four U.S. research universities [25]. The aim of this study is to use the Social Cognitive Career Theory (SCCT) framework to examine technicians' career goals, as well as the intrinsic and extrinsic motivations that influence their career decision-making processes. The original PEARS survey consists of five sections aligned with the SCCT model: (1) degrees and employment, (2) learning experiences then and now, (3) self-concept, outcome expectations, and interests, (4) satisfaction and future plans, and (5) background characteristics. For the purposes of this study, we selected survey items from the degrees and employment and self-concept, outcome expectations, and interests sections, as these factors are most directly aligned with understanding technicians' career motivations and decision-making processes.

The survey was distributed through Qualtrics to students in the first week of the program. The survey included questions such as:"How influential has each of the following been on your career decision-making so far?" measured on a 5-point Likert scale (1 = not influential,

5 = extremely influential), and “How important has each of the following been to you in your career decision-making so far?” also measured on a 5-point Likert scale (1 = not important, 5 = extremely important). The survey also included open-ended questions to complement the multiple-choice responses.

A 16-question multiple-choice knowledge assessment, scored on a scale from 0 to 100, was developed by a subject matter expert to gauge students’ understanding of topics included in the core curriculum: statistical process control, manufacturing systems, technical leadership, and operations management. Students were given 20 minutes of class time to do this assessment during the first week of the course.

Nine one-hour semi-structured interviews were conducted at the end of the program by three researchers for in-depth understanding of their motivations to enroll in this program. Participants received a $30 Amazon gift card at the completion of the interview. All instruments and protocols in this study were reviewed by MIT’s Committee on the Use of Human Experimental Subjects (COUHES).

Data Analysis

Quantitative data comprised descriptive analyses of survey results to summarize participant characteristics and career goals, intrinsic and extrinsic motivations that affect their career decisions, as well as analyses of knowledge assessment scores. Knowledge assessment data were examined using a one-way analysis of variance (ANOVA) to determine whether knowledge levels differed significantly across years of professional experience. Prior to conducting the ANOVA, all relevant statistical assumptions, including normality (Shapiro-Wilk Test) and homogeneity of variance (a Levene’s test for equality of variances), were assessed to ensure the reliability of the findings.

Qualitative data were gathered through open-ended survey questions addressing participants' motivations for program enrollment. Open-ended questions were analyzed using deductive coding based on research questions. Additionally, semi-structured interviews with nine participants were transcribed and systematically analyzed to explore their underlying motivations for entering the program. Patterns of program enrollment motivations were identified and presented alongside example quotes from participants to highlight key themes. To ensure the validity and reliability of the findings, both the open-ended survey responses and the interview transcripts were analyzed independently by two researchers for the reduction of individual bias.

Results

RQ1. Which factors shape TechAMP students’ career decisions across different stages of professional experience?

An analysis of the influential factors in career decision-making reveals differences as individuals progress through different stages of professional experience (See Table 2). For entry-level respondents (less than a year), with "Advice from a mentor" and "Family circumstances growing up" both yielding high mean scores (M=3.50, SD=0.58 and M=3.50, SD=1.29, respectively). In contrast, mid-to-late career professionals demonstrate a heavy reliance on internal experiential knowledge; for those with 5–10 years of experience, "Experiences in my job(s)" emerged as the most dominant influence (M=3.92, SD=1.08), a

trend that remains stable into the participants with 10+ years of experience (*M*=3.76, *SD*=1.14). Economic factors, specifically "Consideration regarding the country's economy," appear more influential during the early stages (1–3 years: *M*=3.14, *SD*=1.29) than for experienced professionals (5–10 years: *M*=2.42, *SD*=1.08), suggesting that as professional experience increases, sensitivity to broader economic fluctuations may decrease. Across all experience levels, "What my peers are doing" remained the least significant factor, consistently recording the lowest mean values (ranging from *M*=1.25 to *M*=1.86). These findings suggest career decision-making evolves over time where individuals transition from being guided by external, social, and familial foundations to being driven by specific, lived professional expertise.

Table 2. Influence of Factors on Career Decision-Making across different stages of professional experience?

Experience Level	Regional Industries	Country's Economy	Current Family Circumst-ances	Family Circum-stances Growing Up	Peers Activity	Job Experiences	Mentor Advice
Less than a year	3.25	3.25	3.5	3.5	1.25	2.25	3.5
1-3 years	2.86	3.14	2.93	3.07	1.86	2.86	2.93
3-5 years	3.17	3.17	2.67	2.58	1.67	3.83	2.42
5-10 years	3.25	2.42	3.25	2.58	1.83	3.92	2.83
10+ years	2.71	2.62	3.05	2.76	1.71	3.76	2.67

5-point Likert scale (1 = not influential, 5 = extremely influential)

Analysis of the importance of factors in career decision-making across varying levels of experience reveals that as people gain more work experience, their personal values change, but they always keep job security as a top priority (See Table 3). Across all experience levels, having a secure job emerged as a primary concern, particularly for those with 1–3 years (M = 4.64) and 3–5 years (M = 4.67) of experience. While early-career individuals with less than a year of experience placed significant emphasis on external impact, such as contributing to the good of society (M = 4.25) and fixing global problems (M = 4.25), these priorities appeared to moderate among mid-career professionals. Conversely, professionals with over 10 years of experience demonstrated a greater focus on personal well-being and autonomy, prioritizing time for family, friends, and hobbies (M = 4.19) and high levels of independence and self-direction (M = 4.00). Additionally, the desire for intellectually interesting work remained a robust motivator throughout most career stages, peaking among those with 1–3 years of experience (M = 4.36). These results suggest that while financial and job security remain fundamental, the weight of social contribution decreases relative to personal autonomy and work-life balance as individuals progress in their professional trajectories.

Table 3. Importance of Factors in Career Decision-Making According to Level of Experience

How important has each of the following been to you in your career decision-making so far?	>1 year	1-3 years	3-5 years	5-10 years	10+ years
Having a secure job	4.00	4.64	4.67	4.50	4.33
Having a well-paying job	4.00	3.71	4.17	4.08	4.00
Job for family, friends, & hobbies	4.25	3.57	3.75	3.92	4.19
Intellectually interesting job	4.00	4.36	3.92	3.75	4.05
Independence & self-direction	3.25	3.71	3.42	3.33	4.00
Desire for education & training	4.25	3.93	3.50	4.17	3.52
Job as a stepping stone	4.25	3.93	3.50	4.00	3.43
Doing work that is fun	3.50	3.86	3.50	3.08	3.62
Contribute to the good of society	4.25	3.07	3.33	2.83	3.57
Fixing problems in the world	4.25	3.14	3.42	3.00	3.38
Figure out real interests	2.75	4.00	3.67	3.33	3.00
Collaboration and teamwork	2.25	3.36	3.08	2.75	3.43
"Fast track" advancement	3.00	3.36	3.42	2.83	3.05
Pleasing my family	3.00	2.50	2.58	2.75	2.76
Desire to live in a certain location	3.25	2.43	3.00	2.75	2.76

5-point Likert scale (1 = not important, 5 = extremely important).
Green fill indicates the highest-rated factor(s) for each group

What motivates people to enroll in TechAMP? : Survey results on motivations for enrolling in TechAMP

Analysis of responses to students' motivations for pursuing TechAMP varied across different levels of professional experience (See Figure 1). Across all experience groups, career advancement and professional growth emerged as the most frequently selected motivation, other than for those with less than one year of experience (50.0%). Notably, while absolute frequencies were higher among participants with greater experience due to larger group sizes, this motivation remained prominent even among early-career respondents (1-3 years: 100.0%; 3-5 years: 91.7%; 5-10 years: 100.0%), suggesting its broad relevance across professional stages. Personal enrichment and intellectual curiosity also represented a substantial motivational factor among participants with less than one year of experience (100.0%) and those with more than ten years of experience (76.2%). This pattern suggests that both newcomers and highly experienced professionals may be driven by intrinsic

learning goals, albeit for different developmental reasons. In contrast, financial gain and opportunity were motivations that were most stated among individuals with over ten years of experience (76.2%), indicating that financial considerations may become increasingly salient at later career stages. Finally, pursuing higher education was among the less frequently selected motivations for several experience groups (3-5 years: 33.3%; 1-3 years: 35.7%; 10+ years: 47.6%), suggesting that many participants viewed TechAMP primarily as a professional development or skills-enhancement pathway rather than a stepping-stone to formal academic advancement.

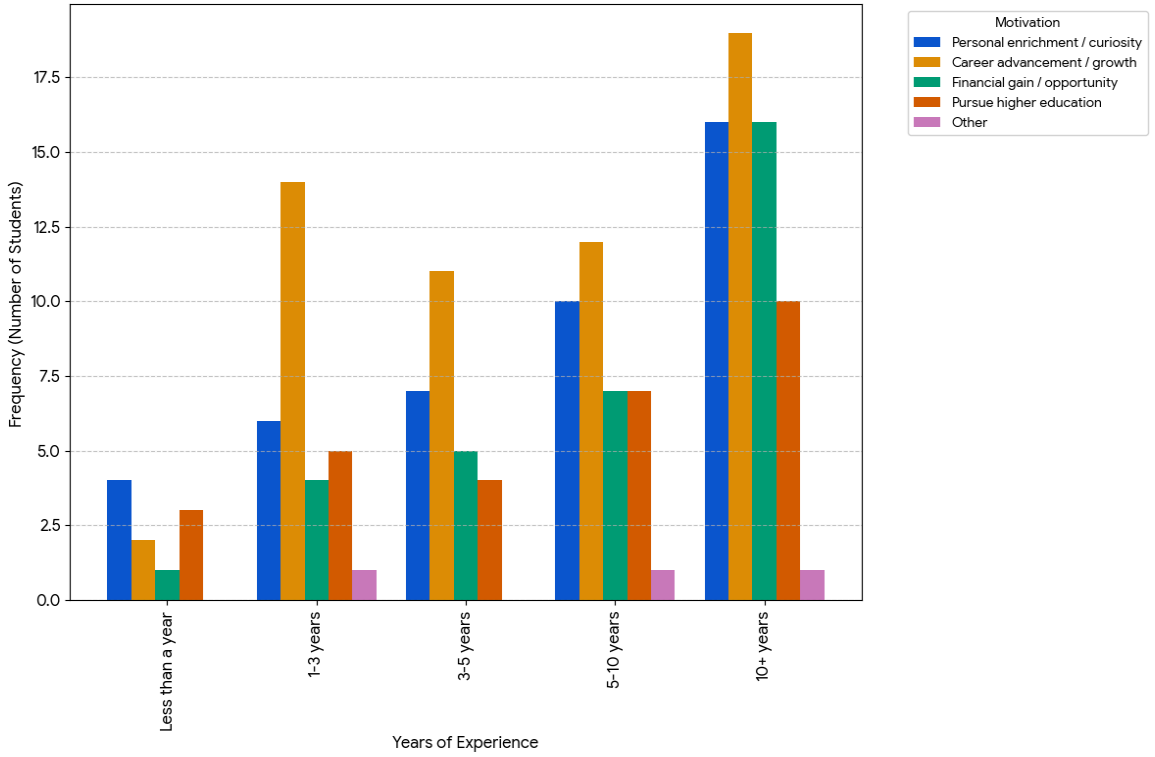

Figure 1. Motivation to Enroll in TechAMP by Years of Experience

Open-ended survey responses revealed diverse motivations for enrolling in TechAMP, with several common themes emerging across participants. Career advancement was a primary motivator, as many viewed the program as a pathway to new roles or promotions; one student noted, "I was stuck in the position I am in at work... with this class, it will open up more doors and give me the motivation to keep going and push myself to see how high up the ladder I can go." Skill development was also central, with participants seeking to "gain a better understanding of the manufacturing process" and become "more well-rounded" by exploring aspects of the industry they hadn't previously encountered. In addition, employer encouragement played a significant role in enrollment decisions. Many participants were inspired by leadership, such as one respondent whose boss "motivated me to study," while others were nominated directly by their companies, describing the transition as a chance to "accept and embrace new challenges for advancement." Practical considerations further influenced participation, particularly the program's low or no cost, paid time to attend, and the value of earning a recognized credential that could strengthen resumes. One participant stated that: "at no cost [it] made the decision easy," allowing students to commit their time to earning a credential that signals professional growth. Finally, some respondents described intrinsic motivations, such as setting an example for family members, contributing to broader societal or organizational missions, and overcoming barriers in technical fields. Some who worked at defense contractors aimed to "help our military be safe," while others

viewed their education as a powerful personal statement, seeking to "show my young kids that even when you are older... you can still be successful and try to get a degree later in life." Together, these findings highlight TechAMP's appeal as an employer-supported program that successfully aligns professional advancement with personal meaning and broader organizational improvement.

Findings from interviews regarding motivations for enrolling in TechAMP

Interview results revealed that motivations for enrolling in TechAMP are primarily driven by a desire for career advancement and upward professional trajectory within the manufacturing sector. Many participants expressed a need to overcome professional stagnation, viewing the curriculum as a vital instrument to transition from frontline production roles into supervisory or engineering-level positions. Students are motivated to "speak the language of engineering" and bridge the substantial "disconnect" that often exists between production staff, supervisors, and management. One student noted that

> *I guess I was fairly settled in my role. I've been at the company for seven years now. The work's been steady, and I'd never really looked past my current role* [until this opportunity provided the] *confidence to start looking at further vertical advancement*. (TechAMP student)

Others highlighted a desire to move away from repetitive tasks, stating they were "just kind of bored" after years in the same position and sought the program to enable them to do something different and grow.

Beyond individual career advancement, participants are motivated by the necessity of skills modernization to remain competitive in a technologically evolving industry. There is a strong inclination toward lifelong learning and a desire to master complex tools to ensure they do not fall behind. One student explained that they "never want to feel like I'm out of date, or that the technology is passing me by". Another participant identified the program as a critical trigger to identify and fill specific knowledge gaps, such as proficiency in Excel or data analysis.

Finally, the program's structural accessibility and industry support serve as significant enrollment incentives. The hybrid format is specifically cited as a "realistic option" for working professionals, providing the flexibility needed to balance rigorous coursework with full-time shifts and family obligations. Financial considerations are equally influential; where students continue to receive their salary during class hours. One participant emphasized that being "paid at the same time so I don't lose out on my salary" was a "huge" factor in their decision to commit to the year-long program.

RQ2. Which factors shape TechAMP students' career decisions across different stages of professional experience?

An analysis of the influential factors in career decision-making reveals differences as individuals progress through different stages of professional experience (See Table 2). For entry-level respondents (less than a year), "Advice from a mentor" and "Family circumstances growing up" both yielded high mean scores (M=3.50, SD=0.58 and M=3.50, SD=1.29, respectively). In contrast, mid-to-late career professionals demonstrate a heavy reliance on internal experiential knowledge; for those with 5–10 years of experience,

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10+ years	2.71	2.62	3.05	2.76	1.71	3.76	2.67

5-point Likert scale (1 = not influential, 5 = extremely influential)

Analysis of the importance of factors in career decision-making across varying levels of experience reveals that as people gain more work experience, their personal values change, but they always keep job security as a top priority (See Table 3). Across all experience levels, having a secure job emerged as a primary concern, particularly for those with 1–3 years (M = 4.64) and 3–5 years (M = 4.67) of experience. While early-career individuals with less than a year of experience placed significant emphasis on external impact, such as contributing to the good of society (M = 4.25) and fixing global problems (M = 4.25), these priorities appeared to moderate among mid-career professionals. Conversely, professionals with over 10 years of experience demonstrated a greater focus on personal well-being and autonomy, prioritizing time for family, friends, and hobbies (M = 4.19), and high levels of independence and self-direction (M = 4.00). Additionally, the desire for intellectually interesting work remained a robust motivator throughout most career stages, peaking among those with 1–3 years of experience (M = 4.36). These results suggest that while financial and job security remain fundamental, the weight of social contribution decreases relative to personal autonomy and work-life balance as individuals progress in their professional trajectories.

Table 3. Importance of Factors in Career Decision-Making According to Level of Experience

How important has each of the following been to you in your	> 1 year	1-3 years	3-5 years	5-10 years	10+ years

career decision-making so far?					
Having a secure job	4.00	4.64	4.67	4.50	4.33
Having a well-paying job	4.00	3.71	4.17	4.08	4.00
Job for family, friends, & hobbies	4.25	3.57	3.75	3.92	4.19
Intellectually interesting job	4.00	4.36	3.92	3.75	4.05
Independence & self-direction	3.25	3.71	3.42	3.33	4.00
Desire for education & training	4.25	3.93	3.50	4.17	3.52
Job as a stepping stone	4.25	3.93	3.50	4.00	3.43

Table 3 (continued). Importance of Factors in Career Decision-Making According to Level of Experience

How important has each of the following been to you in your career decision-making so far?	> 1 year	1-3 years	3-5 years	5-10 years	10+ years
Doing work that is fun	3.50	3.86	3.50	3.08	3.62
Contribute to the good of society	4.25	3.07	3.33	2.83	3.57
Fixing problems in the world	4.25	3.14	3.42	3.00	3.38
Figure out real interests	2.75	4.00	3.67	3.33	3.00
Collaboration and teamwork	2.25	3.36	3.08	2.75	3.43
"Fast track" advancement	3.00	3.36	3.42	2.83	3.05
Pleasing my family	3.00	2.50	2.58	2.75	2.76
Desire to live in a certain location	3.25	2.43	3.00	2.75	2.76

5-point Likert scale (1 = not important, 5 = extremely important**).**

RQ3. What is the baseline knowledge level of TechAMP participants?

Students' baseline knowledge of topics included in the core curriculum is moderate, with a mean score of 45.34 points and a median of 43.75 out of a possible 100. Participants displayed a wide range of initial expertise, as evidenced by a standard deviation of 18.68 points and scores spanning from a minimum of 0 to a maximum of 75. These statistics indicate that while the participants enter the program with some foundational technical knowledge, there is a significant opportunity for growth and a clear need for the training provided by the program to bridge the existing gaps. Statistical analysis indicated no significant difference in students' baseline knowledge across varying degrees of professional experience, ranging from less than one year to over ten years. This was not surprising, as the assessment focused on engineering fundamentals from a course at MIT, so this is knowledge that technicians who do not have an engineering background are unlikely to have. A post-assessment of knowledge was administered in January 2026 and will be administered again at the end of the program.

Discussion

This study addresses a critical gap in the US manufacturing sector by examining the motivations for incumbent workers to participate in a specialized education program

designed to transform technicians into "technologists" capable of being leaders on the modern factory floor. Understanding the career motivations and background knowledge of these workers is essential for creating adaptable manufacturing workforces that can withstand current labor shortages and the impending retirement of nearly 12% of the workforce by 2029 [26]. Understanding the motivations to participate in training is critical for encouraging employees to enroll in these types of training programs [9], [10].

The evolution of career decision-making factors within TechAMP participants suggests a transition from external social influences to internal experiential knowledge as participants progress through their professional lives. According to the survey results, early-career participants with less than one year of experience are significantly guided by external social foundations, identifying mentor advice and family circumstances as their primary influences. This observation aligns with the "Exploration" stage of Super's Life-Span Theory, where individuals in their early stages of careers narrow their career choices through the influence of role models and social supports [27], [28]. Lent, Brown & Hacketts's Social Cognitive Career Theory (SCCT) emphasizes that social support (family, mentors) and contextual factors (culture, opportunities, barriers), together with personal beliefs (self-efficacy, outcome expectations), shape career interests, choices, and persistence by influencing confidence and expected outcomes, guiding career commitment[22], [29]. In contrast, more experienced professionals demonstrate a shift toward internal, lived professional expertise, where specific job experiences become the dominant driver of career choices. This transition mirrors Super's "Establishment" and "Maintenance" stages, where the focus moves from seeking external validation to stabilizing one's position based on professional mastery. Our results support this theoretical framework: financial gain and opportunities were most commonly cited by individuals with over ten years of experience, suggesting that as workers mature in their roles, their "outcome expectations" within SCCT shift toward practical financial gains. Conversely, for those in the early "Exploration" stages, financial factors remain among the least influential motivators, as these individuals are more focused on developing self-efficacy and professional identity through social foundations and mentorship. One area of future research will be to evaluate whether participation in the training results in a pay increase or promotion at work.

Across every level of professional experience, maintaining a secure job remains a primary priority, reflecting a fundamental need for stability within the manufacturing sector. However, as individuals reach more than ten years of experience, their focus shifts away from earlier desires for social contribution or "fixing problems in the world" toward personal well-being. These experienced professionals prioritize personal autonomy, independence, and time for family and hobbies, indicating a re-evaluation of life roles as they move deeper into the maintenance stage of their careers. Results in this study align with existing research in that the incumbent workers face internal and external factors when considering training [15], and cite both intrinsic and extrinsic motivations for participating in the program [16].

Reasons for enrolling in the program are mainly influenced by the ambition for career advancement and the need to update skills. Participants indicated that they view the program as a vehicle to "speak the language of engineering," effectively bridging the communication gap between production staff, supervisors, and management. This shows a deliberate effort to advance professionally, as many participants wanted to move beyond repetitive tasks and roles they found "just kind of boring." The importance of career advancement spanned across workers with very different levels of work experience in this sample, suggesting that workers with all experience levels can be encouraged to engage in training [17], [18].

Interestingly, although career advancement is a common motivator, personal growth and intellectual curiosity are most pronounced among both the newest and most experienced workers. This suggests that lifelong learning fulfills different developmental needs at various stages of a career. The implications for the recruitment of workers in upskilling programs are that different strategies can be used to encourage workers at different points in their careers; programs can highlight the development of career identity through the program for employees with fewer years of experience, while programs can highlight financial gain through potential wage increases for employees with more years of experience.

The baseline knowledge assessment revealed a moderate foundational understanding of core curriculum topics, with a critical finding that knowledge scores do not correlate with years of professional experience. Participants displayed a wide range of initial expertise. This finding suggests that experience in a manufacturing role does not automatically equate to mastery of advanced concepts such as statistical process control or technical leadership. It highlights a clear need for the training provided by TechAMP to bridge the gap between practical shop-floor experience and theoretical knowledge. According to [19], mapping career orientations is vital for the professional formation of students to ensure they do not "fall behind" in a modernizing workforce. This is further supported by [30], who emphasize that preparing a workforce for advanced manufacturing requires targeted education in complex systems like robotics and operations management. The implications of these results are that existing knowledge is important, and measuring the baseline of participants should be a part of all training programs.

Finally, the study underscores that the success of professional development is heavily dependent on organizational support and structural accessibility. The program's hybrid format was cited as a "realistic option" for working professionals, providing the flexibility needed to balance rigorous coursework with full-time shifts and family obligations. A hybrid model that delivers theory online for accessibility and scale, paired with in‑person labs, simulations, and employer‑mentored projects, can extend the strengths of manufacturing education programs while broadening reach and flexibility [30]. Employer-driven motivation, including direct nominations and encouragement from leadership, played a vital role in prompting technicians to embrace new challenges for advancement. Together, these findings provide an understanding of the factors that encourage workers to participate in an employer-supported program that aims to align individual professional growth with broader organizational improvement. A better understanding of these factors enables other programs to be strategic in how they recruit participants to their programs.

Conclusion

The increasing interest in revitalizing manufacturing in the United States requires the development and deployment of training programs to prepare the manufacturing workforce. A key part in creating successful programs is in understanding the audience of workers who will consider these programs, and how to market these training programs to that audience. Career motivations are dynamic and evolve with professional experience. Early-career participants are primarily guided by external social foundations, such as mentors and family, while experienced professionals rely on internal, lived expertise and prioritize personal autonomy and financial stability. Despite these differences, a universal desire for job security remains a fundamental driver across all experience levels. Moreover, the absence of a correlation between years of experience and baseline knowledge highlights a significant knowledge gap, emphasizing the necessity of targeted, competency-based training to

effectively address it and underscoring the need for baseline knowledge assessments to be incorporated into training programs. Successful training programs must recognize the motivations that guide potential participants and align individual aspirations for career advancement with organizational needs through structural and financial support. A flexible model and organizational supports—such as paid training hours—effectively mitigate barriers for working professionals. Programs that maintain strong industry partnerships and that continually update the curriculum to evolve with technological trends will be vital for ensuring long-term national competitiveness and workforce resilience.

Recommendations

Based on the research findings, the following recommendations are suggested for educational institutions and industries:

Program Design:

Implement Hybrid and Scalable Models: Use hybrid models that blend flexible online theory with hands-on, in-person labs to better accommodate the complex schedules of working professionals. The program needs to mitigate the "cost of participation" by providing the training at no cost and ensuring students are paid their regular salary during class hours.

Integrate "21st-Century" Skills: Curriculum must explicitly scaffold nontechnical skills such as communication, teamwork, and technical leadership to prepare technicians for cross-functional shop-floor leadership.

Recruitment strategies: For early-career employees, training should be linked to certifications and clearly defined career pathways to support professional identity formation and skill development. For experienced employees, training should be associated with financial incentives (e.g., bonuses or performance-based rewards) and work-life balance while emphasizing autonomy.

Industry and Employer Engagement:

Employer Support: Strong organizational support is crucial for technician participation, as encouragement from leadership serves as a powerful "trigger" for workers to embrace new professional challenges. This support is most effective when it addresses the opportunity costs of education through structural and financial incentives, such as providing the program at no cost through grants and paying workers their regular salary during class hours to prevent wage loss.

*Modernized Manufacturing Needs***:** To ensure workforce resilience, the program curriculum must be a competency-based model that reflects the rapid technological evolution of Industry. TechAMP uses a "Hub and Spoke" architecture that balances core engineering fundamentals—such as Statistical Process Control and Operations Management—with specialized technical "Spokes" like robotics, mechatronics, and digital manufacturing, and that can be modified as new technologies become important to manufacturing.

Acknowledgments

This study is funded by the Industrial Base Analysis and Sustainment (IBAS) program at the Department of Defense. The authors thank their partner institutions for their dedication in presenting the program. The authors thank Dr. Zhen Zhao for his help in developing the

assessments. Additionally, we thank the students for agreeing to share their motivations, career aspirations, and background information with us. Generative AI tools were used in the editing of this manuscript.