



Examining the Quality, Market Value, and Effectiveness of Manufacturing Credentials in the United States

Published by

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an affiliate of the American National Standards Institute (ANSI)

In partnership with



**MEP • MANUFACTURING
EXTENSION PARTNERSHIP®**

The National Institute of Standards and Technology (NIST)
Hollings Manufacturing Extension Partnership (MEP)

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Workcred
1899 L Street, NW, 11th Floor
Washington, DC 20036

The logo for Workcred, featuring the word "workcred" in a lowercase, sans-serif font. The letters "work" are in blue and "cred" are in green.

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EXECUTIVE SUMMARY

U.S. manufacturing faces a skills mismatch: studies forecast an increase in output and productivity, but also predict a shortage of individuals with the right skills to fill the jobs. To help solve this mismatch and keep up with changing skill needs, a clearer understanding of how credentials are used and valued by the manufacturing industry is essential.

In a first-of-its-kind research study, Workcred—an affiliate of the American National Standards Institute (ANSI)—partnered with the Hollings Manufacturing Extension Partnership (MEP), an operating unit of the National Institute of Standards and Technology (NIST),¹ to examine the quality, market value, and effectiveness of manufacturing credentials, and the need for new or improved manufacturing credentials.

KEY FINDINGS

- » The study revealed that credentials have uneven use in the manufacturing industry and are not routinely required or used as a major factor in hiring or promotion decisions.
- » Many manufacturers do not know what credentials are available or how they are relevant to their workplace.
- » Facility size appears to influence credential use, with large manufacturing facilities (more than 500 employees) more likely to prefer credentials than smaller facilities.
- » Many manufacturers do not view credentials as the most relevant tools to identify new skilled personnel or as incentives to improve the quality of their existing workforce.
- » Manufacturers often feel they need to train new employees regardless of whether or not they held a credential, and could not quantify whether credentials added value in terms of reduced cost or reduced training time.
- » Manufacturers believe that credentials *could* serve as a critical resource if they were better understood and made more in line with skills needed in their facilities.

¹ This research work was performed under the financial assistance award 70NANB16H239, from the U.S. Department of Commerce, National Institute of Standards and Technology.

RECOMMENDATIONS

Credentials can be part of the solution to closing the skills mismatch and helping individuals demonstrate that they possess the right skills. But for this to occur, well-developed credentials must be aligned to current skill needs and updated so that they remain valid as skill requirements evolve.

To help U.S. manufacturing keep pace with changing skill needs, the report details recommendations for multiple stakeholders, including manufacturers, credentialing organizations, educators, accreditors, and policymakers. The recommendations address themes related to:

- » Improving understanding about the content, use, and value of credentials
- » Expanding the use of quality standards for credentials
- » Strengthening relationships between employers, education and training providers, and credentialing organizations
- » Adding an employability skills component to existing and new credentials
- » Creating credentials that focus on performance and address new roles
- » Increasing the number of apprentices and expand apprenticeships to more occupations



INTRODUCTION

Even in an environment with low unemployment, the United States faces a skills mismatch, particularly in the manufacturing sector. Studies indicate an increase in job openings in the manufacturing sector as well as increases in output and productivity, but studies also reveal that skilled manufacturing jobs are difficult to fill and there is a shortage of individuals who possess the right skills.² According to a study by Deloitte and the Manufacturing Institute, an affiliate of the National Association of Manufacturers, while nearly 3.5 million manufacturing jobs will likely be needed over the next decade, 2 million are expected to go unfilled due to the skills gap.³ Additionally, U.S. Department of Labor employment statistics note that the mean age of individuals employed in the manufacturing industry is 44.5 years,⁴ suggesting that many people currently employed will soon reach retirement age, which will intensify the need to find new skilled employees.

The challenge to identify skilled workers is exacerbated by the tremendous growth and diversity of credentials.

Human resources staff as well as individuals interested in pursuing a career in manufacturing struggle to discern credentials of quality from those of lesser caliber or even understand the characteristics of the different types of credentials and how they are used. There are numerous credentials in the manufacturing industry, and most are not recognized by an independent third party. The absence of credible third-party assessments ensuring the quality of the certificate or certification program creates a buyer-beware environment. This leads to confusion in individuals seeking credentials that will enhance their ability to find employment or further their careers, as well as in manufacturers who want to know what type and level of knowledge and skills a credential holder has, how credentials compare to each other, and how much to trust the claims made by credentialing organizations.

The word "credential" is used as an overarching term to encompass such things as certificates, certifications, licenses, apprenticeships, and degrees (see Figure 1).

-
- 2 Manufacturing Institute and Manufacturing Advocacy and Growth Network, The Joyce Foundation, and The Manufacturing Institute. *National Survey on the Value of A Credentialed Workforce, Final report*. November 2013. http://www.themanufacturinginstitute.org/~media/C2F93A04AC134EE-586066006A86A967E/National_Survey_on_the_Value_of_a_Credentialed_Workforce.pdf; Accenture and The Manufacturing Institute. *Out of Inventory: Skills Shortage Threatens Growth for U.S. Manufacturing*, 2014. <http://www.themanufacturinginstitute.org/News-Articles/2014/05/~media/70965D0C4A944329894C96E0316DF336.ashx>; EMSI, *Manufacturing is Not Dead*, March 2018. <http://www.economicmodeling.com/manufacturing-is-not-dead>.
 - 3 Deloitte and The Manufacturing Institute. *The Skills Gap in U.S. Manufacturing 2015 and Beyond*. 2015. <https://www2.deloitte.com/us/en/pages/manufacturing/articles/boiling-point-the-skills-gap-in-us-manufacturing.html>.
 - 4 Bureau of Labor Statistics. *Labor Force Statistics from the Current Population Survey, Household Data Annual Averages, Table 18b. Employed persons by detailed industry and age*. <https://www.bls.gov/cps/cpsaat18b.htm>.

Yet, credentials can be part of the solution to closing the skills gap and helping individuals demonstrate that they possess the right skills. For this to occur, well-developed credentials must be aligned to the current skills needs, and must be updated in order to remain valid as skill requirements continue to change. This can only be done by establishing effective communication among key communities, including manufacturers; credentialing organizations; education and training providers; and local, state, and federal governments.

Figure 1: How Credentials Differ

	CERTIFICATE	CERTIFICATION	DEGREE	LICENSE
Awarded by	Education and training providers	Industry certification bodies	Education institutions	Government agencies
Awarded after	An exam at the end of a training or education course or a one-time assessment	Third-party, independent assessment	Course of study	Meeting requirements
Indicates	Education/basic skills	Skill mastery	Education	Legal permission
Time to Complete	Variable, generally less than 2 years	Variable	Variable, generally 2 years or more	Variable
Time and Renewal Requirements	Often no time limit, no renewal requirement	Time-limited, includes recertification	No time limit, no renewal requirement	Time-limited, renewal generally required
Revocation Process	Cannot be revoked	Can be revoked for incompetence or unethical behavior	Cannot be revoked	Can be revoked for incompetence or unethical behavior
Examples	CNC Machinist, Global Supply Chain, Mechatronics	AWS Certified Welder, Certified Quality Inspector, Certified Supply Chain Professional	Bachelor of Science in Engineering	Electrician, Professional Engineer
Standard for Accreditation	ANSI/ASTM E2659, a globally recognized American National Standard	ANSI/ISO/IEC 17024, an international and national standard	National, regional, or programmatic	State law

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GOALS OF THE RESEARCH STUDY

For U.S. manufacturing to remedy the skills mismatch and maintain competitiveness, an understanding of how credentials are used and valued by industry is essential. The purpose of this study is to examine the quality, market value, and effectiveness of manufacturing credentials, and to examine the need for new or improved credentials to advance U.S. manufacturing. This study was funded by the Hollings Manufacturing Extension Partnership (MEP), an operating unit of the National Institute of Standards and Technology (NIST). All phases of the research study were conducted in partnership with NIST MEP. The findings and recommendations outlined in this report are intended to advance the industry and manufacturing workforce by providing concrete guidance to manufacturers, credentialing bodies, educators, and policymakers.

RESEARCH QUESTIONS

The key questions this research study sought to answer include:

1. How are credentials used in the manufacturing industry?
2. Which credentials are the most prevalent in the manufacturing industry?
3. How are credentials valued, and are there differences in terms of the size of manufacturers?
4. What knowledge, skills, and abilities are manufacturers looking for when hiring?
5. How do manufacturers use credentials to assess potential hires and make promotion decisions?
6. What types of credentials are required and/or preferred by manufacturers and why?
7. What support do individuals receive to obtain a credential after they are hired?
8. What training is conducted to up-skill individuals who hold credentials versus those who do not?
9. What is the relative importance of soft skills⁵ versus technical skills?

METHODOLOGY

This research study was carried out using a mixed methodological approach encompassing: 1) an online survey⁶ to MEP National Network™ Center clients across the U.S., including Puerto Rico; 2) a series of focus groups comprised of representatives from MEP Center's client base; and 3) desk research and analysis of the most commonly cited credentials identified in the survey along with direct outreach to the issuers of those credentials to gather information about market value.

ONLINE SURVEY

Using SurveyGizmo,⁷ a survey software program used by many Fortune 500 companies and government agencies, the research team designed a survey instrument to gather answers to the research questions. In order to gather input from the population to be served, the research team fielded feedback on the draft survey, including its goals, questions, and format, from a small focus

5 Soft skills (also commonly referred to as employability skills, non-cognitive skills, workplace skills, or executive function skills) refer to skills and attributes such as communication, teamwork, work appropriate behavior, critical thinking, and problem solving.

6 **Appendix A** is a copy of the online survey.

7 Any mention of commercial products is for information only; it does not imply recommendation or endorsement by NIST MEP.

group of representatives from MEP Centers across the U.S. The survey was also piloted with several companies working with the MEP Centers. Once revised with the input received, the online survey was distributed to the MEP National Network of 51 Centers across the U.S. including Puerto Rico, requesting that individuals with hiring authority complete the survey. Additionally, NIST MEP staff distributed the survey to stakeholders including Manufacturing USA™ Institutes and National Industry Associates. Each Center or stakeholder was asked to invite at least 10 clients or members to complete the survey. It is projected that more than 10,000 individuals may have received the invitation to participate. The response rate is estimated to be approximately 10 percent.

[There is] a lot of ignorance about what credentials are out there and what they mean. If somebody could tell us or teach us what . . . these things mean, and I see them on the resume, it might mean something to me. But right now it's just 'who cares?' I'll put you on a machine and see how well you can make a part. Whether you have a credential or you don't have a credential is not meaningful.

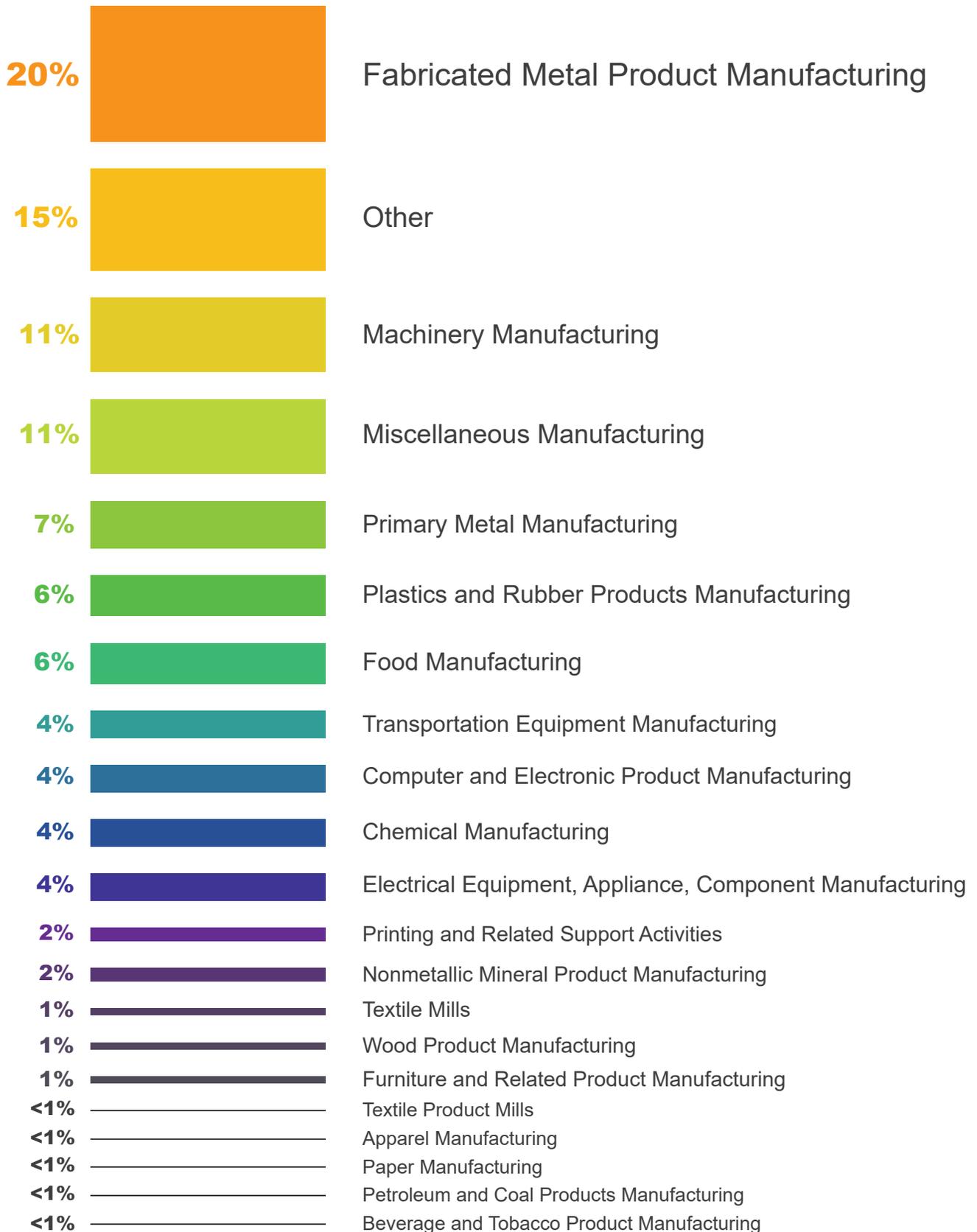
-Small manufacturer, Northeast region

Nine hundred forty-five individuals participated in the online survey, representing a wide range of manufacturing sectors, facility sizes, geographic regions, and job roles. Statistically, the survey respondents would be considered a convenience group⁸ and therefore not *statistically* generalizable; however, given the breadth and diversity of the sample group as illustrated by the demographic charts, the findings are believed to be meaningful and applicable to the MEP National Network and the small and medium-sized manufacturers they serve.⁹

8 A convenience group is a set of people who volunteered to participate in a research study.

9 The research team's analysis of the survey results ranged from frequency distributions, central measures, and variance analyses to more advanced analyses. The responses were compared across a variety of factors to determine relationships between type of manufacturing sector, geographic region, job type, and the role of survey respondents to identify factors that influence the use and perceived value of credentials, as well as what manufacturers are looking for in making workforce decisions. Based on this analysis, it was determined that size of manufacturing organization was the strongest factor that contributed to differences with the MEP manufacturing client base.

Figure 2: Survey Respondents by Manufacturing Sector



FOCUS GROUPS

Following the analysis of the online survey results, the research team conducted a series of virtual focus groups to test, examine, and validate the data gathered through the online survey. These focus groups also served to explore how credentials are currently used and valued, how they could be more useful, and what new credentials may be needed.¹⁰ In total, 19 people participated in 7 focus groups.

The focus groups were asked to respond to questions addressing:¹¹

1. Credentials currently used in manufacturing facilities, and the jobs they align with
2. What skills or attributes (safety, quality, or technical) do the most important credentials in the facility address
3. Whether (and what) credentials are required and/or preferred in manufacturing facilities for hiring, promotion, or salary differential
4. The perceived importance of industry-specific credentials versus those used across industries
5. The perceived relative importance of experience and/or education in relation to credentials
6. Whether participants agreed that “credentials allow us to more easily identify qualified people”
7. Reasons why participants believe credentials are not used
8. How credentials could add more value and how their usefulness could be improved
9. What new credentials are needed to address skills found to be lacking, and how participants would know the credential was successful in doing so
10. The importance of soft skills and technical skills
11. How participants view critical thinking and problem solving, and whether credentials are needed to help identify individuals with those skills

¹⁰ A pilot focus group comprised of representatives from the MEP National Network client base who indicated on the survey they would like to provide further input into the study were invited to refine draft questions that would serve as the basis for a uniform protocol to use for all the subsequent focus groups. Email invitations were then sent to all survey respondents who indicated they would be interested in further discussion. Additionally, MEP technical specialists publicized the focus groups among their constituents and encouraged participation.

¹¹ See [Appendix B](#) for the Focus Group Protocol.

COMPARISON OF SURVEY RESPONDENTS AND FOCUS GROUPS DEMOGRAPHICS

As illustrated by the charts in Figures 3–6, the survey and focus group respondents share demographic similarities, in terms of facility size, geographic diversity, the length of respondents' service in the manufacturing industry, and their role.

Figure 3: Comparison of Survey and Focus Group Participants by Facility Size

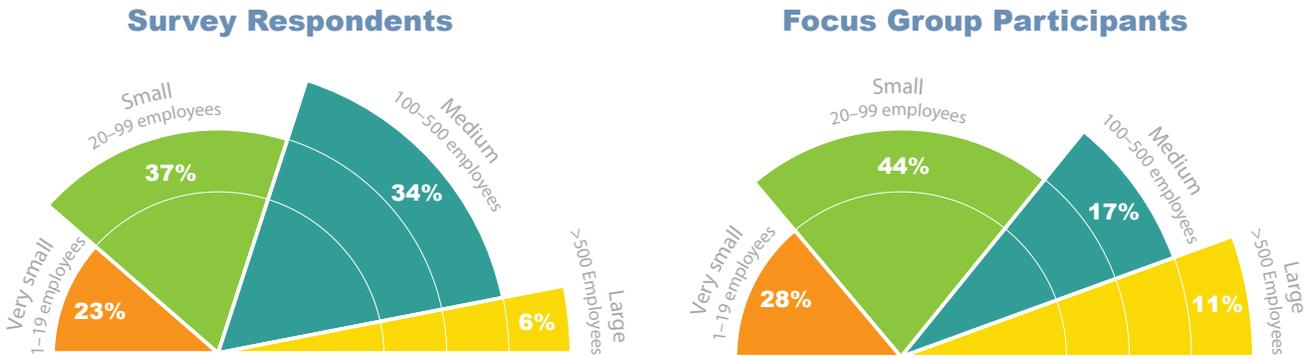
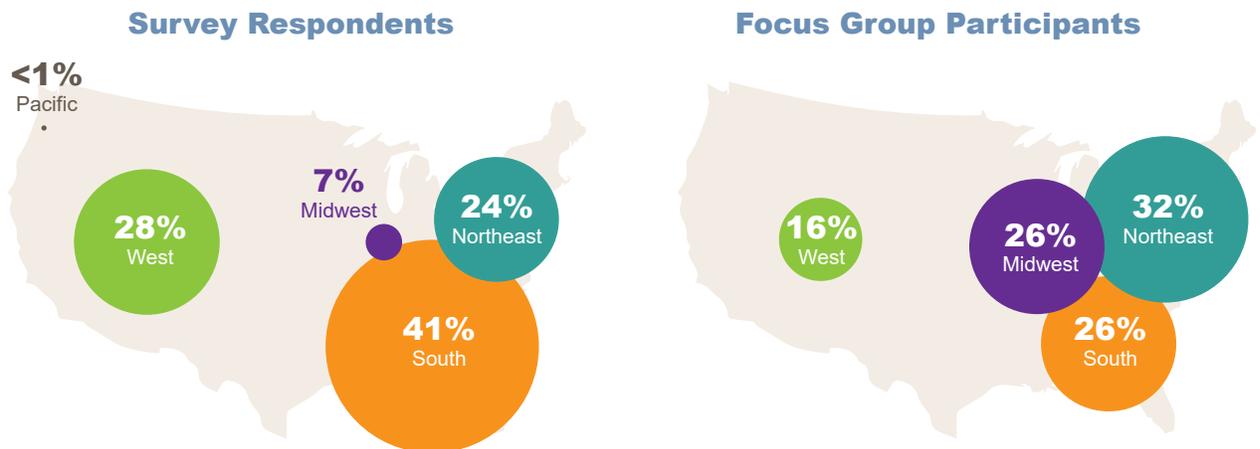


Figure 4: Comparison of Geographic Regions Represented¹²



12 The regions are based on the U.S. Census Bureau's definitions: https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.

Figure 5: Comparison of Number of Years Participants Have Spent in the Manufacturing Industry

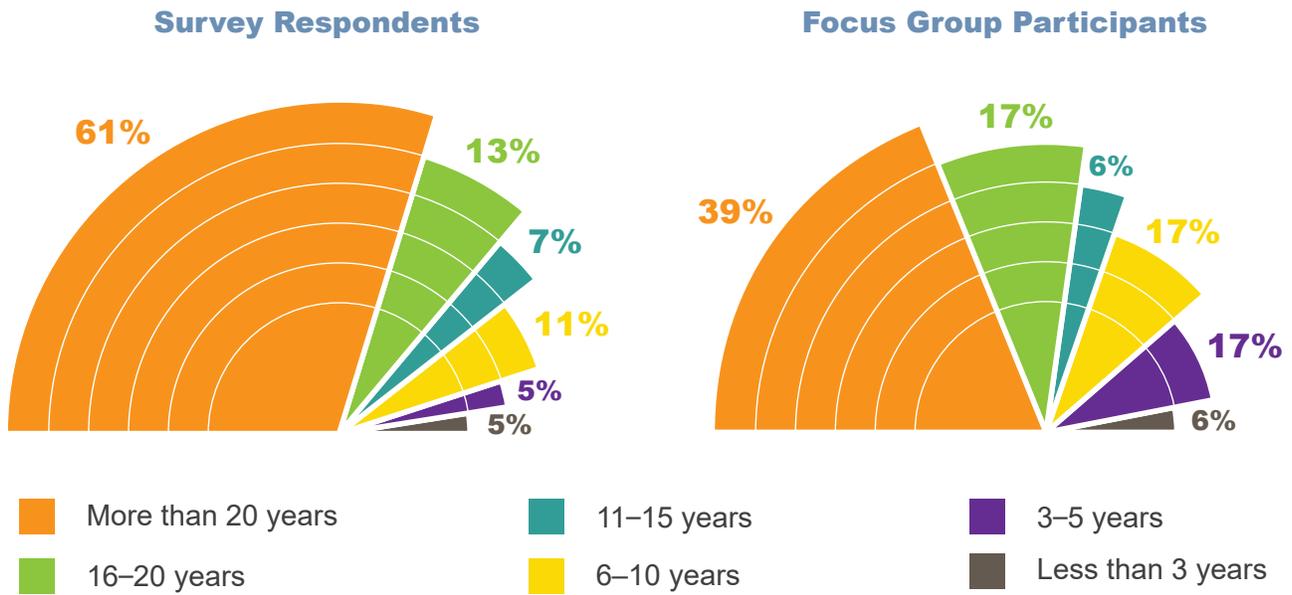
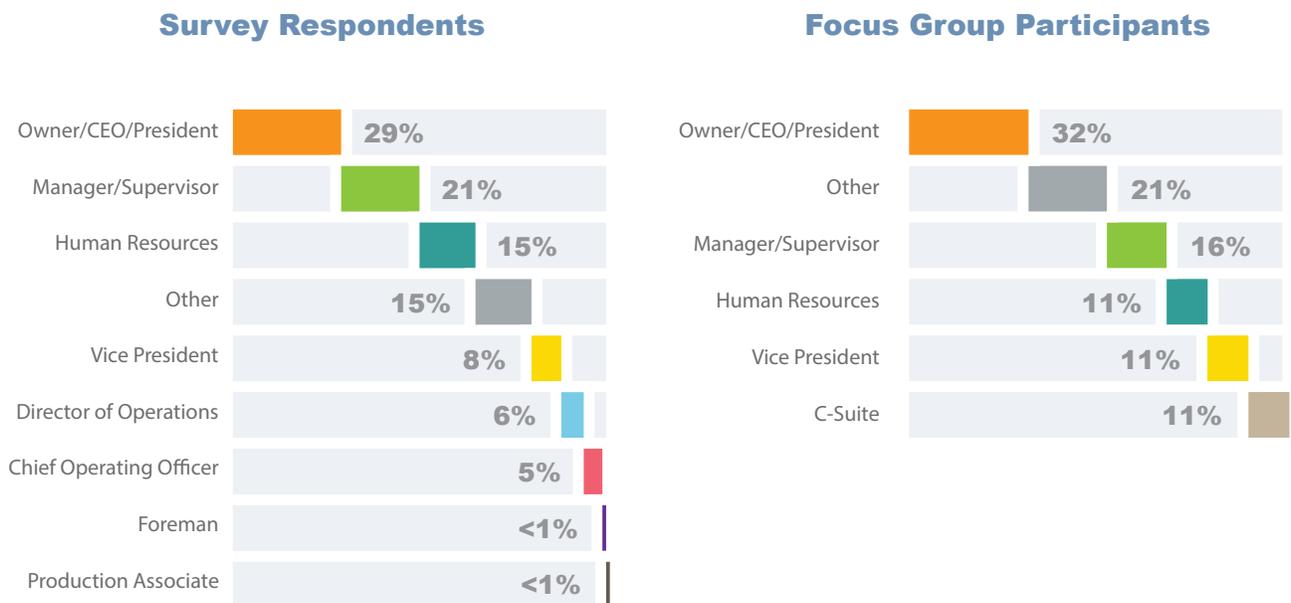


Figure 6: Comparison of the Roles Represented



ANALYSIS AND MARKET VALUE OF THE MOST COMMONLY CITED CREDENTIALS IDENTIFIED IN THE SURVEY

The most commonly cited credentials identified in the survey were analyzed using desk research to determine key characteristics including:

- » Type (certificate, certification, etc.)
- » Issuing agency
- » Geographic scope
- » Accreditation status
- » Accrediting agency
- » If it is based on national and/or international standards
- » If it can be revoked
- » If it is connected to a recertification program
- » Purpose of the credential
- » Audience for whom the credential is geared
- » Information about the exam (if described on the website)

In order to determine the market value of these credentials, the research team conducted direct outreach to the credential issuers requesting information about:

- » The number of certificants in the issuers' database
- » What organizations/industries use the credential
- » Whether any company, corporation, or organization publicly declared they prefer or require the credential
- » The mean salary of the certificants
- » Data about how the credential is being used

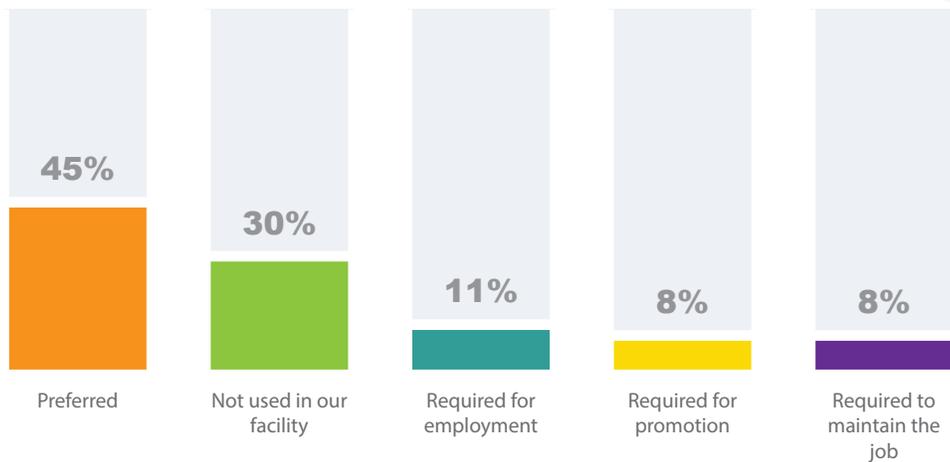
The results of these analyses are detailed in [Appendix C](#).

SURVEY FINDINGS

HOW CREDENTIALS ARE USED IN MANUFACTURING FACILITIES

In response to the question, “How are credentials (apprenticeships, certifications, certificates, licenses) used in your specific facility?”¹³ our research revealed that 45% of survey respondents prefer credentials, while 30% of respondents indicated that credentials are not used at all.

Figure 7: How Credentials Are Used in Manufacturing Facilities



We don't require credentials to be hired . . . but we certainly prefer them, and they are used as part of the salary differential. Most of the credentials that our people have, they have achieved while they're working here.

-Medium-sized manufacturer, South region

¹³ Participants could select more than one answer.

Table 1 summarizes the survey responses across facility size.¹⁴ It is noteworthy to point out that large manufacturing facilities (those with more than 500 employees) prefer credentials more than very small, small, and medium-sized facilities, and also have the lowest response rate for not using credentials. With some variation, there is a relatively low requirement of credentials for employment, promotion, and job retention across the size categories.

Table 1: How Credentials Are Used in Manufacturing Facilities According to Facility Size

Response	Very Small	Small	Medium	Large
Preferred	42%	56%	62%	82%
Not used in our facility	46%	40%	33%	9%
Required for employment	17%	8%	18%	14%
Required for promotion	6%	6%	15%	18%
Required to maintain the job	7%	9%	12%	18%

DIFFERENCES CREDENTIALS MAKE IN MANUFACTURING FACILITIES

In response to the question, “What difference do credentials make in your facility?”¹⁵ more than two-thirds (69%) of the participants believed that credentials help them easily identify qualified people in their facility. Fifty-two percent of respondents felt that credential holders required less on-the-job training (see Figure 8), although 36% of respondents indicated that individuals have to be retrained anyway when asked why they did not use credentials (see Figure 10). Increased productivity, work ethic, and staying on the job longer were also recognized as positive factors of credentials, while only 3% believed that credentials do not make a difference. There is general agreement for each response across the size categories (see Table 2).

I think that [a credentialed] employee will have more success on the job. They will be more engaged. They'll contribute more to the company, and they also are able to take advantage of . . . promotional opportunities within the company.

-Large manufacturer, Midwest region

¹⁴ Each cell throughout the report must be reviewed independently. For example, 82% in the large manufacturing category means that 82% of the large manufacturers indicated they “preferred credentials in the[ir] facility” whereas the very small manufacturers indicated that 42% “preferred credentials in the[ir] facility.”

¹⁵ Participants could select more than one answer.

Figure 8: Differences Credentials Make in Manufacturing Facilities

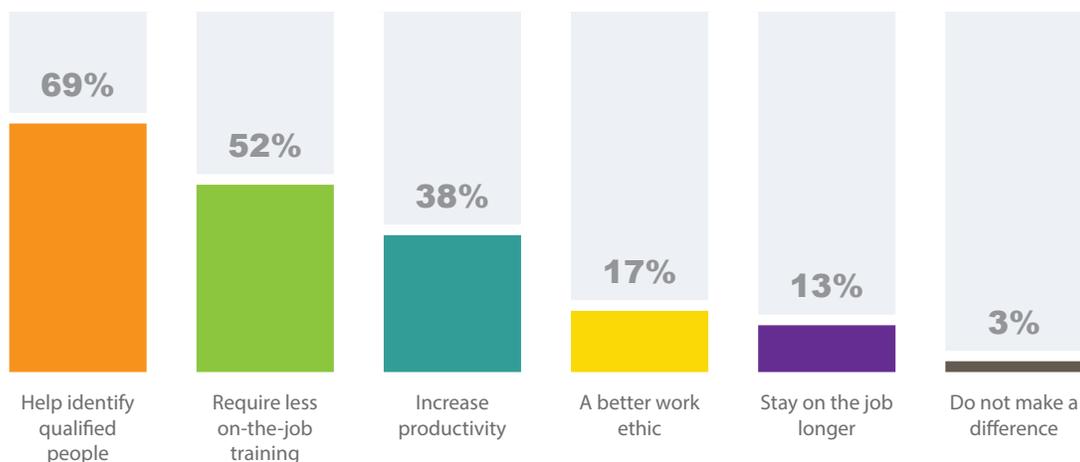


Table 2: Differences Credentials Make in Manufacturing Facilities According to Facility Size¹⁶

Response	Very Small	Small	Medium	Large
Help identify qualified people	73%	84%	87%	90%
Require less on-the-job training	67%	65%	64%	50%
Increase productivity	46%	54%	44%	30%
A better work ethic	21%	22%	20%	10%
Stay on the job longer	15%	18%	12%	10%
Do not make a difference	4%	5%	1%	...

PERCEPTIONS OF THE VALUE OF EARNING MANUFACTURING CREDENTIALS

Survey participants were asked to indicate their level of agreement with a number of statements related to the value of earning manufacturing credentials. There was agreement across responses that earning manufacturing credentials could have positive impacts (see Table 3), despite the fact that 20% of survey respondents agreed that credentials do not make any difference in an individual’s performance (see Figure 9). Table 4 illustrates the statistical variances between facility sizes.¹⁷

¹⁶ Throughout the report, the use of “...” in the data tables indicates that no response was received.

¹⁷ ANOVA is a statistical procedure that determines if there is a significant difference between the means. If there is a significant difference, a post-hoc analysis is conducted to determine specific significant differences of the means; [Appendix D](#) contains the results broken down by facility size.

Table 3: Perceptions of the Value of Earning Manufacturing Credentials

Earning a Manufacturing Credential:	Strongly Disagree	Disagree	Agree	Strongly Agree
Indicates a greater level of commitment to the industry	5%	8%	60%	28%
Provides a competitive edge	7%	19%	53%	22%
Offers a sense of personal accomplishment	3%	2%	51%	44%
Supports professional development	3%	2%	53%	42%
Facilitates recognition from peers and management	4%	22%	55%	19%
Helps individuals gain credibility	5%	24%	50%	22%
Enhances job performance (e.g., accuracy, efficiency)	4%	17%	52%	28%

Table 4: Analysis of Variance (ANOVA) across the Four Facility-Size Categories

Statement	Significant (ANOVA)	Post-hoc Significance (Scheffe)	Interpretation
Earning a manufacturing credential indicates a greater level of commitment to the industry	Yes	Yes	Large manufacturers rated this item significantly higher than very small manufacturers
Earning a manufacturing credential provides a competitive edge in my facility	Yes	Yes	Medium-sized and large manufacturers rated this item significantly higher than very small manufacturers
Earning a manufacturing credential offers a sense of personal accomplishment	No	N/A	No significant difference was found between facility sizes
Earning a manufacturing credential supports professional development	Yes	Yes	Medium-sized and large manufacturers rated this item significantly higher than very small manufacturers
Earning a manufacturing credential facilitates recognition from peers and management	No	N/A	No significant difference was found between facility sizes
Earning a manufacturing credential helps individuals gain credibility	Yes	Yes	Medium-sized manufacturers rated this item significantly higher than very small manufacturers
Earning a manufacturing credential enhances job performance (e.g., accuracy, efficiency)	Yes	No	No significant difference was found between facility sizes

REASONS CREDENTIALS ARE NOT USED

When asked, “What are the reasons credentials are not used?”¹⁸ respondents most frequently indicated that credentials are not relevant to the jobs in their facility (27%).

Figure 9: Reasons Credentials Are Not Used

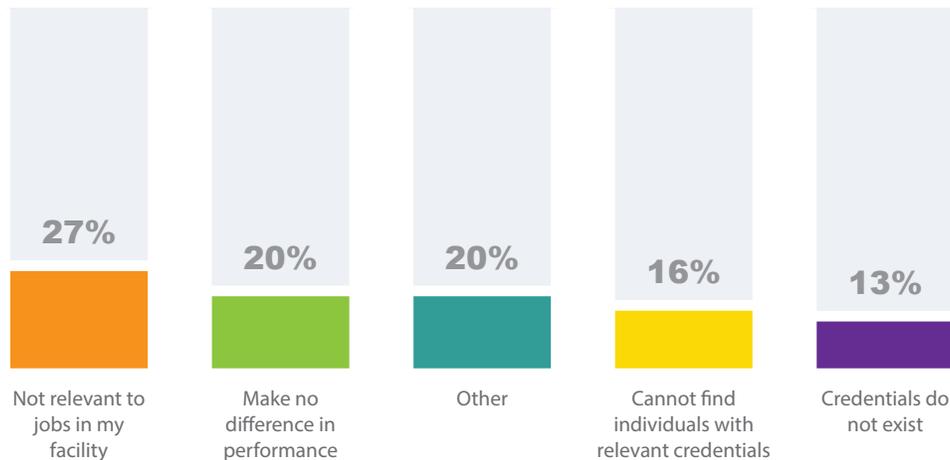


Table 5: Reasons Credentials Are Not Used According to Facility Size

Response	Very Small	Small	Medium	Large
Not relevant to jobs in my facility	39%	31%	31%	...
Make no difference in performance	34%	27%	13%	50%
Cannot find individuals with relevant credentials	16%	24%	27%	50%
Credentials do not exist	14%	20%	13%	...
Other	25%	27%	38%	...

Twenty percent of survey respondents selected “other,” citing a lack of awareness of credentials, a preference for experience over credentials, the perception that individuals have to be trained regardless of whether they hold credentials, and a lack of commitment by leadership. Below are some specific survey write-in comments related to the reasons credentials are not used:

“No one in the company is familiar with existing credentials that would be appropriate for our facility.”

“For the vast majority of jobs, credentials are superseded by experience and proprietary knowledge and skills. Credentials would be in title only and a ‘perk’ at best.”

“On-the-job training is more important than credentials.”

¹⁸ Participants could select more than one answer.

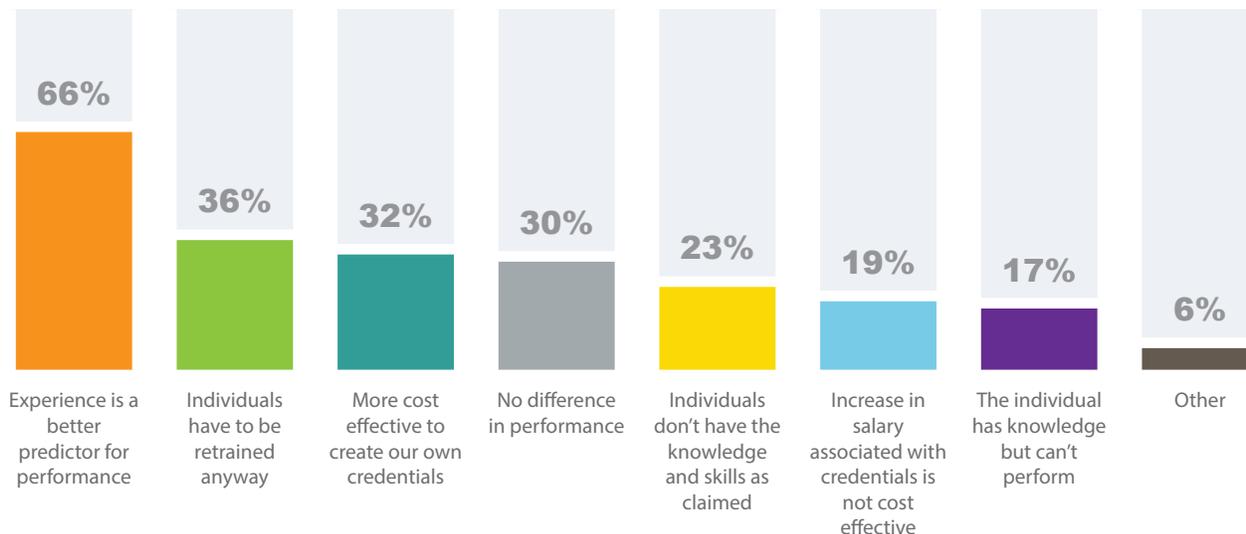
I have hired people here that are very good and book smart and yet, when you put them on a machine, they don't have the skill set. I find if I have a credential that has some hands-on experience, gives the student that understanding of 'here is how I apply what I've learned in the book,' then that employee winds up being that much better.

-Medium-sized manufacturer, South region



When individuals selected “credentials do not make a difference in an individual’s performance”¹⁹ they were asked to select a reason why. The most frequent reason provided was that experience is a better predictor than credentials for successful performance (66%, Figure 10). This information further substantiates the responses related to the survey question, “How do you use credentials in your facility?” (see Figure 7), which indicated credentials are more frequently preferred rather than required.

Figure 10: Reasons Why Credentials Do Not Make a Difference in an Individual's Performance



The perceptions that individuals need to be retrained and that there is no difference in performance between credentialed and non-credentialed employees seem to have some commonality among the very small, small, and medium-sized manufacturers (see Table 6). Because of the medium-sized manufacturers’ preference for using credentials (62%; see Table 1), it is possible that they have had more experience evaluating credentials than the very small and small facilities.

This could explain why a large percentage of medium-sized manufacturers (67%) discover that credentialed individuals come without the knowledge and skills the credential issuer claims they should have acquired through obtaining the credential. A fairly sizable percentage of the very small and small facilities (40% and 38% respectively) indicated that creating their own credential (or training program) was more cost effective, but the medium-sized and large facilities did not seem to agree, with only 17% and 0% respectively indicating so, which seems to be in alignment with their preference for using credentials (see Table 1).

¹⁹ Participants could select more than one answer.

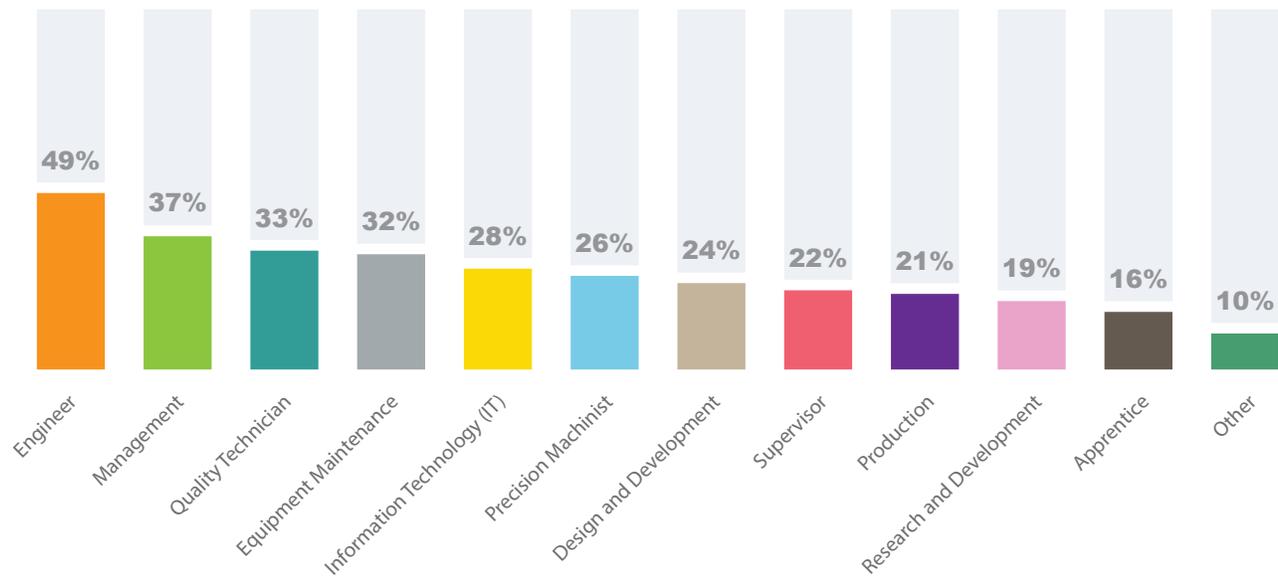
Table 6: Why Credentials Do Not Make a Difference in an Individual's Performance According to Facility Size

Response	Very Small	Small	Medium	Large
Experience is a better predictor for performance	67%	75%	67%	100%
Individuals have to be retrained anyway	33%	50%	17%	...
More cost effective to create our own credentials	40%	38%	17%	...
No difference in performance	33%	38%	33%	...
Individual has knowledge but can't perform	20%	19%	50%	...
Individuals don't have the knowledge and skills as claimed	20%	19%	67%	...
Increase in salary associated with the credential is not cost effective	40%	13%	33%	...
Other	7%	6%	...	...

MOST COMMONLY CITED ROLES THAT REQUIRE OR PREFER CREDENTIALS FOR HIRING OR PROMOTION

In response to the question, “What roles in your facility require or prefer credentials for hiring or promotion?”²⁰ almost half of the participants (49%) indicated the role of engineer, followed by the responses indicated in Figure 11:

Figure 11: Most Commonly Cited Roles That Require or Prefer Credentials for Hiring or Promotion



²⁰ Participants could select more than one answer.

The data in Table 7 provides an indication that large facilities tend to use a wider variety of credentials as compared to very small and small facilities. Engineers, production, management, quality technicians, and precision machinists are among the roles for which credentials are required or preferred by very small and small facilities.

Table 7: Most Commonly Cited Roles That Require or Prefer Credentials for Hiring or Promotion According to Facility Size

Response	Very Small	Small	Medium	Large
Engineer	39%	69%	70%	75%
Management	33%	51%	46%	50%
Quality Technician	29%	42%	54%	60%
Equipment Maintenance	26%	29%	57%	65%
IT	24%	31%	42%	55%
Precision Machinist	29%	34%	36%	40%
Production	35%	26%	33%	30%
Design and Development	16%	30%	30%	50%
Supervisor	24%	26%	30%	30%
Research and Development	16%	22%	19%	40%
Apprentice	20%	14%	26%	30%
Other	14%	13%	20%	5%

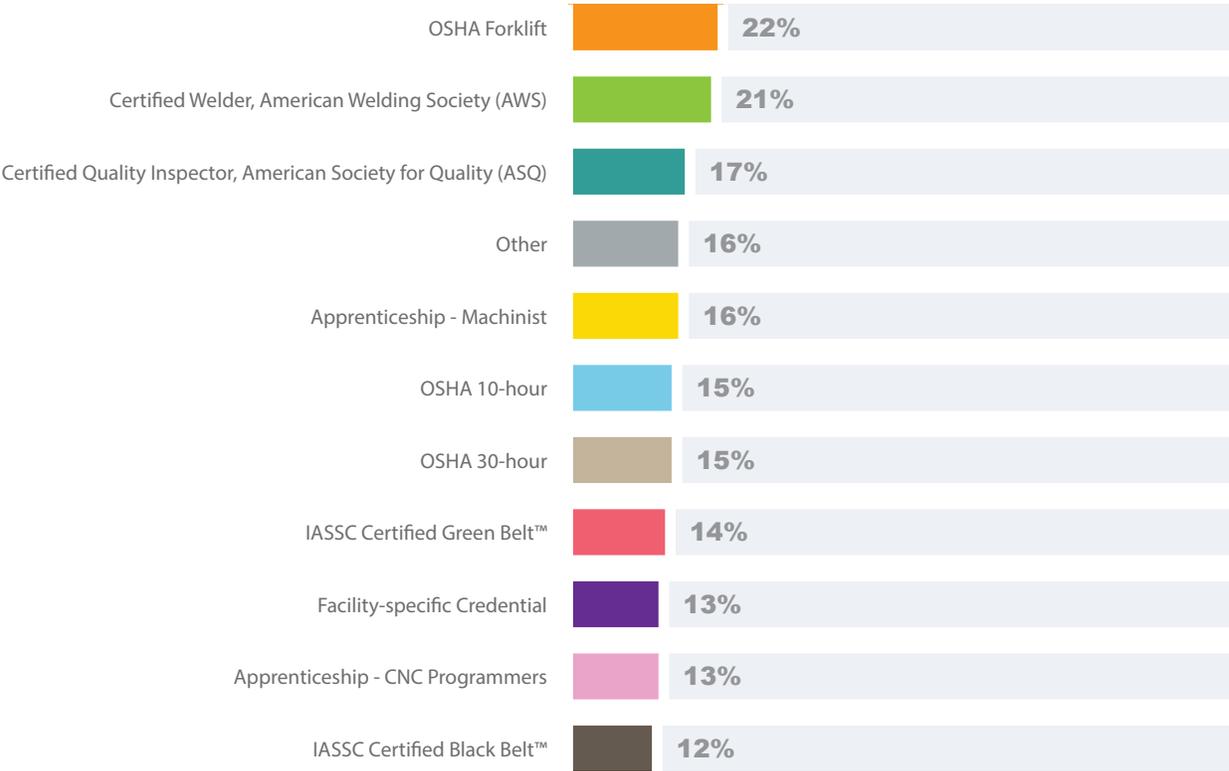


MOST IMPORTANT CREDENTIALS IN MAKING EMPLOYMENT DECISIONS (HIRING, PROMOTION)

Participants were asked to specify up to five credentials that were most important in making employment decisions (e.g., hiring, promotion) out of a list of 44 manufacturing-related credentials. Of the 16% of survey respondents who indicated “other,” various credentials offered by the National Institute of Metalworking Skills (NIMS) and IPC²¹ and the national HVAC credentials were among the most commonly cited. The Professional Engineer license was identified multiple times as well. It is interesting to note that 13% of respondents develop facility-specific credentials designed to meet specific job roles.

The following (Figure 12) represents the overall most commonly cited credentials from the survey:²²

Figure 12: Most Commonly Cited Credentials Identified in the Survey



²¹ IPC, the Association Connecting Electronics Industries, is a global trade association serving the printed board and electronics assembly industries, their customers, and suppliers.

²² Figure 12 reports those credentials with a 10% response rate or higher; the analysis of the use, characteristics, and market value of each of these credentials is reported in [Appendix C](#).

Table 8: Most Commonly Cited Credentials Identified in the Survey According to Facility Size

Very Small			
22% Apprenticeship - CNC Programmers	20% OSHA Forklift	18% Other	12% Geometric Dimensioning & Tolerancing Professional, American Society of Mechanical Engineers (ASME)
22% Apprenticeship - Machinist	18% Machining Level I (NIMS)	14% OSHA 10-hour	12% Facility-specific credential
20% Certified Welder (AWS)	18% OSHA 30-hour	14% IASSC Certified Black Belt™	10% Certified Production Technician, Manufacturing Skill Standards Council (MSSC)
Small			
34% Certified Welder (AWS)	21% Certified Quality Inspector (ASQ)	17% OSHA 10-hour	12% Apprenticeship – Tool and Die Maker
28% OSHA Forklift	20% Apprenticeship - CNC Programmers	15% Certified Supply Chain Professional (APICS)	12% Machining Level I (NIMS)
25% Apprenticeship - Machinist	18% OSHA 30-hour	15% IASSC Certified Black Belt™	12% Facility-specific credential
22% Other	18% IASSC Certified Green Belt™	13% Certified in Production and Inventory Management (APICS)	11% State-specific credential
Medium			
39% OSHA Forklift	22% IASSC Certified Green Belt™	17% Apprenticeship – Machinist	11% Geometric Dimensioning & Tolerancing Professional (ASME)
30% Certified Quality Inspector (ASQ)	19% OSHA 30-Hour	15% Certified in Production and Inventory Management (APICS)	10% Apprenticeship – CNC Programmers
26% OSHA 10-Hour	19% Other	14% IASSC Certified Black Belt™	
24% Certified Welder (AWS)	18% Facility-specific credential	11% Certified Supply Chain Professional (APICS)	
Large			
30% Certified Welder, AWS	25% IASSC Certified Green Belt™	15% Certified Internal Auditor, Institute of Internal Auditors (IIA)	10% Apprenticeship – Tool and Die Maker
30% IASSC Certified Black Belt™	25% Facility-specific credential	15% Certified Supply Chain Professional (APICS)	10% Certified in Production and Inventory Management, (APICS)
25% Certified Quality Inspector (ASQ)	25% Other	15% Geometric Dimensioning & Tolerancing Professional (ASME)	10% Machine Maintenance, Service & Repair Level II (NIMS)
25% OSHA Forklift	20% Certified Production Technician (MSSC)	10% Apprenticeship – CNC Programmers	10% OSHA 10-Hour
25% OSHA 30-Hour	15% Apprenticeship – Electricians	10% Apprenticeship – Electro-Mechanical Technicians	10% State-specific credential

ASSESSING POTENTIAL HIRES

More than half of the participants (55%) indicated that industry-specific certifications were most important when making hiring decisions in their facility. Of the 15% who selected “other,” the most common write-in responses were experience and degrees.

Figure 13: Type of Credentials Used to Assess Potential Hires



Table 9: Type of Credentials Used When Assessing Potential Hires According to Facility Size

Response	Very Small	Small	Medium	Large
Industry-specific certification	53%	64%	68%	79%
Certificate earned at an apprenticeship	11%	11%	9%	5%
Certificate issued by a career and technical high school	7%	2%	5%	...
License	7%	7%	6%	...
Other	22%	16%	12%	16%

ASSESSING PROMOTIONAL DECISIONS

A large percentage of the participants (64%) believed that industry-specific certifications were most important when making promotion decisions in their facility. Of the 17% who selected “other,” degrees and demonstrated performance were the most common write-in responses provided.

Figure 14: Type of Credentials Used to Assess Promotional Decisions



Table 10: Type of Credentials Used When Making Promotional Decisions According to Facility Size

Response	Very Small	Small	Medium	Large
Industry-specific certification	53%	64%	68%	79%
Certificate earned at an apprenticeship	11%	11%	9%	5%
Certificate issued by a career and technical high school	7%	2%	5%	...
License	7%	7%	6%	...
Other	22%	16%	12%	16%

TRAINING WITHIN A MANUFACTURING FACILITY

Survey respondents were asked to describe training that their facility conducts to up-skill individuals who already hold credentials as opposed to those who do not. Survey results revealed the two greatest needs for training were to fill specific technical skills (e.g., machining, blue-print reading, inspection) and training in soft skills, also referred to as employability skills (e.g., communication, teamwork, work appropriate behavior, critical thinking, and problem solving). The research study found no major difference in the training needed for individuals who hold a credential and those who do not (Table 11).

Table 11: Training Conducted to Up-skill Employees (Regardless of Credential Status)

Response	Hold credential	Do Not Hold Credential
Training to help people earn another credential	23%	35%
Training where no credential covering required skills existed	23%	32%
Training to fill unique technical skills needed in the facility	50%	54%
Training in soft skills	41%	44%
No training provided	16%	13%
Other	7%	5%

I've had some who had credentials who have needed as much training or more training than the person without a credential.

-Small manufacturer, Midwest region

TYPE OF TRAINING TO UP-SKILL INDIVIDUALS ALREADY HOLDING CREDENTIALS

In response to the question, “What training does your facility conduct to up-skill individuals who already hold credentials?”²³ 50% of the survey respondents reported that they do so through training to fill specific technical skills.

Table 12 shows that large facilities seem to have a greater need to up-skill individuals who already hold a credential in specific technical skills than the very small facilities, likely due to the increased complexity of operations at the large facilities. Additionally, there seems to be a major difference between the very small and large facilities in their need for training in soft skills (27% versus 68% respectively).

²³ Participants could select more than one answer.

Table 12: Type of Training to Up-skill Individuals Who Already Hold a Credential According to Facility Size

Response	Very Small	Small	Medium	Large
Training to fill technical skills needed in the facility	48%	56%	60%	77%
Training in soft skills	27%	48%	58%	68%
Training where no credential covering required skills existed	24%	28%	28%	23%
Training to help people earn another credential	20%	21%	33%	28%
No training provided	23%	16%	16%	5%
Other	8%	7%	8%	5%

TYPE OF TRAINING TO UP-SKILL INDIVIDUALS WHO DO NOT HOLD CREDENTIALS

More than half (54%) of the participants responding to the question, “What training does your facility conduct to up-skill individuals who do not hold credentials?”²⁴ stated they also up-skill those individuals through training to fill unique technical skills.

Very similar to the results in Table 12, large facilities indicate a greater need to up-skill individuals who do not already hold a credential in specific technical skills as well as soft skills than do the very small facilities. However, one of the major differences seems to be that large facilities provide opportunities for individuals to earn another credential, whereas the very small manufacturers indicated less of a tendency to help individuals earn another credential. The reason for this dissimilarity could be due to the tendency of large facilities to have more complex operations and more specialized job roles.

Table 13: Type of Training to Up-skill Individuals Who Do Not Hold a Credential According to Facility Size

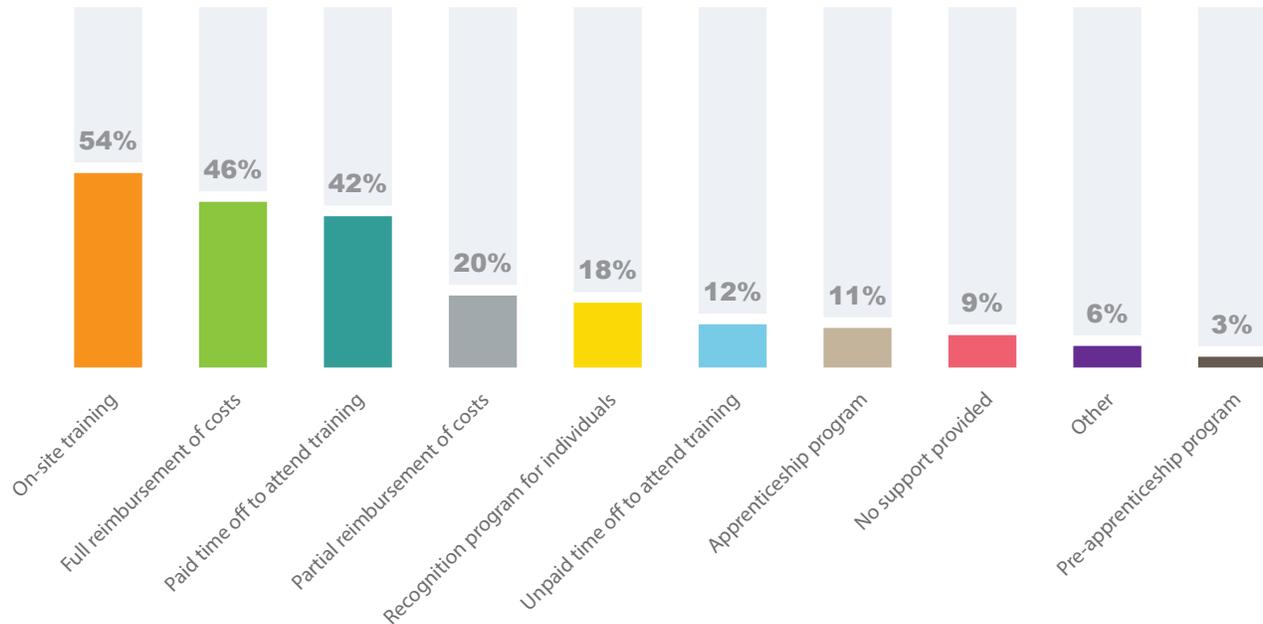
Response	Very Small	Small	Medium	Large
Training to fill unique technical skills needed in the facility	51%	63%	65%	82%
Training in soft skills	32%	54%	57%	64%
Training where no credential covering required skills existed	29%	37%	36%	46%
Training to help people earn another credential	27%	37%	51%	50%
No training provided	17%	12%	12%	5%
Other	8%	5%	5%	...

²⁴ Participants could select more than one answer.

TYPE OF SUPPORT FOR TRAINING

When asked about the type of support that facilities provided to encourage individuals to obtain additional skills,²⁵ more than half (54%) of survey participants stated that on-site training was the most common type of support, followed by full reimbursement of training costs (46%) and paid time off to attend training (42%).

Figure 15: Type of Support Provided for Training



Unsurprisingly, large facilities tend to be able to provide more support for training than very small facilities (Table 14), presumably because the large facilities have more resources. Similarly, the very small and small facilities indicated limited opportunities for apprenticeship programs.

Table 14: Type of Support Offered for Training According to Facility Size

Response	Very Small	Small	Medium	Large
On-site training (e.g., courses/workshops)	45%	62%	67%	82%
Full reimbursement of costs	34%	58%	56%	64%
Paid time off to attend training	39%	50%	51%	50%
Partial reimbursement of costs	24%	18%	23%	41%
Recognition program for individuals	14%	22%	23%	32%
Unpaid time off to attend training	16%	9%	15%	18%
Apprenticeship program	5%	9%	17%	23%
No support provided	12%	7%	9%	5%
Pre-apprenticeship program	3%	1%	4%	5%
Other	11%	5%	7%	...

²⁵ Participants could select more than one answer.

IMPROVING THE USEFULNESS OF CREDENTIALS

Almost two-thirds (64%) of the participants believe that credentials should focus on more hands-on skills, not just knowledge, when asked, “How can the usefulness of credentials be improved?”²⁶

Figure 16: Ways Credentials Can Be Improved

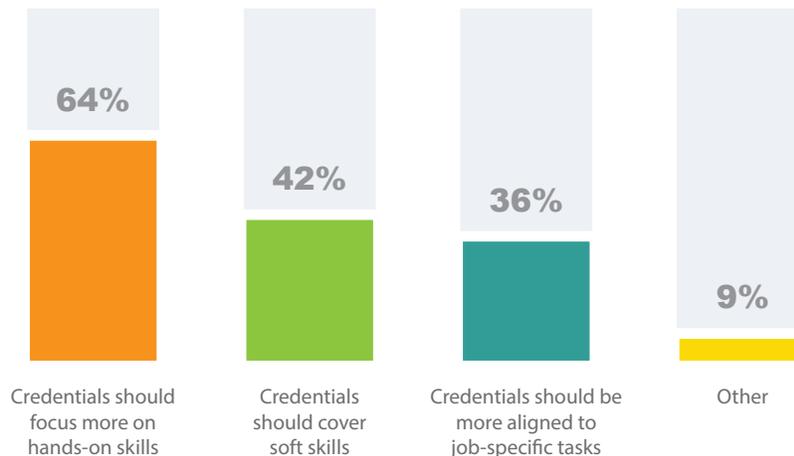


Table 15: Ways Credentials Can Be Improved According to Facility Size

Response	Very Small	Small	Medium	Large
Credentials should focus more on hands-on skills	67%	70%	74%	64%
Credentials should cover soft skills	30%	49%	56%	59%
Credentials should be more aligned to job-specific tasks	27%	43%	46%	50%
Other	12%	10%	8%	10%

Below are some specific survey write-in comments related to increasing the use and effectiveness of credentials.

“Credentials need to reflect the ability to perform the credentialed skill proficiently in the workplace. Knowledge and skills are two different things. In today’s workplace both are required in equal measure. Most credentials seem to have little development of why a thing is done in a particular way. Without good fundamentals much is lost.”

“[Credentials] should be replaced with performance measurement.”

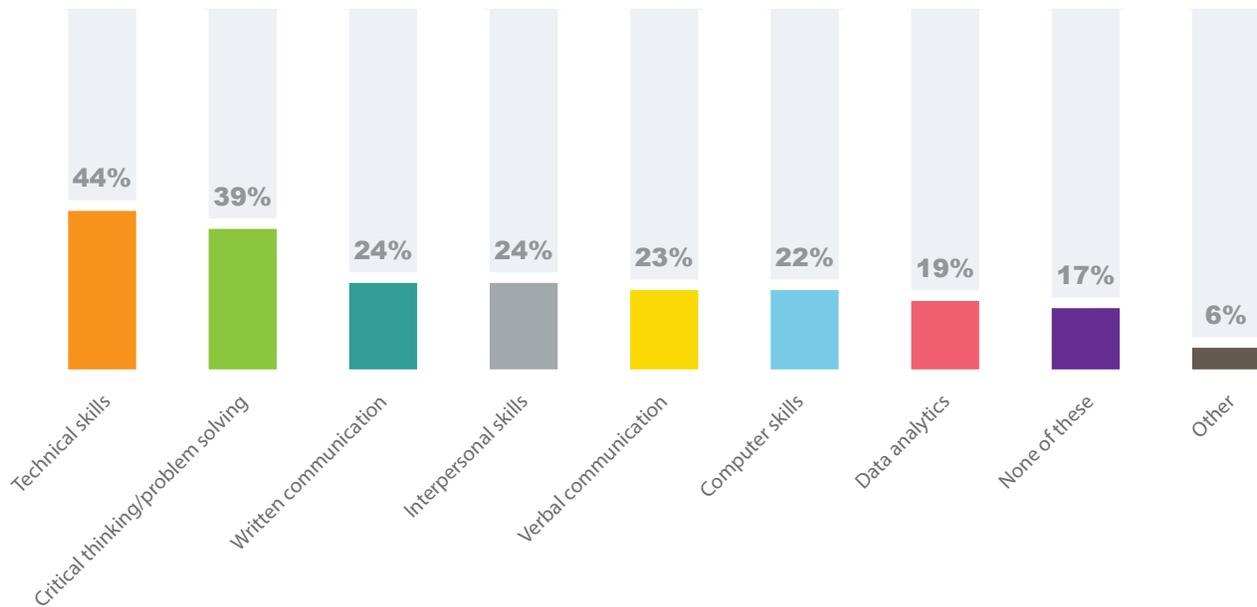
“We judge employees based on performance, not credentials. I have encountered many people who are heavily credentialed and non-productive. I have little confidence in the institutions that issue the credentials.”

²⁶ Participants could select more than one answer.

AREAS IN NEED OF NEW CREDENTIALS

Almost half (44%) of the participants chose technical skills as the area that needs new credentials, followed closely by critical thinking/problem solving (39%).²⁷

Figure 17: Areas Needing New Credentials



The two major distinctions between respondents of different-sized facilities fall under critical thinking/problem solving and data analytics. Twenty-five percent of very small facilities identified critical thinking/problem solving as an area needing new credentials, while 68% of the large facilities chose that response. Only 8% of the very small facilities recorded data analytics as an area in which new credentials are needed, opposed to 27% of the large facilities.

Table 16: Areas Needing New Credentials According to Facility Size

Response	Very Small	Small	Medium	Large
Technical skills	38%	52%	52%	46%
Critical thinking/problem solving	25%	42%	54%	68%
Written communication	23%	30%	29%	23%
Interpersonal skills	14%	30%	30%	41%
Verbal communication	21%	28%	27%	27%
Computer Skills	19%	24%	31%	18%
Data analytics	8%	20%	30%	27%
Other	7%	7%	6%	9%
None of the above	30%	16%	16%	9%

²⁷ Participants could select more than one answer.

[Problem solving is] sound decisions based on gathering good data . . . understanding very clearly what our objective is, and be[ing] able to put that data together.

Critical thinking helps bring the outside-of-the-box thinking, maybe what hasn't been done in the company before and trying new things. . . . It has to do with your tolerance for risk and how the things that you're doing now will have an impact on how you're running your business.

-Very small manufacturer, Northeast region



FOCUS GROUP FINDINGS

The input gathered during the focus groups validated the findings of the online survey. For example, similar to survey respondents, a majority of the focus group participants also indicated that they did not require manufacturing-specific credentials, except in isolated cases such as requiring specific engineering credentials or when mandated by OSHA or other specific government agencies. Most respondents equated credentials with technical or safety skills, or advanced courses of study such as engineering.

In general, very few manufacturers require credentials, although several said they would prefer to hire individuals who hold credentials. Reasons provided by participants for not making credentials a requirement included:

- » A lack of relevant credentials to the skills required to perform the tasks involved on the job (or not knowing which credentials might be relevant)
- » The challenge in finding appropriate staff, with or without credentials
- » A belief that credentials are meaningless
- » Certain qualities (e.g., work ethic or experience) are not measured in a credential, but are more important to identify the right candidate for the job
- » Requiring credentials may not improve job performance and may set the bar too high and make a challenging hiring process even more challenging and expensive

Credentials were often cited as an appropriate baseline for identifying qualified personnel, with other factors, such as employment history, being equal. Credentials often appear to be used as a screening device, even though the credential may not match the competencies of the particular manufacturing role.

We don't require them . . . but we do feel that the credential is important in order for us to get a baseline skill level for new hires or entry-level employees.

-Small manufacturer, Northeast region

Apprenticeships appeared to be the most relevant and valued type of credential by focus group participants. However, regardless of the credentials a person may or may not have, all participants indicated that they need to do on-the-job training, which is consistent with the survey respondents. Often this training is to introduce employees to specific facility requirements and procedures, but many reported that on-the-job training is often required even when the necessary skills are more generic in scope.

Focus group attendees discussed a variety of credentials ranging from secondary education diplomas and postsecondary education degrees, to certificates, certifications, licenses, and apprenticeships. Some of the most commonly mentioned credentials during the sessions included the Professional Engineer license;²⁸ APICS Certification in Production and Inventory Management; AWS Certified Welder; MSSC certifications;²⁹ Six Sigma certifications; Lean Certification; NIMS certifications (e.g., Computer Numerical Control (CNC) Programmer); OSHA training courses; and WorkKeys®.³⁰

A critical theme that emerged from every focus group session was the importance of employability skills in making hiring or promotion decisions or in predicting job success. As with the survey responses, many focus group participants indicated that work experience and employability skills are better predictors of job success than credentials.

Although the majority of participants agreed that finding employees who possess such skills was valuable, there were differences of opinion regarding whether these skills could be acquired through a credential. If a credential did exist or could be developed to assess employability skills, focus group participants indicated interest in using it.



28 This license is required in several states to sign and submit engineering plans and teach engineering.

29 MSSC offers certifications in areas that address front-line manufacturing production and supply chain management. It offers two certifications, Certified Production Technician (CPT) and Certified Logistics Technician (CLT).

30 ACT WorkKeys® assessments measure foundational skills required for success in the workplace, and help measure workplace skills that can affect job performance. Individuals who successfully complete three WorkKeys assessments - Applied Math, Graphic Literacy, and Workplace Documents - earn WorkKeys National Career Readiness Certificate® (ACT WorkKeys NCRC®). ACT WorkKeys NCRC® measures job readiness based on skills found to be essential for job success across industries and occupations.

SUMMARY AND RECOMMENDATIONS

In general, credentials are used inconsistently in the manufacturing industry. They are not routinely required nor used as a major factor in hiring or promotion decisions, except in certain job roles (such as engineer or human resources) or when required by law or regulation. There appear to be several reasons for this, including lack of awareness of credentials, preference for on-the-job training, and a recognition that experience is a more valuable predictor of performance. In fact, several respondents reported, “credentials don’t mean anything.” Manufacturers indicated that they could, and in fact often needed to, provide training to new employees regardless of whether they possess a credential or not. Although there were some exceptions, manufacturers also could not quantify whether credentials provided added value in terms of reduced cost or reduced training time for people possessing credentials. Furthermore, many manufacturers do not appear to know what credentials are available or how a credential might be applicable to their workplace. The lack of transparency regarding the competencies of a credential may be contributing to the issue that manufacturers do not see the relevance of many credentials.

Overall, it seems that many manufacturers do not see credentials as the most appropriate tools to identify new skilled personnel or as incentives that might improve the quality of their incumbent workforce. Some manufacturers believe that credentials could serve as a critical resource to them if they could be made more in line with skills needed in their facilities and were better understood. Several manufacturers reported that they expect people with credentials to require less on-the-job training, have relevant experience, make fewer mistakes, improve the quality of the business, and be more innovative. They also believe that appropriate credentials that clearly articulate the competencies associated with the credential could improve job opportunities for the individuals who possess them.

While cost was mentioned as a deterrent to requiring credentials, it appears to be a minor factor. In fact, some manufacturers stated that they would pay more to hire personnel with relevant credentials and would financially support the cost of having current workers participate in credentialing programs if they believed that a credentialed person would improve business practices and make better contributions.

The size of the manufacturing facility appears to influence how credentials are used. Large manufacturing facilities are more likely to prefer credentials for employment than smaller facilities. Very small manufacturers are most likely not to use credentials at all, while only a very small percentage of the large manufacturers report not using credentials. It may be that large manufacturers:

- » are more likely to do work that requires individuals to hold credentials, such as engineering or other advanced technical operations;
- » may be better equipped to invest in supporting incumbent workers to earn a credential; and
- » are more likely to have opportunities to participate in developing the credential.

Both the data from the survey and the focus groups were consistent on how credentials are used (or not used), which credentials are used most often, and what needs to be accomplished to improve the usefulness of the credentialing system for the manufacturing industry.

It's very tough for us to require any kind of credentials at this point because to find the skillsets that we need to be successful in our work environment, [they] simply don't exist. We have to go out to find people that have the right attitude, that ha[ve] a positive work ethic, and then give them the skillsets that are necessary to be successful in our environment.

-Large manufacturer, Midwest region



RECOMMENDATIONS

The recommendations that emerged from the study are derived from analysis of the survey data and information gathered from the focus groups, as well as best practices for improving the credentialing system and workforce quality.³¹

IMPROVE UNDERSTANDING ABOUT THE CONTENT, USE, AND VALUE OF CREDENTIALS

Experience and work-based learning rather than credentials are considered among the key variables influencing success in the workplace. The top two reasons that manufacturers said they did not use credentials are that credentials were not relevant to the jobs in their facility and that credentials did not make a difference in an individual's performance.

For credentials to have more value, there must be greater transparency about the purpose, scope, and specific competencies that are assessed. To strengthen the understanding of credentials, the following actions should be taken.

- » **Support efforts to increase transparency about the purpose, use, and competencies of credentials.**

Improved and expanded systems

that offer information to the public on what credentials are available and how they align with specific job requirements should be developed. One example of this is Credential Finder, a software application built on Credential Engine's³² Credential Registry that provides comparable information on all types of credentials to help align credentials with the needs of students, job seekers, workers, and employers.

- » **Expand information about quality and market value.** Credentialing organizations should expand the type and quality of information that is publicly available on their websites regarding the content of the credentials they issue. At a minimum, publicly available data should include: a clear set of competencies, third-party recognition, the requirements to earn and maintain the credential, how much experience the individual obtained to earn the credential, how the credentials are used and valued by manufacturers and workers, evidence of effectiveness, and cost. Recognizing that there are existing public databases, there is an increased need for organizations to synthesize and evaluate data from those databases to make informed decisions about quality.
- » **Develop and strengthen criteria to recognize credentials for education and training programs.** State agencies should do a better job developing and expanding systems that explain which types of credentials are



31 Pew Research Center. "The State of American Jobs." October 6, 2016. <http://www.pewsocialtrends.org/2016/10/06/the-state-of-american-jobs>; Merisotis, Jamie. "Revving Up the New Credential Engine." March 13, 2017. https://www.huffingtonpost.com/entry/revving-up-the-new-credential-engine_us_58bf8136e4b070e55af9e940.

32 Credential Engine is a non-profit organization dedicated to promoting transparency and credential literacy in the marketplace to reveal the world of credentials and inform the public through a web-based Credential Registry and software applications built on the registry's data. Visit www.credentialengine.org for more information.

most needed by manufacturers. The criteria that states create and use should be established against a national standard for quality. State agencies should develop and use publicly accessible central databases or utilize existing repositories to describe the uses and content of these credentials, how they are alike and different, and the requirements to earn them.

EXPAND THE USE OF QUALITY STANDARDS FOR CREDENTIALS

Despite the importance of training cited by survey and focus group participants, there is little use of standards that ensure the quality of the training provided or the relevance of the content of the training to manufacturers' needs.

There are several standards that define quality training, education, and credentialing systems that are relevant to the manufacturing industry. For example, for certificate programs, there is an American National Standard developed by ASTM International³³ and a standard developed by the Institute of Credentialing Excellence (ICE).³⁴ The national and international standard ANSI/ISO/IEC 17024³⁵ sets the bar for quality for certification programs.

Accreditation against these standards provides a neutral, third-party attestation that a given certificate or certification program meets globally accepted benchmarks. This increases the integrity of the credential, the credibility of the credential holder, and provides a strong signal to manufacturers.

Although most two- and four-year degrees and higher education certificates have some form of third-party recognition, this is not as common for industry certifications and certificates. Workcred estimates that of the more than 4,000 certifications in the United States, only 10 percent are accredited. While no specific information is available for certificate programs, we believe similar results would hold true. The manufacturing industry is not alone in its lack of reliance on accredited credentialing programs.

To address the need to improve quality in manufacturing credentials, the following actions are recommended.

- » **Increase awareness of the benefits of standards for quality credentials.** Educational events can be developed for stakeholders aligned with the manufacturing community (e.g., education and training providers, trade and professional associations, workforce intermediaries, and credentialing organizations) to highlight the benefits of developing and using credentials that adhere to quality standards. These outreach activities can be stand-alone events or incorporated into other existing educational events such as industry conferences. An international and national standard, ANSI/ISO/IEC 17024:2012, *Conformity assessment: General requirements for bodies operating certification programs*, defines what constitutes a quality certification. For certificate programs, there are two standards, ASTM E2659-18, *Standard Practice for Certificate Programs*, and ICE 1100 2010(E) – *Standard for Assessment-Based Certificate Programs (2009)*.
- » **Publicize the value of accreditation.** Accreditors should increase awareness of the value of accreditation and its role in improving workforce quality. Regulators and funders should also be encouraged to highlight the importance of accreditation in their policy guidance and grant requirements.

33 ASTM International is an ANSI-accredited standards developer that created and maintains ASTM E2659-18, *Standard Practice for Certificate Programs*. For more information, visit www.astm.org.

34 ICE is a professional membership association that provides education, networking, and other resources for organizations and individuals who work in and serve the credentialing industry. The organization created and maintains ICE 1100 2010(E) – *Standard for Assessment-Based Certificate Programs (2009)*. For more information, visit www.credentialingexcellence.org.

35 For more information on ANSI/ISO/IEC 17024:2012, *Conformity assessment: General requirements for bodies operating certification programs*, visit <https://www.iso.org/standard/52993.html>.

- » **Develop incentives for credentialing organizations to use quality standards for credentials.** The cost and time associated with adhering to quality standards for credentials and seeking accreditation can be significant. Federal and state agencies and private funders interested in improving practices and quality in the manufacturing industry should offer financial incentives and resources to help credentialing organizations offset these costs.

STRENGTHEN RELATIONSHIPS BETWEEN MANUFACTURERS, EDUCATION AND TRAINING PROVIDERS, AND CREDENTIALING ORGANIZATIONS

The last decade has seen enormous growth in the number and variety of labor market credentials, including certificates, certifications, licenses, apprenticeships, and degrees, as well as micro-credentials and badges. This growth has intensified uncertainty about whether manufacturers have input into the development of credentials. It is notable that among the most commonly cited credentials (Figure 12) were many that, as a category, are reported as “facility-specific credentials,” meaning credentials that are developed by manufacturers for their internal use. This suggests that many manufacturers may be unable to find existing credentials that meet their needs, perhaps because they do not know about them, or that the credentials do not assess the relevant competencies.

Employer signals about the skills and competencies required are critical. Clear and specific employer signals allow education and training providers to develop appropriate curricula. Credentialing organizations can use this information to create validated credentials that demonstrate that the competencies have been properly measured and achieved.

Strengthening relationships between manufacturers, education and training providers, and credentialing organizations would help alleviate the challenges manufacturers have finding appropriate credentials. The following recommendations support stronger relationships among organizations that develop and use credentials.

The industry is growing so rapidly that what we do today, we may not be doing tomorrow. How do we keep our workforce up to date on those principles? Things have changed drastically in the last five years. We all have watched the change with technology. That’s another thing, just to keep our workforce up to date.

- Large manufacturer, Midwest region

- » **Align competencies and create a continuous feedback process.** Manufacturers should be involved in developing processes that continually signal competency requirements to credential developers. Manufacturers should be more proactive in signaling their competency, credential, and experience requirements on an ongoing and systematic basis. This ensures that education and training content and the credentials continue to be relevant and meet manufacturers' needs as jobs evolve and new jobs are created. Credentialing organizations benefit by being able to maintain the validity of the credential and improve the recertification components. Individuals benefit by knowing that the certification will have greater relevance throughout their career.
- » **Develop more flexible learning opportunities.** The education and training community should create shorter, more specific, and stackable learning opportunities that offer greater flexibility for students and manufacturers. The result of these learning opportunities should be a credential with an assessment that accurately measures that the holder has met the learning outcomes.
- » **Increase opportunities to demonstrate workplace behaviors.** Educators and manufacturers should identify more opportunities for students to participate in work-based learning. Students would benefit from experiences to demonstrate situationally appropriate workplace behaviors. Employability skills are often developed by repetitive work experiences and not in the classroom. Integrating work-based learning is a more valid approach to developing employability skills that manufacturers state are so critical.
- » **Increase engagement of manufacturers in the development of credentials.** Credentials should more directly reflect the skills that manufacturers deem important. In particular, the input from small and medium-sized manufacturers should be sought to increase the validity of the credential. One way to address this is to be more transparent about the manufacturers involved in the job task analysis to ensure there is a representative sample of the population being served. In addition, quality assurance for credentialing organizations should further emphasize the appropriate representation of manufacturers based on the scope of the credential.
- » **Strengthen collaboration among credentialing organizations, education and training providers, and test developers.** Instead of working in isolation, greater collaboration among these groups should occur through joint conferences, events, and other means. This will help create a more coherent credentialing system, which benefits everyone involved.



ADD AN EMPLOYABILITY SKILLS COMPONENT TO EXISTING AND NEW CREDENTIALS

The survey and focus group data indicate that employability skills are one of the most important predictors of workplace success. Many credentials do not include, measure, or provide information about these skills. Both survey and focus group respondents stated that training for employability skills

(also referred to as soft skills) is necessary to up-skill both individuals who hold credentials and those that do not (see Table 11).

Some focus group participants expressed doubt about the feasibility of designing credentials that attest to employability skills, but many agreed that if such credentials could be developed, they would provide significant benefit. The following recommendations address how employability skills could be integrated into credentials.

- » **Embed employability skills into credentials.** Credential requirements should include content and assessments that address employability as well as technical skills. Employability skills are best learned through work-based learning and experience. Therefore, requirements for experience should go beyond a specified number of years and identify demonstration of specific tasks. Credentials associated with specific industries allow the employability skills to be tailored to the scope of the credential.³⁶
- » **Increase opportunities to earn credentials that also assess employability skills in secondary schools.** Since employability skills are frequently learned through habituation,³⁷ it is important to provide opportunities to begin developing these skills in K-12. Working with manufacturers and credentialing experts, educators should seek to embed more credentials into the secondary education system to incorporate the necessary employability skills needed to succeed in the workplace.

Any credential that would include problem solving and group working to solve problems would be beneficial.

-Small manufacturer, South region

CREATE CREDENTIALS THAT FOCUS ON PERFORMANCE AND ADDRESS NEW ROLES

Manufacturers consistently stated they want to know what prospective employees can do and how they will perform on the job. Credentialing organizations should address these concerns of manufacturers and redesign credentials and assessments to focus on performance, not just knowledge. Credentials should use more innovative test items that measure an individual's application of knowledge, which is more predictive of performance. The following recommendations highlight opportunities for credentialing organizations to improve or develop credentials.

- » **Redesign assessments.** Credentialing assessments should move from focusing predominantly on knowledge-based multiple-choice exams to assessments designed to measure applied knowledge and skills. This can be done through performance assessments that use a structured, standardized rubric for observation, computer

³⁶ Burning Glass Technologies, "The Human Factor," November 2015. http://www.burning-glass.com/wp-content/uploads/Human_Factor_Baseline_Skills_FINAL.pdf.

³⁷ Labour Econ, "Hard Evidence on Soft Skills," August 2012. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612993/>.

or virtual reality simulations, employer rating scales, work portfolio reviews, oral exams, product development, or case studies.

- » **Develop credentials for growing and evolving roles.** Manufacturers identified several roles as lacking relevant credentials, such as ISO auditor, quality control, quality and inspection, and industrial maintenance. Some manufacturers expressed interest in credentials that address the working relationships between various functions (e.g., finance, marketing, production,) within a facility.

INCREASE THE NUMBER OF APPRENTICES AND EXPAND APPRENTICESHIPS TO MORE OCCUPATIONS

Many manufacturers value apprenticeships and indicate a need to have more apprenticeship programs. The number of apprentices has shown steady growth, from 375,425 in fiscal year 2013 to 505,371 in fiscal year 2016.³⁸ Despite this growth, this is still a small number when compared to the nearly 17.5 million part-time and full-time students enrolled in undergraduate education.³⁹

There is growing bipartisan support from policymakers to increase the number of apprentices and expand apprenticeships to more occupations. In June 2017, President Trump issued an executive order⁴⁰ targeted to expand the number of apprenticeships. *Room to Grow: Identifying New Frontiers for Apprenticeships*, a report by Burning Glass Technologies and the Managing the Future of Work Project at Harvard Business School, determined that the number of occupations commonly filled by apprentices could be nearly tripled, from 27 to 74.⁴¹ Manufacturers who have apprenticeships have been shown to reap such benefits as increased production from their workforce, reduction in errors,

[Apprenticeships are] a great opportunity to join credentialing with on-the-job training, provided that we can come up with a system that is usable across the board . . . that would give people training and strengths that we are on an even playing field.

-Small manufacturer, Northeast region

38 U.S. Department of Labor Employment and Training Administration, "Registered Apprenticeship National Results FY 2016 (10/01/2015 to 9/30/2016)," October 19, 2017. Accessed January 29, 2018. https://doleta.gov/oa/data_statistics.cfm.

39 National Center for Education Statistics, "Enrollment in elementary, secondary, and degree-granting postsecondary institutions, by level and control of institution, enrollment level, and attendance status and sex of student: Selected years, fall 1990 through fall 2026," Accessed January 29, 2018, https://nces.ed.gov/programs/digest/d16/tables/dt16_105.20.asp?current=yes.

40 Expanding Apprenticeships in America, Exec. Order No. 13801, 82 Fed. Reg. 28229 (June 15, 2017). Federal Register: *The Daily Journal of the United States*. Web. 4 June 2018.

41 Fuller, Joseph B. and Sigelman, Matthew. *Room to Grow: Identifying New Frontiers for Apprenticeships*. Burning Glass Technologies and the Managing the Future of Work Project at Harvard Business School, November 2017. Accessed January 29, 2018. <http://burning-glass.com/research/apprenticeships>.

reduced turnover, improved retention, a more reliable pipeline of employees, and improved employee engagement.⁴² Several recommendations could be implemented to increase the number of apprentices and strengthen the quality of apprenticeships.

- » **Promote competency-based apprenticeships.** Through a combination of on-the-job training and technical instruction, competency-based apprenticeships allow individuals to advance by demonstrating that they have the requisite skills and knowledge required by the manufacturer. This allows individuals to reach productivity more quickly and reduces the cost to the manufacturer.
- » **Provide focused resources and incentives.** Consistent with President Trump's Executive Order 13801, *Expanding Apprenticeships in America*, regulators and policymakers should integrate support for apprenticeships at the state and federal levels through focused funding and incentives that encourage the development of apprenticeship programs for existing and new occupations. Specific attention should be given to ensure that very small, small, and medium-sized manufacturers can participate.
- » **Use quality standards and conformity assessment.** Policymakers should require apprenticeship programs to demonstrate alignment with quality standards. Apprenticeships that are not part of the Registered Apprenticeship system should meet an apprenticeship standard developed and promoted by industry. Also, quality assurance by a third party should be used to confirm that the apprenticeship program meets quality standards.



⁴² U.S. Department of Commerce and Case Western University, *The Benefits and Costs of Apprenticeship: A Business Perspective*, November 2016. Accessed January 29, 2018. <http://www.esa.doc.gov/reports/benefits-and-costs-apprenticeships-business-perspective>.

RECOMMENDATIONS BY STAKEHOLDER

RECOMMENDATIONS FOR MANUFACTURERS

- » **Support efforts to increase transparency about the purpose, use, and competencies of credentials.** Improved and expanded systems that offer information to the public on what credentials are available and how they align with specific job requirements should be developed. One example of this is Credential Finder, a software application built on Credential Engine's Credential Registry that provides comparable information on all types of credentials to help align credentials with the needs of students, job seekers, workers, and employers.
- » **Align competencies and create a continuous feedback process.** Manufacturers should be involved in developing processes that continually signal competency requirements to credential developers. Manufacturers should be more proactive in signaling their competency, credential, and experience requirements on an ongoing and systematic basis. This ensures that education and training content and the credentials continue to be relevant and meet manufacturers' needs as jobs evolve and new jobs are created. Credentialing organizations benefit by being able to maintain the validity of the credential and improve the recertification components. Individuals benefit by knowing that the certification will have greater relevance throughout their career.
- » **Increase opportunities to demonstrate workplace behaviors.** Educators and manufacturers should identify more opportunities for students to participate in work-based learning. Students would benefit from experiences to demonstrate situationally appropriate workplace behaviors. Employability skills are often developed by repetitive work experiences and not in the classroom. Integrating work-based learning is a more valid approach to developing employability skills that manufacturers state are so critical.
- » **Increase opportunities to earn credentials that also assess employability skills in secondary schools.** Since employability skills are frequently learned through habituation, it is important to provide opportunities to begin developing these skills in K–12. Working with manufacturers and credentialing experts, educators should seek to embed more credentials into the secondary education system to incorporate the necessary employability skills needed to succeed in the workplace.
- » **Develop credentials for growing and evolving roles.** Manufacturers identified several roles as lacking relevant credentials, such as ISO auditor, quality control, quality and inspection, and industrial maintenance. Some manufacturers expressed interest in credentials that address the working relationships between various functions (e.g., finance, marketing, production) within a facility.
- » **Increase engagement of manufacturers in the development of credentials.** Credentials should more directly reflect the skills that manufacturers deem important. In particular, the input from small and medium-sized manufacturers should be sought to increase the validity of the credential. One way to address this is to be more transparent about the manufacturers involved in the job task analysis to ensure there is a representative sample of the population being served. In addition, quality assurance for credentialing organizations should further emphasize the appropriate representation of manufacturers based on the scope of the credential.
- » **Promote competency-based apprenticeships.** Through a combination of on-the-job training and technical instruction, competency-based apprenticeships allow individuals to advance by demonstrating that they have the requisite skills and knowledge required by the manufacturer. This allows individuals to reach productivity more quickly and reduces the cost to the manufacturer.

RECOMMENDATIONS FOR CREDENTIALING ORGANIZATIONS

- » **Support efforts to increase transparency about the purpose, use, and competencies of credentials.** Improved and expanded systems that offer information to the public on what credentials are available and how they align with specific job requirements should be developed. One example of this is Credential Finder, a software application built on Credential Engine’s Credential Registry that provides comparable information on all types of credentials to help align credentials with the needs of students, job seekers, workers, and employers.
- » **Expand information about quality and market value.** Credentialing organizations should expand the type and quality of information that is publicly available on their websites regarding the content of the credentials they issue. At a minimum, publicly available data should include: a clear set of competencies, third-party recognition, the requirements to earn and maintain the credential, how much experience the individual obtained to earn the credential, how the credentials are used and valued by manufacturers and workers, evidence of effectiveness, and cost. Recognizing that there are existing public databases, there is an increased need for organizations to synthesize and evaluate data from those databases to make informed decisions about quality.
- » **Increase awareness of the benefits of standards for quality credentials.** Educational events can be developed for stakeholders aligned with the manufacturing community (e.g., education and training providers, trade and professional associations, workforce intermediaries, and credentialing organizations) to highlight the benefits of developing and using credentials that adhere to quality standards. These outreach activities can be stand-alone events or incorporated into other existing educational events such as industry conferences.

An international and national standard, ANSI/ISO/IEC 17024:2012, *Conformity assessment: General requirements for bodies operating certification programs*, defines what constitutes a quality certification. For certificate programs, there are two standards, ASTM E2659-18, *Standard Practice for Certificate Programs*, and ICE 1100 2010(E) – *Standard for Assessment-Based Certificate Programs (2009)*.
- » **Publicize the value of accreditation.** Accreditors should increase awareness of the value of accreditation and its role in improving workforce quality. Regulators and funders should also be encouraged to highlight the importance of accreditation in their policy guidance and grant requirements.
- » **Align competencies and create a continuous feedback process.** Manufacturers should be involved in developing processes that continually signal competency requirements to credential developers. Manufacturers should be more proactive in signaling their competency, credential, and experience requirements on an ongoing and systematic basis. This ensures that education and training content and the credentials continue to be relevant and meet manufacturers’ needs as jobs evolve and new jobs are created. Credentialing organizations benefit by being able to maintain the validity of the credential and improve the recertification components. Individuals benefit by knowing that the certification will have greater relevance throughout their career.
- » **Embed employability skills into credentials.** Credential requirements should include content and assessments that address employability as well as technical skills. Employability skills are best learned through work-based learning and experience. Therefore, requirements for experience should go beyond a specified number of years and identify demonstration of specific tasks. Credentials associated with specific industries allow the employability skills to be tailored to the scope of the credential.⁴³
- » **Increase opportunities to earn credentials that also assess employability skills in secondary schools.** Since employability skills are frequently learned through habituation, it is important to provide opportunities to begin developing these skills in K-12. Working with manufacturers and credentialing experts, educators

43 Burning Glass Technologies, “The Human Factor,” November 2015. http://www.burning-glass.com/wp-content/uploads/Human_Factor_Baseline_Skills_FINAL.pdf.

should seek to embed more credentials into the secondary education system to incorporate the necessary employability skills needed to succeed in the workplace.

- » **Redesign assessments.** Credentialing assessments should move from focusing predominantly on knowledge-based multiple-choice exams to assessments designed to measure applied knowledge and skills. This can be done through performance assessments that use a structured, standardized rubric for observation, computer or virtual reality simulations, employer rating scales, work portfolio reviews, oral exams, product development, or case studies.
- » **Develop credentials for growing and evolving roles.** Manufacturers identified several roles as lacking relevant credentials, such as ISO auditor, quality control, quality and inspection, and industrial maintenance. Some manufacturers expressed interest in credentials that address the working relationships between various functions (e.g., finance, marketing, production) within a facility.
- » **Increase engagement of manufacturers in the development of credentials.** Credentials should more directly reflect the skills that manufacturers deem important. In particular, the input from small and medium-sized manufacturers should be sought to increase the validity of the credential. One way to address this is to be more transparent about the manufacturers involved in the job task analysis to ensure there is a representative sample of the population being served. In addition, quality assurance for credentialing organizations should further emphasize the appropriate representation of manufacturers based on the scope of the credential.
- » **Strengthen collaboration among credentialing organizations, education and training providers, and test developers.** Instead of working in isolation, greater collaboration among these groups should occur through joint conferences, events, and other means. This will help create a more coherent credentialing system, which benefits everyone involved.

RECOMMENDATIONS FOR EDUCATION AND TRAINING PROVIDERS

- » **Support efforts to increase transparency about the purpose, use, and competencies of credentials.** Improved and expanded systems that offer information to the public on what credentials are available and how they align with specific job requirements should be developed. One example of this is Credential Finder, a software application built on Credential Engine's Credential Registry that provides comparable information on all types of credentials to help align credentials with the needs of students, job seekers, workers, and employers.
- » **Align competencies and create a continuous feedback process.** Manufacturers should be involved in developing processes that continually signal competency requirements to credential developers. Manufacturers should be more proactive in signaling their competency, credential, and experience requirements on an ongoing and systematic basis. This ensures that education and training content and the credentials continue to be relevant and meet manufacturers' needs as jobs evolve and new jobs are created. Credentialing organizations benefit by being able to maintain the validity of the credential and improve the recertification components. Individuals benefit by knowing that the certification will have greater relevance throughout their career.
- » **Develop more flexible learning opportunities.** The education and training community should create shorter, more specific, and stackable learning opportunities that offer greater flexibility for students and manufacturers. The result of these learning opportunities should be a credential with an assessment that accurately measures that the holder has met the learning outcomes.
- » **Increase opportunities to demonstrate workplace behaviors.** Educators and manufacturers should identify more opportunities for students to participate in work-based learning. Students would benefit from experiences to demonstrate situationally appropriate workplace behaviors. Employability skills are often developed by

repetitive work experiences and not in the classroom. Integrating work-based learning is a more valid approach to developing employability skills that manufacturers state are so critical.

- » **Increase opportunities to earn credentials that also assess employability skills in secondary schools.** Since employability skills are frequently learned through habituation, it is important to provide opportunities to begin developing these skills in K-12. Working with manufacturers and credentialing experts, educators should seek to embed more credentials into the secondary education system to incorporate the necessary employability skills needed to succeed in the workplace.
- » **Develop credentials for growing and evolving roles.** Manufacturers identified several roles as lacking relevant credentials, such as ISO auditor, quality control, quality and inspection, and industrial maintenance. Some manufacturers expressed interest in credentials that address the working relationships between various functions (e.g., finance, marketing, production) within a facility.
- » **Strengthen collaboration among credentialing organizations, education and training providers, and test developers.** Instead of working in isolation, greater collaboration among these groups should occur through joint conferences, events, and other means. This will help create a more coherent credentialing system, which benefits everyone involved.

RECOMMENDATIONS FOR POLICYMAKERS

- » **Support efforts to increase transparency about the purpose, use, and competencies of credentials.** Improved and expanded systems that offer information to the public on what credentials are available and how they align with specific job requirements should be developed. One example of this is Credential Finder, a software application built on Credential Engine's Credential Registry that provides comparable information on all types of credentials to help align credentials with the needs of students, job seekers, workers, and employers.
- » **Develop and strengthen criteria to recognize credentials for education and training programs.** State agencies should do a better job developing and expanding systems that explain which types of credentials are most needed by manufacturers. The criteria that states create and use should be established against a national standard for quality. State agencies should develop and use publicly accessible central databases or utilize existing repositories to describe the uses and content of these credentials, how they are alike and different, and the requirements to earn them.
- » **Develop incentives for credentialing organizations to use quality standards for credentials.** The cost and time associated with adhering to quality standards for credentials and seeking accreditation can be significant. Federal and state agencies and private funders interested in improving practices and quality in the manufacturing industry should offer financial incentives and resources to help credentialing organizations offset these costs.
- » **Promote competency-based apprenticeships.** Through a combination of on-the-job training and technical instruction, competency-based apprenticeships allow individuals to advance by demonstrating that they have the requisite skills and knowledge required by the manufacturer. This allows individuals to reach productivity more quickly and reduces the cost to the manufacturer.
- » **Provide focused resources and incentives.** Consistent with President Trump's Executive Order 13801, Expanding Apprenticeships in America, regulators and policymakers should integrate support for apprenticeships at the state and federal levels through focused funding and incentives that encourage the development of apprenticeship programs for existing and new occupations. Specific attention should be given to ensure that very small, small, and medium-sized manufacturers can participate.

- » **Use quality standards and conformity assessment.** Policymakers should require apprenticeship programs to demonstrate alignment with quality standards. Apprenticeships that are not part of the Registered Apprenticeship system should meet an apprenticeship standard developed and promoted by industry. Also, quality assurance by a third party should be used to confirm that the apprenticeship program meets quality standards.
- » **Publicize the value of accreditation.** Accreditors should increase awareness of the value of accreditation and its role in improving workforce quality. Regulators and funders should also be encouraged to highlight the importance of accreditation in their policy guidance and grant requirements.

RECOMMENDATIONS FOR ACCREDITORS

- » **Publicize the value of accreditation.** Accreditors should increase awareness of the value of accreditation and its role in improving workforce quality. Regulators and funders should also be encouraged to highlight the importance of accreditation in their policy guidance and grant requirements.



RECOMMENDATIONS FOR FURTHER RESEARCH

During the course of the study, the research team identified several areas that merit further research to better understand how credentials can meet the needs of the manufacturing industry.

Analyze Supply and Demand for Workforce Competencies

As noted in the recommendations, manufacturers should be more proactive in signaling their competency, credential, and experience requirements on an ongoing basis. Research is needed about a system that can be developed to integrate supply and demand for workforce competencies. The system should use databases that are open and accessible to all stakeholders.

Validate the Need for New Credentials

During the course of this research study, manufacturers identified several roles as lacking relevant credentials, such as ISO auditor, quality control, quality and inspection, and industrial maintenance. Additional research is needed to validate the need for new credentials in these areas.

Examine Other Factors That Impact Use of Credentials

Qualitative research, using sociological and anthropological methodologies, is needed to explore reasons other than facility size that influence how and if credentials are used. This would provide further insight into the variables that impact credential use.

Compare Existing Manufacturing Certifications with Validated Manufacturing Skills

Manufacturers are looking for employees with an increasingly complex combination of skills. Research is needed to examine whether skill clusters, identified in previous research, are reflected in current manufacturing certifications and how these certifications can maintain their relevance.

Increase the Quality and Efficiencies of On-the-Job Training in Small and Medium-Sized Manufacturers

Often small and medium-sized manufacturers have to resort to doing their own training, which is both time consuming and costly. Using principles and methodologies of adult learning theories and current learning technologies, research is needed to determine how the on-the-job training process could be modified to obtain competency goals faster, while retaining quality and reducing training costs.

Conduct an In-Depth Analysis of Employability Skills

A more in-depth analysis of employability skills, also referred to as soft skills (e.g., communication, teamwork, work appropriate behavior, critical thinking, and problem solving) is needed to examine how

these skills vary within manufacturing sectors or types of roles performed. This can provide data for credentialing bodies to better integrate these competencies into their credentials.

Study the Impact of Performance Exams on Job Performance

Research should be conducted to determine whether certifications with performance exams predict better job outcomes. Affirmative data would encourage certification bodies to move from using traditional multiple-choice exams to performance-based exams.

Examine Facility-Specific Credentials

Thirteen percent of survey respondents indicated they develop facility-specific credentials to meet specific job roles within their facilities. Research would examine the competencies of these facility-specific credentials, where commonalities exist, and whether there is sufficient need for a regional or national credential to be developed.

Study the Return on Investment of Work-Based Learning for Manufacturers

Research is needed to better quantify the return on investment (ROI) of work-based learning to manufacturers. Understanding the ROI would result in more effective partnerships with educational institutions that benefit the industry and build a skilled workforce.



ABOUT THE RESEARCH ORGANIZATIONS

NIST MEP

Since 1988, the Hollings Manufacturing Extension Partnership (MEP) has worked to strengthen U.S. manufacturing. The Program was created to improve the competitiveness of U.S. based manufacturing by making manufacturing technologies, processes, and services more accessible to small and medium-sized manufacturers (SMMs). MEP is part of the National Institute of Standards and Technology (NIST), an agency of the U.S. Department of Commerce.

MEP National Network™

The MEP National Network comprises NIST MEP, the 51 MEP Centers located in all 50 states and Puerto Rico, and more than 1,300 trusted advisors and experts at over 400 MEP service locations, providing any U.S. manufacturer with access to resources they need to succeed.

The MEP National Network's strength is in its partnerships. Centers are the hub for manufacturers, connecting them with government agencies, trade associations, universities and research laboratories, state and federal initiatives, and a host of other resources to help them grow and innovate.

Delivering Value

As a public-private partnership, the Program delivers a high return on investment to taxpayers. In FY2017, for every one dollar of federal investment, the MEP National Network generated \$17.90 in new sales growth for manufacturers and \$27.00 in new client investment. This translates into \$2.3 billion in new sales annually. And, for every \$1,501 of federal investment, the Network creates or retains one manufacturing job.

WORKCRED

Formed in 2014, Workcred is an affiliate of the American National Standards Institute (ANSI) whose mission is to strengthen workforce quality by improving the credentialing system, ensuring its ongoing relevance, and preparing employers, workers, educators, and governments to use it effectively. Workcred's vision is a labor market that relies on the relevance, quality, and value of workforce credentials for opportunities, growth, and development.

ACKNOWLEDGMENTS

This research work was made possible by the generous support of the U.S. Department of Commerce, National Institute of Standards and Technology, under the financial assistance award 70NANB16H239.

Sincere gratitude is extended to the individuals who contributed to the research study and development of the report from Workcred, its contractors AERE (Assessment, Education, and Research Experts) and Goldsmith International, and NIST MEP. Workcred is particularly grateful for the time and input shared by all survey and focus group participants.

workcred

1899 L Street, 11th Floor, NW
Washington, DC 20036

(202) 293-8020
info@workcred.org

www.workcred.org



**MEP • MANUFACTURING
EXTENSION PARTNERSHIP®**

100 Bureau Drive
Gaithersburg, MD 20899

(800) MEP-4MFG
mfg@nist.gov

www.nist.gov/mep

APPENDIX A

COPY OF 2017 NIST MEP CREDENTIAL SURVEY

2017 NIST MEP CREDENTIAL SURVEY



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OMB Control No. 0693-0033

Expiration Date: 06/30/2019

WELCOME

The National Institute of Standards and Technology (NIST) through the Hollings Manufacturing Extension Partnership (MEP) is embarking on a very important study to determine the impact and value of the credentials used in manufacturing as perceived by individuals responsible for workforce hiring and promotion decisions. There are many credentials but a significant lack of independent research regarding their perceived quality, market value, and effectiveness specifically related to manufacturing industry sector needs. This research will provide information to US Manufacturers, career counselors, credential developers and job seekers. The information on Manufacturing Credentials will be helpful in reducing training costs, narrowing the skills gap, and aligning workforce to industry needs.

We hope you are willing to be part of this important study by completing this survey. As part of your participation, we are asking you to also complete demographic information about yourself. The information you provide will be used in technical reports in the aggregate and held in confidence.

We estimate that the survey can be completed in 15 minutes. We asked that you complete the survey by Friday, June 30, 2017. If you have any technical difficulties, desire to opt-out of any future communications, or wish to speak to a member of the project team (who is hosting the survey) please contact mary.pacelli@nist.gov.

As this is a new undertaking, the items on this survey are copy written, proprietary, and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of NIST MEP and their contractor, Workcred. Thank you again for lending your time to a very important activity.

1. Please provide the name of your facility (This information will not be disclosed).

2. If applicable, name your parent company.

3. How are credentials (apprenticeship, certifications, certificates, licenses) used in your specific facility? (Please select all that apply.)

- | | |
|--|--|
| <input type="checkbox"/> Preferred | <input type="checkbox"/> Required to maintain the job after employment |
| <input type="checkbox"/> Required for employment | <input type="checkbox"/> Credentials are not used in our facility |
| <input type="checkbox"/> Required for promotion | |

Note: If respondent selects "Credentials are not used in our facility" then jump to question 9.

4. What roles in your facility require or prefer credentials for hiring or promotion? (Please select all that apply.)

- | | |
|---|---|
| <input type="checkbox"/> Apprentice | <input type="checkbox"/> Precision Machinist |
| <input type="checkbox"/> Design and Development | <input type="checkbox"/> Production |
| <input type="checkbox"/> Engineer | <input type="checkbox"/> Quality Technician |
| <input type="checkbox"/> IT | <input type="checkbox"/> Research and Development |
| <input type="checkbox"/> Equipment Maintenance Technician | <input type="checkbox"/> Supervisor |
| <input type="checkbox"/> Management | <input type="checkbox"/> Other - Write In: _____ |

5. Which type of credential is the MOST important when making HIRING decisions in your facility?

- | |
|---|
| <input type="checkbox"/> Certificate issued by vocational high school |
| <input type="checkbox"/> Certificate earned at an apprenticeship |
| <input type="checkbox"/> Industry-specific certification |
| <input type="checkbox"/> License |
| <input type="checkbox"/> Other - Write In: _____ |

6. Which type of credential is the **MOST** important when making **PROMOTION** decisions in your facility?

- Certificate issued by vocational high school
- Certificate earned at an apprenticeship
- Industry-specific certification
- License
- Other - Write In: _____

7. Please specify up to **five** credentials that are **most important** in your facility to make employment decisions (hiring, promotion) using the list of credentials below.

- Apprenticeship - CNC Programmers
- Apprenticeship - Electricians
- Apprenticeship - Electro-Mechanical Technicians
- Apprenticeship - Industrial Machinery Mechanics
- Apprenticeship - Machinist
- Apprenticeship - Millwright
- Apprenticeship - Pipefitter
- Apprenticeship - Sheet Metal Worker
- Apprenticeship - Structural Iron and Steel Worker
- Apprenticeship - Tool and Die Maker
- Certified Composites Technician (CCT), American Composites Manufacturers Association (ACMA)
- Certified Internal Auditor, Institute of Internal Auditors
- Certified Logistics Technician, Manufacturing Skill Standards Council (MSSC)
- Certified Production Technician (CPT), Manufacturing Skill Standards Council (MSSC)
- Certified in Production and Inventory Management (CPIM), Association for Operations Management (APICS)
- Certified Supply Chain Professional (CSCP), Association for Operations Management (APICS)
- Certified Quality Inspector, American Society for Quality (ASQ)
- Certified Welder, American Welding Society (AWS)
- Fluid Power Certified Mechanic, International Fluid Power Society (IFPS)
- Geometric Dimensioning & Tolerancing (GD&T) Professional, American Society of Mechanical Engineers (ASME)
- Lean Bronze Certification, ASQ - AME - Shingo Institute - SME
- Lean Silver Certification, ASQ - AME - Shingo Institute - SME
- Lean Gold Certification, ASQ - AME - Shingo Institute - SME
- Machine Maintenance, Service & Repair Level II, National Institute for Metalworking Skills (NIMS)
- Machining Level I, National Institute for Metalworking Skills (NIMS)
- Mechatronics: Fluid Power 1, Packaging Machinery Manufacturing Institute (PMMI)
- NADCA Die Casting Certification, North American Die Casting Association (NADCA)
- National Aerospace Defense Contractors Accreditation Program (NAD-CAP) Certification, National Aerospace Defense Contractors Accreditation Program (NAD-CAP)
- National Career Readiness Certificate (NCRC), ACT
- OSHA Fork Lift, Occupational Safety & Health Administration (OSHA)
- OSHA Safety - 10 Hour, Occupational Safety & Health Administration (OSHA)
- OSHA Safety - 30 Hour, Occupational Safety & Health Administration (OSHA)
- PMMI Mechatronics Certifications, Packaging Machinery Manufacturing Institute (PMMI)
- PMMI Mechanics: Industrial Electricity 1, Packaging Machinery Manufacturing Institute (PMMI)
- PMMI Mechatronics: Mechanical Components 1, Packaging Machinery Manufacturing Institute (PMMI)
- PMMI Mechatronics: Programmable Logic Controls (PLCs) 1, Packaging Machinery Manufacturing Institute (PMMI)
- Precision Sheet Metal Operator Certification (PSMO), Fabricators & Manufacturers Association, International (FMA)
- Siemens Certified Mechatronic Systems Level I: Assistant, Siemens Mechatronic Systems Certification Program
- Six Sigma Black Belt, International Association of Six Sigma Certification
- Six Sigma Green Belt, International Association of Six Sigma Certification
- Supply Chain Operations Reference Professional (SCOR-P), American Production and Inventory Control Society (APICS)
- Facility-specific credential
- Locally-specific credential
- State-specific credential
- Other - Write In: _____

7(cont). Indicate how each of these credentials are used in your facility.

Required for employment	Required for promotion	Preferred when making hiring decisions	Preferred when making promotion decisions	Recognized but not used in hiring/ promotion decisions
-------------------------	------------------------	--	---	--

When are the credentials used in your facility generally acquired?

- Before individual is hired After individual is hired

Please indicate how the credentials you have noted above affected the facility. (Please select all that apply)

- | | |
|--|--|
| <input type="checkbox"/> Error Reduction | <input type="checkbox"/> Promoting the Right People |
| <input type="checkbox"/> Reducing Waste (Reducing Inventory) | <input type="checkbox"/> Meeting Strategic Organizational Goals |
| <input type="checkbox"/> Cost Savings | <input type="checkbox"/> Meeting Department Goals |
| <input type="checkbox"/> Quality | <input type="checkbox"/> Customer Satisfaction |
| <input type="checkbox"/> Efficiencies | <input type="checkbox"/> Ensuring Compliance (e.g., safety, environment) |
| <input type="checkbox"/> Communications | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Hiring the Right People | |

8. What difference do credentials make in your facility? (Please select all that apply.)

- Credentials allow us to more easily identify qualified people
- Individuals with credentials require less on the job training
- Individuals with credentials increase productivity in my facility
- Individuals with credentials have a better work ethic
- Individuals with credentials stay in their job longer
- Credentials don't make a difference

9. What are the reasons credentials are **NOT** used? (Please select all that apply.)

- Credentials do not exist
- Credentials are not relevant to the jobs in my facility
- Our facility can't find individuals who hold relevant credentials
- Credentials don't make any difference in an individual's performance
- Other - Write In: _____

10. Please indicate the reason(s) below for selecting "Credentials don't make any difference in an individual's performance." (Please select all that apply.)

- Individuals have to be retrained anyway
- Individuals don't have the knowledge and skills that the credential claims
- The individual has knowledge but can't perform
- There is no difference in performance between credentialed and non-credentialed employees
- Experience is a better predictor for successful performance
- The increase in salary associated with the credential is not cost effective
- It is more cost effective to create our own credentials (or training program)
- Other - Write In: _____

11. What type of support does your facility provide to encourage individuals to obtain additional training? (Please select all that apply.)

- Paid time off to attend training
- Unpaid time off to attend training
- Full reimbursement of training costs
- Partial reimbursement of training costs
- Recognition program for individuals who complete training/education programs
- On-site training (e.g., courses, workshops)
- Pre-apprenticeship program
- Apprenticeship program
- No support provided
- Other - Write In: _____

12. What training does your facility conduct to up-skill individuals **who ALREADY hold credentials?** (Please select all that apply.)

- Training to help people earn another credential
- Training where no credential covering required skills existed
- Training to fill unique technical skills needed in the facility (e.g., machining, blue-print reading, inspection, etc.)
- Training in "soft skills" (e.g., communication, teamwork, work appropriate behavior, etc.)
- No training provided
- Other - Write In: _____

13. What training does your facility conduct to up-skill individuals who **DO NOT** hold credentials? (Please select all that apply.)

- Training to help people earn a credential
- Training where no credential covering required skills exists
- Training to fill unique technical skills needed in the facility (e.g., machining, blue-print reading, inspection, etc.)
- Training in "soft skills" (e.g., communication, teamwork, work appropriate behavior, etc.)
- No training provided
- Other - Write In: _____

14. What roles in your facility are difficult to fill due to a lack of qualified candidates?

Role: _____

Role: _____

Role: _____

Role: _____

Role: _____

15. How could the usefulness of credentials be improved? (Please select all that apply.)

Credentials must focus more on hands on skills, not just knowledge

Credentials should be more aligned to specific tasks (such as operating specific types of equipment)

Credentials should cover soft skills such as communication, getting along with others, work ethic, team work

Other - Write In: _____

16. Which of the following areas need new credentials? (Please select all that apply.)

Computer skills

Verbal communication

Critical thinking/problem solving

Written communication

Data analytics

Other - Write In: _____

Interpersonal skills

None of the above

Technical skills

17. What NAICS code describes your facility?

Food Manufacturing: NAICS 311

Nonmetallic Mineral Product Manufacturing: NAICS 327

Beverage and Tobacco Product Manufacturing: NAICS 312

Primary Metal Manufacturing: NAICS 331

Textile Mills: NAICS 313

Fabricated Metal Product Manufacturing: NAICS 332

Textile Product Mills: NAICS 314

Machinery Manufacturing: NAICS 333

Apparel Manufacturing: NAICS 315

Computer and Electronic Product Manufacturing: NAICS 334

Leather and Allied Product Manufacturing: NAICS 316

Electrical Equipment, Appliance, and Component Manufacturing: NAICS 335

Wood Product Manufacturing: NAICS 321

Transportation Equipment Manufacturing: NAICS 336

Paper Manufacturing: NAICS 322

Furniture and Related Product Manufacturing: NAICS 337

Printing and Related Support Activities: NAICS 323

Miscellaneous Manufacturing: NAICS 339

Petroleum and Coal Products Manufacturing: NAICS 324

Other

Chemical Manufacturing: NAICS 325

Plastics and Rubber Products Manufacturing: NAICS 326

18. In what state or U.S. territory is the facility you work in located?

- | | | | |
|---|--|---|---|
| <input type="checkbox"/> Alabama | <input type="checkbox"/> Illinois | <input type="checkbox"/> Montana | <input type="checkbox"/> Puerto Rico |
| <input type="checkbox"/> Alaska | <input type="checkbox"/> Indiana | <input type="checkbox"/> Nebraska | <input type="checkbox"/> Rhode Island |
| <input type="checkbox"/> Arizona | <input type="checkbox"/> Iowa | <input type="checkbox"/> Nevada | <input type="checkbox"/> South Carolina |
| <input type="checkbox"/> Arkansas | <input type="checkbox"/> Kansas | <input type="checkbox"/> New Hampshire | <input type="checkbox"/> South Dakota |
| <input type="checkbox"/> California | <input type="checkbox"/> Kentucky | <input type="checkbox"/> New Jersey | <input type="checkbox"/> Tennessee |
| <input type="checkbox"/> Colorado | <input type="checkbox"/> Louisiana | <input type="checkbox"/> New Mexico | <input type="checkbox"/> Texas |
| <input type="checkbox"/> Connecticut | <input type="checkbox"/> Maine | <input type="checkbox"/> New York | <input type="checkbox"/> Utah |
| <input type="checkbox"/> Delaware | <input type="checkbox"/> Maryland | <input type="checkbox"/> North Carolina | <input type="checkbox"/> Vermont |
| <input type="checkbox"/> District of Columbia | <input type="checkbox"/> Massachusetts | <input type="checkbox"/> North Dakota | <input type="checkbox"/> Virginia |
| <input type="checkbox"/> Florida | <input type="checkbox"/> Michigan | <input type="checkbox"/> Ohio | <input type="checkbox"/> Washington |
| <input type="checkbox"/> Georgia | <input type="checkbox"/> Minnesota | <input type="checkbox"/> Oklahoma | <input type="checkbox"/> West Virginia |
| <input type="checkbox"/> Hawaii | <input type="checkbox"/> Mississippi | <input type="checkbox"/> Oregon | <input type="checkbox"/> Wisconsin |
| <input type="checkbox"/> Idaho | <input type="checkbox"/> Missouri | <input type="checkbox"/> Pennsylvania | <input type="checkbox"/> Wyoming |

19. What is your role in your facility?

- | | |
|--|--|
| <input type="checkbox"/> Chief Operating Officer | <input type="checkbox"/> Foreman |
| <input type="checkbox"/> Owner/CEO/President | <input type="checkbox"/> Manager/Supervisor |
| <input type="checkbox"/> Vice President | <input type="checkbox"/> Production Associate |
| <input type="checkbox"/> Director of Operations | <input type="checkbox"/> Other - Write In: _____ |
| <input type="checkbox"/> Human Resources | |

20. Who makes decisions about how credentials are used in your facility? (Please select all that apply.)

- | | |
|--|--|
| <input type="checkbox"/> Chief Operating Officer | <input type="checkbox"/> Foreman |
| <input type="checkbox"/> Owner/CEO/President | <input type="checkbox"/> Manager/Supervisor |
| <input type="checkbox"/> Vice President | <input type="checkbox"/> Production Associate |
| <input type="checkbox"/> Director of Operations | <input type="checkbox"/> Other - Write In: _____ |
| <input type="checkbox"/> Human Resources | |

21. How long have you worked in your current role?

- | | |
|---|---|
| <input type="checkbox"/> Less than one year | <input type="checkbox"/> 7 to 10 years |
| <input type="checkbox"/> 1 to 3 years | <input type="checkbox"/> More than 10 years |
| <input type="checkbox"/> 4 to 6 years | |

22. How many years have you worked in the manufacturing industry?

- | | |
|--|---|
| <input type="checkbox"/> Less than three years | <input type="checkbox"/> 11 to 15 years |
| <input type="checkbox"/> 3 to 5 years | <input type="checkbox"/> 16 to 20 years |
| <input type="checkbox"/> 6 to 10 years | <input type="checkbox"/> More than 20 years |

23. How many individuals are employed in your facility?

- | | |
|-----------------------------------|-------------------------------------|
| <input type="checkbox"/> 1 to 19 | <input type="checkbox"/> 100 to 250 |
| <input type="checkbox"/> 20 to 49 | <input type="checkbox"/> 251 to 500 |
| <input type="checkbox"/> 50 to 99 | <input type="checkbox"/> Over 500 |

24. Which of the following most closely describes your facility?

- Sole Proprietorship
- Privately-held Company
- Publicly-traded Corporation
- Other - Write In: _____

25. Is the facility you work in U.S. owned?

- Yes
- Partially U.S.-owned
- No

26. Please state the degree to which you agree or disagree with the following statements below.

	Strongly Disagree	Disagree	Agree	Strongly Agree
Earning a manufacturing credential indicates a greater level of commitment to the industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential provides a competitive edge in my facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential offers a sense of personal accomplishment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential supports professional development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential facilitates recognition from peers and management in my facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential helps individuals gain credibility in my facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earning a manufacturing credential enhances job performance (e.g. accuracy, efficiency)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. Thank you for lending your expertise, experience, and time to completing the survey! Would you be willing to participate in more detailed discussions on this topic?

Yes

No

If you would like to receive a copy of the final research report when it is completed, please provide your information below:

First name: _____

Last name: _____

Company: _____

Email Address: _____

Thank you for taking the time to complete the survey. Your participation will be helpful in collecting key information on the value and use of credentials. We hope that this survey will provide data to many organizations to improve the workplace. If you have any further questions please contact us at mary.pacelli@nist.gov.

This collection of information contains Paperwork Reduction Act (PRA) requirements approved by the Office of Management and Budget (OMB). Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA unless that collection of information displays a currently valid OMB control number. Public reporting burden for this collection is estimated to be 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed and completing and reviewing the collection of information. Send comments regarding this burden estimate or any aspect of this collection of information, including suggestions for reducing this burden, to the National Institute of Standards and Technology, Attn: Mary Ann Pacelli, Manager, Workforce Development at Manufacturing Extension Partnership (MEP), NIST Phone: (301) 975-4850; Email: mary.pacelli@nist.gov.

OMB Control No. 0693-0033

Expiration Date: 06/30/2019

APPENDIX B

FOCUS GROUP PROTOCOL

NIST MEP FOCUS GROUP ORIENTATION DOCUMENT AND PROTOCOL

workcred

Connecting credentials,
competencies, careers, customers

an affiliate of ANSI

WELCOME AND INTRODUCTION

This focus group is an important part of a research study sponsored by the National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP) to examine the quality, market value, and effectiveness of manufacturing credentials. Conducted in partnership with Workcred, an affiliate of the American National Standards Institute (ANSI), the initiative will contribute to the body of knowledge for manufacturing-related skills credentials and identify skill gaps that could be filled by new credentials.

We are going to be talking about why some of you may think credentials are considered important in your facility, and why and how they are used. Equally important, we will also talk about why some of you might think that credentials aren't used or important and what might make credentials more useful.

In this context, credentials include industry certifications and certificates, licenses, badges, and apprenticeships.

AGENDA

Estimated Time	Activity
4 min	Welcome, Introductions, and Ground Rules
85 min	Questions (Focus Group Protocol) Question Block A: 35 minutes Question Block B: 10 minutes Question Block C: 20 minutes Question Block D: 15 minutes Question Block E: 5 minutes
1 min	Wrap-Up & Adjournment

FOCUS GROUP PROTOCOL INTRODUCTION

Welcome! First, on behalf of NIST MEP, Workcred, and the project team, we would like to thank you for participating, making yourself available, and lending your expertise to this very important research task.

My name is Karen Elzey, and I am joined by my co-facilitator, Sharon Goldsmith.

As a reminder, we will be digitally recording our conversation, and everyone should have already confirmed agreement to be recorded during the registration process.

Before we begin to address the questions in this focus group, we would like to remind of you some ground rules outlined in the webinar reminder email:

1. **CONFIDENTIAL.** Everything said will remain private and confidential. In any future reports, we will not identify you or your organization.
2. **YOUR OPINION COUNTS.** There are no wrong answers. We are interested in your expertise, experiences, and above all, your opinion.
3. **SUCCINCT.** Please keep your responses succinct and relevant to the questions.
4. **INTERACT.** If you feel like you need to respond to others to understand or expand on the conversations, please feel free. You do not have to interact only with the facilitators.
5. **SPEAK UP.** We are digitally audio recording this session to ensure we capture everything appropriately, so please speak up.
6. **DISRUPTIVE TECHNOLOGY.** To ensure a clear connection, please keep your line muted until you are ready to speak.

Now that we have introduced ourselves and laid out the ground rules, let's take roll call.

[Call out the names of registrants; as they respond, ask if anyone else has joined them.]

QUESTION BLOCK A: USES AND REASONS FOR CREDENTIALS

1. Can you provide some examples of any credential(s) used in your facility, such as industry certifications and certificates, licenses, badges, and apprenticeships? What jobs do they align with?
2. When you think about the credentials that are most important in your facilities, what skills or attributes do they address, for example, safety, quality, or technical skills?
3. What credentials do you **REQUIRE AND/OR PREFER** your employees to have in your facility and why? Do you require them for hiring, promotion, or for salary differential?

Prompt: What is it about any credential, or the skills it represents, that would make it required for employment, promotion, or salary differential?

4. What credentials are specific to your industry? Can you provide some reasons and/or examples? Do you think they are more important than credentials that are used across different industries? Why or why not?
5. What other factors, such as experience and/or education, do you think are as important as—or even more important—than holding a credential? Can you provide me some reasons and/or examples?
6. Do you agree with the following statement—why or why not?
 - ♦ “Credentials allow us to more easily identify qualified people.”
7. How do you think credentials can add more value?

Prompt: Some examples of value include earnings, promotions, turnover reduction, obtaining jobs more easily, recognition from peers, pursuing life-long learning, and so forth.

QUESTION BLOCK B: REASONS FOR NOT USING CREDENTIALS

1. What do you think might be the reasons that you or others do not use credentials? For example:
 - ♦ I cannot find individuals who hold relevant credentials.
 - ♦ Credentials are not relevant to the jobs in my facility.
 - ♦ Credentials don't make any difference in an individuals' performance.
 - ♦ Credentials don't make any difference in an individual's performance because they have to be retrained anyway.
 - ♦ It is more cost-effective to create our own credential or training program.

QUESTION BLOCK C: IMPROVING CREDENTIALS

1. How could the usefulness of credentials be improved?

Prompt: You can talk about credentials in general or discuss specific credentials. We will not release the specific name of any specific credentials you want to comment on.

2. What new credentials do you think are needed to address the skills you find lacking?
3. If a new credential was created to address those skills you find lacking, how would you know the credential was successful at doing so?

Prompt: What improvements would you see in your current workers?

QUESTION BLOCK D: RELATIONSHIP BETWEEN TRAINING AND CREDENTIALS

1. In your experience, do people who hold credentials require more or less training? Why?
2. What are some of the specific technical skills (such as machining, blue-print reading, inspection, etc.) that you train on for individuals who **ALREADY DO** or **DO NOT** hold credentials?
3. When you say someone has to be trained, what do you mean?

QUESTION BLOCK E: KNOWLEDGE, SKILLS, AND ABILITIES

1. What seems to be the appropriate balance between soft skills and technical skills? What is the reason for your response? Can you provide examples?

Prompt: In other words, if someone asked you what percentage should be soft skills and technical skills, what would you say?

2. Are credentials needed to identify individuals with problem solving and critical thinking skills, why or why not? What does “critical thinking” mean to you? What does “problem solving” mean to you?

WRAP UP

On behalf of NIST MEP, Workcred, and the project team, thank you very much for your participation in today’s focus group. If you would like to share additional information or speak with a member of the project team, please contact Workcred at info@workcred.org.

NOTWITHSTANDING STATEMENT

This collection of information contains Paperwork Reduction Act (PRA) requirements approved by the Office of Management and Budget (OMB). Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA unless that collection of information displays a currently valid OMB control number. Public reporting burden for this collection is estimated to be **no more than 1.5 hour per response**, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed and completing and reviewing the collection of information. Send comments regarding this burden estimate or any aspect of this collection of information, including suggestions for reducing this burden, to the National Institute of Standards and Technology, Attn: Mary Ann Pacelli, Manager, Workforce Development at Manufacturing Extension Partnership (MEP), NIST Phone: (301) 975-4850; Email: mary.pacelli@nist.gov.

OMB Control No. 0693-0033

Expiration Date: 06/30/2019

APPENDIX C

ANALYSIS OF THE MOST COMMONLY CITED CREDENTIALS IN THE SURVEY⁴⁴

⁴⁴ Reporting only those credentials with a 10% response rate or higher; however, the “other” (16%) and “facility-specific credential” (13%) responses are omitted from this appendix due to the lack of specific information; the information provided through this appendix comes from a combination of desk research and outreach to credential issuers.

1. OSHA FORKLIFT (STANDUP OR SIT-DOWN)

Percentage of survey respondents that named this credential	22%
Type of credential	Certificate ⁴⁵
Issuing agency	Multiple organizations, employers, and independent training organizations offer this credential; OSHA defines the content but does not issue the credential
Geographic scope	Depending on the issuing agency it can be national, regional, or local
Accreditation status	Not Accredited
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	Yes, it is based on OSHA 29 CFR 1910-178
Can this credential be revoked?	No
Is this credential connected to a recertification program?	No
Purpose of this credential	To demonstrate that forklift operators have completed a mandatory period of instruction whose content is specified through OSHA
Audience for whom this credential is geared	Forklift operators and employers of operators; all employers must be able to show that their employees have been trained
Information about the exam (if described on its website)	Since there are multiple training providers, there are no uniform exam or assessment requirements, but it does appear to have a performance assessment
Number of certificants in the issuing agency's database	Since multiple providers offer this training, there is not specific data on the numbers of people who have gone through the training; however, OSHA requires all employers to train their employees on the safe operation of their forklifts (29 CFR 1910.178(l)) as applicable
Organizations/Industries that use this credential	Organizations across industries that employ forklift operators are required to train their employees
Any company, corporation, or organization publicly declared they prefer or require this credential	No information available to indicate this
Mean salary of certificants	OSHA does maintain this type of information
Data about how this credential is being used	OSHA has not conducted any surveys to determine who may have received or require this credential; and trainers conduct training both within the companies that they work for and as private consultants/trainers.

⁴⁵ Although OSHA considers this a training program, and employers often refer to it as a license, based on the definitions of credentials (see Figure 1) Workcred considers this a certificate.

2. CERTIFIED WELDER

Percentage of survey respondents that named this credential	21%
Type of credential	Certification
Issuing agency	American Welding Society (AWS)
Geographic scope	National
Accreditation status	Not Accredited
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	Yes, it is based on the AWS QC7-93 Standard for AWS Certified Welder
Can this credential be revoked?	Yes; there is an ethics code and ethics committee that can take enforcement actions
Is this credential connected to a recertification program?	Yes; AWS calls it the Certification Maintenance System. The process requires that every six months, the employer must verify to AWS that the certified individual is still successfully performing the welds he/she was initially tested on. If renewal lapses for an additional six months, the individual must re-test
Purpose of this credential	To identify individuals who can perform specified types of welds
Audience for whom this credential is geared	Individuals who are interested in pursuing a career as a welder; employers who can use the credential in making hiring decisions
Information about the exam (if described on its website)	This is a performance exam only; the exam must be completed in an AWS-accredited test facility, there are no other prerequisites needed to earn the credential
Number of certificants in the issuing agency's database	Approx. 60,000-65,000; data updated every 1-2 years
Organizations/Industries that use this credential	In order of greatest participation, industries include structural steel construction, heavy equipment and machinery manufacturing, pipeline, energy, shipbuilding, aerospace, automotive, chemical refinery, and other industries that utilize welding
Any company, corporation, or organization publicly declared they prefer or require this credential	Mandated by the Ironworkers and the Sheet Metal Workers (ITI); the United Automobile Workers have publicly declared its use; the City of New York requires welders to be certified but accepts any welding credential; the City of Los Angeles mentions it on its website, but it is not required; and Maryland Department of Transportation also mentions it on its website
Mean salary of certificants	No data available to indicate this; however, AWS has future plans to survey and collect this information
Data about how this credential is being used	No

3. CERTIFIED QUALITY INSPECTOR

Percentage of survey respondents that named this credential	17%
Type of credential	Certification
Issuing agency	American Society for Quality (ASQ)
Geographic scope	National
Accreditation status	Not Accredited
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	Yes, it is based on ASMEY14.5M
Can this credential be revoked?	No
Is this credential connected to a recertification program?	No; it is a lifetime certification and no recertification is required
Purpose of this credential	Used to identify individuals who have the skills to evaluate hardware, perform laboratory procedures, perform documentation, measure processes, and collect data. Certification is applicable across many industries
Audience for whom this credential is geared	Analyst, auditor, calibration technician, inspector, manager, project/process/manufacturing engineer, quality engineer, statistician, and technician are some of the positions that use this certification
Information about the exam (if described on its website)	A written four-hour multiple-choice exam that addresses quality terms, calibration, measurement, and the difference between accuracy and precision
Number of certificants in the issuing agency's database	15,190
Organizations/Industries that use this credential	Aerospace, fabricated metal products, medical products and services, transportation equipment (including automotive industries), and various other industries (including oil and gas, industrial and commercial machinery, electrical and electronic equipment and components, rubber and plastic products, general healthcare, air craft assembly inspection, and agricultural equipment)
Any company, corporation, or organization publicly declared they prefer or require this credential	No information is available
Mean salary of certificants	Mean salary reported \$49,694 per year
Data about how this credential is being used	ASQ conducted a job analysis survey to review the body of knowledge for its exam, and determined that the following roles use this credential: 24.66% Inspector, 17.35% Engineer, 15.98% Manager, 15.07% Technician, 10.96% Other (which includes switched to sales/marketing, reliability/safety engineer, internal consultant, metrologist, lead auditor/QA engineer, auditor, calibration technician, lead QA/QC inspector, QA auditor (process, internal audits, and ISO certification), and CMM programmer), 5.48% Specialist, 3.65% Supervisor, 3.65% Director, and 3.20% Analyst

4. APPRENTICESHIP – MACHINIST

Percentage of survey respondents that named this credential	16%
Type of credential	Certificate; some programs can also lead to college credit or an Associate's degree depending on the issuer
Issuing agency	Numerous organizations across the U.S., including employers, unions, state apprenticeship agencies, military, and industry trade associations
Geographic scope	Depending on the individual organization that is overseeing the apprenticeship, this credential can be national, regional, or local
Accreditation status	Not accredited; however, apprenticeship programs may have their in-class component offered through an accredited institution
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	No, it is not based on a uniform national standard
Can this credential be revoked?	No information available to indicate this
Is this credential connected to a recertification program?	No information available to indicate this
Purpose of this credential	Programs combine on-the-job learning with related instruction in machining to produce qualified, highly-productive employees, ensuring workers have the knowledge and competencies needed
Audience for whom this credential is geared	Employers who want to make sure that their employees are trained in performing facility-specific tasks required of machinists; individuals who want a national or regional credential that can help them secure a job in machining
Information about the exam (if described on its website)	Differs based on the issuing agency, but most test for basic skills in mathematics, reading, and writing; also includes blueprint reading
Number of certificants in the issuing agency's database	In FY 2016, there were 1,518 active (registered) apprentices reported in machining ⁴⁶
Organizations/Industries that use this credential	Some include DOW, Ford, UAW, Siemens, and Nestle ⁴⁷
Any company, corporation, or organization publicly declared they prefer or require this credential	No information available to indicate this; data is often internally maintained by the individual organizations that oversee the program
Mean salary of certificants	\$15.44 per hour ⁴⁸
Data about how this credential is being used	No information available to indicate this; data is often internally maintained by the individual organizations that oversee the program

46 For FY 2016, there were 14,422 active (registered) apprentices reported in the broad area of manufacturing (https://www.doleta.gov/oa/data_statistics.cfm).

47 Additional information is available at the U.S. Department of Labor Advanced Manufacturing Apprenticeship website (<https://www.dol.gov/apprenticeship/industry/advanced-manufacturing.htm>).

48 Mean hourly rate derived from https://www.payscale.com/research/US/Job=Apprentice_Machinist/Hourly_Rate.

5. OSHA 10-HOUR (OUTREACH TRAINING PROGRAM)

Percentage of survey respondents that named this credential	15%
Type of credential	Certificate ⁴⁹
Issuing agency	Multiple organizations, employers, and independent training organizations offer this credential; OSHA defines the content but does not issue the credential
Geographic scope	Depending on the issuing agency it can be national, regional, or local
Accreditation status	Not Accredited
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	Yes, it is based on OSHA 2254-09R 2015 ⁵⁰
Can this credential be revoked?	No
Is this credential connected to a recertification program?	It depends on the job role; some require "annual refresher training"
Purpose of this credential	It provides basic awareness training on the recognition, avoidance, abatement, and prevention of workplace hazards, the program also provides information regarding workers' rights, employer responsibilities, and filing a complaint
Audience for whom this credential is geared	The 10-hour program is primarily intended for entry level workers
Information about the exam (if described on its website)	Determined per each issuing agency
Number of certificants in the issuing agency's database	In FY 2017, there were 906,532 total trainees ⁵¹
Organizations/Industries that use this credential	No information available to indicate this
Any company, corporation, or organization publicly declared they prefer or require this credential	No information available to indicate this
Mean salary of certificants	No information available to indicate this
Data about how this credential is being used	OSHA has not conducted any surveys to determine who may have received or require this credential; and trainers conduct training both within the companies that they work for and as private consultants/trainers

49 Although OSHA considers this a training program, and employers often refer to it as a license, based on the definitions of credentials (see Figure 1) Workcred considers this a certificate.

50 This regulation is based on the Occupational Safety and Health Act of 1970. Within this regulation there are differing requirements for length of instruction and content based on the industry and role of the employee in the organization. There are no specific requirements clustered under manufacturing, although there are differing requirements based on the type of job that might be held within a manufacturing facility.

51 OSHA does not maintain a database of each individual who completes the training. They report over 36,000 authorized Outreach trainers who are private individuals who conduct this training. The trainers do not work for OSHA, but must follow OSHA's requirements in order to be an authorized trainer. Annually, this program trains more than 900,000 workers and employers. Further information can be found at https://www.osha.gov/dte/outreach/outreach_growth.html.

6. OSHA 30-HOUR (OUTREACH TRAINING PROGRAM)

Percentage of survey respondents that named this credential	15%
Type of credential	Certificate ⁵²
Issuing agency	Multiple organizations, employers, and independent training organizations offer this credential; OSHA defines the content but does not issue the credential
Geographic scope	Depending on the issuing agency it can be national, regional, or local
Accreditation status	Not Accredited
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	Yes, it is based on OSHA 2254-09R 2015 ⁵³
Can this credential be revoked?	No
Is this credential connected to a recertification program?	It depends on the job role; some require "annual refresher training"
Purpose of this credential	The 30-hour program also covers an overview of the hazards a worker may encounter on a job site, plus it provides a greater depth and variety of training on an expanded list of topics associated with workplace hazards in each industry
Audience for whom this credential is geared	It is more appropriate for supervisors or workers with some safety responsibility
Information about the exam (if described on its website)	Determined per each issuing agency
Number of certificants in the issuing agency's database	In FY 2017, there were 906,532 total trainees ⁵⁴
Organizations/Industries that use this credential	No information available to indicate this
Any company, corporation, or organization publicly declared they prefer or require this credential	No information available to indicate this
Mean salary of certificants	No information available to indicate this
Data about how this credential is being used	OSHA has not conducted any surveys to determine who may have received or require this credential; and trainers conduct training both within the companies that they work for and as private consultants/trainers

52 Although OSHA considers this a training program, and employers often refer to it as a license, based on the definitions of credentials (see Figure 1) Workcred considers this a certificate.

53 This regulation is based on the Occupational Safety and Health Act of 1970. Within this regulation there are differing requirements for length of instruction and content based on the industry and role of the employee in the organization. There are no specific requirements clustered under manufacturing, although there are differing requirements based on the type of job that might be held within a manufacturing facility.

54 OSHA does not maintain a database of each individual who completes the training. They report over 36,000 authorized Outreach trainers who are private individuals who conduct this training. The trainers do not work for OSHA, but must follow OSHA's requirements in order to be an authorized trainer. Annually, this program trains more than 900,000 workers and employers. Further information can be found at https://www.osha.gov/dte/outreach/outreach_growth.html.

7. IASSC CERTIFIED GREEN BELT™⁵⁵

Percentage of survey respondents that named this credential	14%
Type of credential	Certification
Issuing agency	International Association of Six Sigma Certification (IASSC)
Geographic scope	International
Accreditation status	Not accredited ⁵⁶
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	No
Can this credential be revoked?	Yes; revoked status is applied only to certifications that are withdrawn either at the candidate's request or by IASSC due to some form of disciplinary action
Is this credential connected to a recertification program?	Yes; this certification is only valid for three years
Purpose of this credential	To prepare individuals for core to advanced elements of Lean Six Sigma Methodology
Audience for whom this credential is geared	Individuals who participate on process improvement teams that analyze and solve quality problems
Information about the exam (if described on its website)	It is a 100 question, closed book, proctored, three-hour exam. The exam contains approximately 20 multiple-choice and true or false questions from each major section of the IASSC Lean Six Sigma Green Belt Body of Knowledge. Exams are administered through PearsonVue testing sites; there is also on-demand web-based testing through ProctorU. There are no prerequisites to sit for the exam. Training is available, though not mandated, through IASSC-accredited training providers
Number of certificants in the issuing agency's database	3,893 recorded IAASC Certified Green Belts
Organizations/Industries that use this credential	This credential is utilized in diverse industries and across many companies ⁵⁷
Any company, corporation, or organization publicly declared they prefer or require this credential	Yes; but IASSC does not actively monitor nor is made aware of this information ⁵⁸
Mean salary of certificants	\$96,637 per year ⁵⁹
Data about how this credential is being used	No information available to indicate this

55 Also commonly referred to as Six Sigma Green Belt Certification.

56 IASSC indicates on their website that they are exploring ANSI and/or NCCA accreditation.

57 See <https://www.iassc.org/our-customers/> for further information. The partial list of IASSC customers displayed have all placed at least one certification exam order directly with IASSC, either through e-commerce or through some other authorized mechanism such as offline exam packet order(s). All parties have been confirmed to have either a valid email extension from the company that they are purchasing from. i.e. —@acme.com and/or list the company name in processing / invoicing or payment for their IASSC order(s). This does not account for customers of Accredited Providers who utilize IASSC Certification Exams with their Customers. This only accounts for customers who have purchased Certification Exam directly from IASSC.

58 A search on Monster.com currently shows seven jobs where the employer either lists IASSC Certification as a preference or a requirement (https://www.monster.com/jobs/search/?q=IASSC&intcid=skr_navigation_nhps_searchMain).

59 Information taken from Glassdoor.com (https://www.glassdoor.com/Salaries/lean-six-sigma-green-belt-salary-SRCH_KO0,25.htm).

8. APPRENTICESHIP – COMPUTER NUMERICAL CONTROLLED (CNC) PROGRAMMER

Percentage of survey respondents that named this credential	13%
Type of credential	Certificate; some programs can also lead to college credit or an Associate's degree depending on the issuer, and the apprentice may be eligible to qualify for certain NIMS credentials
Issuing agency	Numerous organizations across the U.S., including employers, unions, state apprenticeship agencies, military, and industry trade associations
Geographic scope	Depending on the individual organization that is overseeing the apprenticeship, this credential can be national, regional, or local
Accreditation status	Not accredited; however, apprenticeship programs may have their in-class component offered through an accredited institution
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	No, it is not based on a uniform national standard
Can this credential be revoked?	No information available to indicate this
Is this credential connected to a recertification program?	No information available to indicate this
Purpose of this credential	Programs combine on-the-job learning with related instruction in CNC programming to produce qualified, highly-productive employees, ensuring workers have the knowledge and competencies needed
Audience for whom this credential is geared	Individuals who are interested in programming machines (e.g., those that turn, bore, thread, or face metal or plastic materials such as wire, rod, or bar stock) that produce complicated identical parts; also geared for individuals who want to acquire blueprint reading, planning, NC Codes, design, and specific math skills
Information about the exam (if described on its website)	Differs based on the issuing agency, but most test for a solid understanding of G code programming, part dimensioning, workpiece materials, speeds and feeds, cutting tool theory, and workholding setups
Number of certificants in the issuing agency's database	No information available to indicate this
Organizations/Industries that use this credential	Some include Rolls-Royce and Hypertherm ⁶⁰
Any company, corporation, or organization publicly declared they prefer or require this credential	No information available to indicate this; data is often internally maintained by the individual organizations that oversee the program
Mean salary of certificants	\$19.75 per hour ⁶¹
Data about how this credential is being used	No information available to indicate this; data is often internally maintained by the individual organizations that oversee the program

60 Additional information is available at the U.S. Department of Labor Advanced Manufacturing Apprenticeship website (<https://www.dol.gov/apprenticeship/industry/advanced-manufacturing.htm>).

61 Mean hourly rate derived from [https://www.payscale.com/research/US/Job=Computer_Numerically_Controlled_\(CNC\)_Operator_and_Programmer/Hourly_Rate](https://www.payscale.com/research/US/Job=Computer_Numerically_Controlled_(CNC)_Operator_and_Programmer/Hourly_Rate)

9. IASSC CERTIFIED BLACK BELT™⁶²

Percentage of survey respondents that named this credential	12%
Type of credential	Certification
Issuing agency	International Association of Six Sigma Certification (IASSC)
Geographic scope	International
Accreditation status	Not accredited ⁶³
Accrediting agency	N/A
Is this credential based on a national and/or international standard?	No
Can this credential be revoked?	Yes; revoked status is applied only to certifications that are withdrawn either at the candidate's request or by IASSC due to some form of disciplinary action
Is this credential connected to a recertification program?	Yes; this certification is only valid for three years
Purpose of this credential	To prepare individuals who lead complex industry and workplace improvement projects using a specific methodology defined in the Lean Six Sigma Method. This is considered an advanced credential
Audience for whom this credential is geared	Fulltime quality improvement specialists
Information about the exam (if described on its website)	It is a 150 question, closed book, proctored, four-hour exam. The exam contains approximately 30 multiple-choice and true or false questions from each major section of the IASSC Lean Six Sigma Black Belt Body of Knowledge. Exams are administered through PearsonVue testing sites; there is also on-demand web-based testing through ProctorU. There are no prerequisites to sit for the exam. Training is available, though not mandated, through IASSC-accredited training providers
Number of certificants in the issuing agency's database	1,808 recorded IAASC Certified Black Belts
Organizations/Industries that use this credential	This credential is utilized in diverse industries and across many companies; it is listed as "trusted by" Tesla, Vanderbilt University, Caterpillar, U.S. Department of Defense, Johns Hopkins, and Google, among others ⁶⁴
Any company, corporation, or organization publicly declared they prefer or require this credential	Yes; but IASSC does not actively monitor nor is made aware of this information ⁶⁵
Mean salary of certificants	\$96,637 per year ⁶⁶
Data about how this credential is being used	No information available to indicate this

62 Also commonly referred to as Six Sigma Black Belt Certification.

63 IASSC indicates on their website that they are exploring ANSI and/or NCCA accreditation.

64 See <https://www.iassc.org/our-customers/> for further information. The partial list of IASSC customers displayed have all placed at least one certification exam order directly with IASSC, either through e-commerce or through some other authorized mechanism such as offline exam packet order(s). All parties have been confirmed to have either a valid email extension from the company that they are purchasing from. i.e. —@acme.com and/or list the company name in processing / invoicing or payment for their IASSC order(s). This does not account for customers of Accredited Providers who utilize IASSC Certification Exams with their Customers. This only accounts for customers who have purchased Certification Exam directly from IASSC.

65 A search on Monster.com currently shows seven jobs where the employer either lists IASSC Certification as a preference or a requirement (https://www.monster.com/jobs/search?q=IASSC&intcid=skr_navigation_nhps_searchMain).

66 Information taken from Glassdoor.com (https://www.glassdoor.com/Salaries/lean-six-sigma-black-belt-salary-SRCH_KO0,25.htm).

APPENDIX D

**PERCEPTIONS OF THE VALUE OF EARNING
MANUFACTURING CREDENTIALS ACROSS
FACILITY SIZE**

Earning a manufacturing credential:	Very Small				Small				Medium				Large			
	Strongly disagree	Disagree	Agree	Strongly agree	Strongly disagree	Disagree	Agree	Strongly agree	Strongly disagree	Disagree	Agree	Strongly agree	Strongly disagree	Disagree	Agree	Strongly agree
Indicates a greater level of commitment to the industry	7%	12%	64%	17%	4%	7%	61%	28%	5%	6%	59%	31%	...	5%	48%	48%
Provides a competitive edge in my facility	10%	27%	54%	10%	7%	15%	57%	21%	5%	19%	49%	28%	...	10%	57%	33%
Offers a sense of personal accomplishment	4%	4%	58%	35%	4%	1%	54%	41%	3%	1%	46%	50%	...	...	43%	57%
Supports professional development	4%	5%	64%	27%	4%	2%	57%	38%	3%	1%	47%	49%	...	...	27%	71%
Facilitates recognition from peers and management in my facility	5%	29%	54%	12%	4%	23%	54%	18%	3%	16%	58%	23%	...	24%	48%	29%
Helps individuals gain credibility in my facility	7%	33%	44%	16%	5%	29%	46%	20%	5%	15%	56%	25%	...	10%	65%	25%
Enhances job performance (e.g., accuracy, efficiency)	2%	29%	45%	23%	6%	17%	51%	25%	3%	9%	56%	32%	...	10%	48%	43%

workcred

1899 L Street, 11th Floor, NW
Washington, DC 20036

(202) 293-8020
info@workcred.org

www.workcred.org



**MEP • MANUFACTURING
EXTENSION PARTNERSHIP®**

100 Bureau Drive
Gaithersburg, MD 20899

(800) MEP-4MFG
mfg@nist.gov

www.nist.gov/mep