



Nuts, Bolts & Thingamajigs Foundation

PROGRAM IMPACT STUDY

Evaluating NBT Summer Manufacturing Camps



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Executive Summary

Program Background

Although U.S. manufacturing continues to expand, industry studies predict that as many as two million jobs will remain unfilled in the next decade due to thousands of workers reaching retirement age and insufficient numbers of qualified candidates getting trained. Having a skilled workforce in the future is the top concern for manufacturers, and an alarming 82% of manufacturing executives believe the skills gap will adversely affect their ability to meet customer demand.¹ Nuts, Bolts & Thingamajigs® (NBT), the foundation of the Fabricators & Manufacturers Association, International® (FMA), is working to address the impending skilled labor shortage crisis by fulfilling its mission to engage, nurture, and excite individuals in the pursuit of manufacturing careers.

NBT awards scholarships to students enrolled in study programs that lead to manufacturing careers. The scholarship program has had an immediate impact on NBT's mission to fill the pipeline of skilled manufacturing workers. However, scholarships support a previously chosen career path, and it's simply not enough to solve the problem as the worker shortage is predicted to worsen in coming years.

NBT believes a better solution is to reach individuals at an earlier age in order to influence their career decisions. NBT summer manufacturing camps expose youth ages 12 to 16 to the world of manufacturing through hands-on, project-based learning that introduces them to a variety of career options. The camps use an entrepreneurship curriculum as well as local manufacturing plant tours and guest speakers to help ground camp participant learning in real-world experiences.

Key Findings

NBT embarked on an impact study of their manufacturing camps to ascertain the effects that attending an NBT manufacturing camp can have on participants' future decisions to pursue degrees and careers in manufacturing. This report highlights the first formal impact evaluation of NBT's manufacturing camps utilizing six years of evaluation data. A mixed-methods evaluation approach, using both quantitative and qualitative data, was taken to evaluate the impact of NBT's manufacturing camps on camp participants' knowledge, awareness, and acquisition of new skills. The findings presented in this report are comprised of survey data collected from camp participants and camp hosts, as well as interview data collected from manufacturers. Key findings from the report are highlighted below.

1. NBT camps expose middle and early high school youth to manufacturing careers and increase their awareness of educational pathways and manufacturing jobs in their community.

- 92% of camp participants reported that they were aware of career options in manufacturing by the end of the camp, a 20% increase from pre-camp to post-camp responses.
- 95% of camp participants reported that they increased their understanding of how STEM and CTE (Career and Technical Education) courses are used in careers in manufacturing by attending the camp.
- 68% of camp participants reported that they knew the types of manufacturing jobs available in their local community by the end of camp, an 82% increase from pre to post responses.
- 79% of camp participants reported that they understood the training needed for a future manufacturing career by the end of camp, a 43% increase from pre to post responses.



2. NBT camps provide a fun, engaging atmosphere for camp participants to learn new skills using manufacturing equipment and learn about courses and programs to continue building on those skills.

- 78% of camp participants reported that they understood how to construct a product from start to finish using manufacturing equipment and tools by the end of camp, a 53% increase from pre to post responses.
- 100% of camp hosts informed camp participants of STEM-related courses and CTE programs offered at local high schools and community/trade colleges.
- 62% of camp hosts reported stories of individuals who continued to pursue what they learned at the camp and/or were inspired to pursue a career in manufacturing.

3. NBT camps provide meaningful benefits to the schools and organizations that host camps and to the local manufacturers that sponsor and support the camps.

- 90% of camp hosts reported that they made new connections and/or strengthened relationships with local manufacturing companies.
- 100% of camp hosts reported that hosting a manufacturing camp helped their school or organization to increase their visibility and promote a positive image in the community.
- 70% of manufacturers saw their support of manufacturing camps as a means to collaborate with local middle and high schools and/or colleges, thereby reaching a younger population in the community.
- 100% of manufacturers reported that a major benefit of sponsoring camps was the opportunity to grow the future workforce for their company and in their communities.



Recommendations

Recommendations for future actions will ensure that program evaluation is embedded into the organization and is sustainable for years to come. They include:

- **Take steps to embed program evaluation into NBT's organizational culture.**
- **Use results from this impact study to refine existing evaluation measures and inform the development of new measures.**
- **Consider future studies to measure the impact of NBT manufacturing camps.**

NBT has demonstrated evidence that it is living up to its mission – to raise awareness of manufacturing careers. The recommended next steps will provide the data and further evidence that NBT's programs are effective in increasing the number of people pursuing educational and career pathways related to manufacturing and, ultimately, working in manufacturing environments.

¹ Deloitte LLP (2018) 2018 Skills Gap in Manufacturing Study.

Retrieved from: <https://www2.deloitte.com/us/en/pages/manufacturing/articles/future-of-manufacturing-skills-gap-study.html>

Identifying the Problem and NBT's Mission

According to industry studies, indications are that manufacturing will continue to grow over the next decade and nearly 3.5 million jobs will be needed in the US.² Yet due to thousands of workers reaching retirement age and insufficient numbers of qualified candidates getting trained, as many as two million positions will remain unfilled. Having a skilled workforce in the future is the top concern for manufacturers across the country, and an alarming 82% of manufacturing executives believe the skilled labor gap will adversely affect their ability to meet customer demand.³ In addition, the industry battles the myth that manufacturing is dark, dirty, and dangerous – an inaccurate perception which shapes opinions amongst a number of influencers in a very negative light. ■

Nuts, Bolts & Thingamajigs® (NBT), the foundation of the Fabricators & Manufacturers Association, International® (FMA), is working to address the impending labor shortage crisis. NBT's mission is to engage, nurture, and excite individuals of all ages in the pursuit of careers in manufacturing.

Overview of Nuts, Bolts & Thingamajigs (NBT) Programs

NBT awards scholarships twice each year to high school graduates enrolled in study, degree, or certificate programs that will lead to a manufacturing career. Students enrolled in technical and skilled training programs at trade or community colleges are given priority consideration, along with employees and their dependents of FMA member companies and schools.

The scholarship program has made a positive and immediate impact on fulfilling NBT's mission to fill the pipeline of skilled manufacturing workers. However, scholarships from NBT and other organizations merely support a previously-chosen career path, and it's simply not enough to solve the problem as the worker shortage is predicted to worsen in coming years.

NBT believes that by reaching students at a younger age, there is better opportunity to influence future career decisions. However, there is a lack of awareness about manufacturing and manufacturing careers, particularly among middle and high school students. NBT targets their summer manufacturing camps to youth ages 12 to 16 with the goal of exposing middle and high school students to manufacturing career options at an early age. The NBT camp experience provides hands-on, project-based learning that shows youth the world of manufacturing and introduces them to a variety of career options. The NBT camp format includes local manufacturing plant tours and guest speakers to help ground camp participant learning in real-world experiences. NBT's ultimate objective is to raise awareness of manufacturing careers in order to increase the number of people pursuing educational and career pathways related to manufacturing and working in manufacturing environments.



In 2005 NBT awarded its first grant to a community college willing to host a summer manufacturing camp for students in grades 6th through 8th and provided marketing support to help promote the camp. Today NBT provides grant funding on a three-year cycle to encourage camp hosts to seek additional sources of financial support. NBT also continues to offer marketing support throughout and beyond the three years as long as the host continues to offer the camp. Regardless of a camp's funding stage, NBT provides each camp participant with a 365-day license to the student edition of SolidWorks CAD design software and a customized T-shirt branded with each camp host's logo along with their sponsors' logos.

In addition to grant funding and material support, NBT provides manufacturing camp hosts with a five-section entrepreneurship curriculum. Developed in partnership with the National Association for Community College Entrepreneurship (NACCE), the NBT Camp curriculum is designed to lead a student through the manufacturing process by following a product from its original concept development through design (using CAD software), production (using machines and equipment), and introduction into the marketplace. The curriculum helps instructors apply the concepts to their camp's project, and along the way, students are exposed to an array of manufacturing career possibilities.

For over 15 years, NBT manufacturing camps have offered unique opportunities for younger students to explore the world of manufacturing through hands-on learning experiences. Most campers come with little to no prior exposure to manufacturing. From 2005 through 2019, NBT provided over \$1 million in grant funding and supported 468 camps, impacting more than 8,000 young people in 37 U.S. states. The NBT manufacturing camp program has grown tremendously over the last 15 years. In the summer of 2019 alone, NBT supported 125 camps in 28 states, impacting approximately 1,900 youth. The expansion of NBT camps across the country indicates how successful they are in introducing middle and high school students to manufacturing and the career choices available today in the industry. ■



² Deloitte LLP and The Manufacturing Institute (2015) The Skills Gap in U.S. Manufacturing, 2015 and Beyond.

³ Deloitte LLP (2018) 2018 Skills Gap in Manufacturing Study.

Retrieved from: <http://www2.deloitte.com/us/en/pages/manufacturing/articles/boiling-point-the-skills-gap-in-us-manufacturing.html>

Literature Review and Best Practices

Research and best practices literature have identified middle school as a time to foster career development and exploration of career pathways.^{4,5,6} The literature identified this time in students' lives as when they are most at-risk of disengaging in school, forming stereotypes about gender-appropriate occupations, and limiting career choices.⁷ Reports on best practices in student career development, in general, and developing student interest in manufacturing, specifically, share the same solutions to waning student engagement at this age: provide opportunities to develop abstract thinking and teamwork skills and deliver project-based learning that is tied to real-life scenarios.^{8,9}

Research and best practices in changing perceptions about manufacturing state that it is not enough to change the perceptions of parents, but also expose children to manufacturing early in life.¹⁰ A 2019 study, which supports this claim, polled 1,000 Minnesotans about their perceptions of manufacturing.¹¹ While almost all respondents (97%) believe that manufacturing is important, only 56% said they would consider working in the manufacturing industry. The answer changed depending on the amount of exposure to manufacturing careers a respondent had as 67% of those respondents that grew up learning about manufacturing said they would consider working in the manufacturing industry. In other words, **early education and awareness of manufacturing careers drives interest.**

Two aspects that further drive career interest in manufacturing are manufacturing tours and guest speakers. One study of 2,369 students in Florida found that exposure to real STEM-focused workplaces and manufacturing field trips raised the students' awareness of manufacturing careers, furthermore increasing their consideration of a career in manufacturing and strengthening their commitment to apply themselves to STEM studies at school.¹² By the end of the tour, 60% of students in this study strongly agreed the tour gave them important information on manufacturing careers and 60% strongly agreed or agreed to commit to applying themselves to STEM studies in school.



At a manufacturing camp, as in other educational settings, guest speakers tend to have a lasting impact. From a theoretical standpoint, guest speakers can provide social capital, albeit temporarily, by giving students access to someone with a career background that is different from their family-based social networks.¹³ Perhaps due to the fact that the speaker is outside of their normal social networks, one study found that students perceived their interactions with guest speakers to be of more value when thinking about their career choices than information from family, friends, or social media.¹⁴

Given NBT's growth and success in their manufacturing camps, it was necessary to conduct an external evaluation to determine the extent to which the camps have had an impact in raising camp participants' awareness of careers in manufacturing. ■



⁴ Association for Career and Technical Education (ACTE) (2017) Career Exploration in Middle School: Setting Students on the Path to Success. Virginia. Retrieved from: <https://files.eric.ed.gov/fulltext/ED596321.pdf>

⁵ Kerka, S. (2000). Middle School Career Education and Development. Practice Application Brief No. 9. Washington, DC: ERIC Clearinghouse on Adult, Career and Vocational Education. Retrieved from: <https://files.eric.ed.gov/fulltext/ED442992.pdf>

⁶ Achieving the Dream (2018) Career Pathways in Advanced Manufacturing. Retrieved from: <http://www.tri-c.edu:443/workforce/advanced-manufacturing-and-engineering/employer-convening-forum/documents/ami-career-pathways-2018-b.pdf>

⁷ Kerka, S. (2000). Middle School Career Education and Development. Practice Application Brief No. 9. Washington, DC: ERIC Clearinghouse on Adult, Career and Vocational Education. Retrieved from: <https://files.eric.ed.gov/fulltext/ED442992.pdf>

⁸ Strom, S. (2019) "What does 'career readiness' look like in middle school?" The Hechinger Report. Retrieved from: <https://hechingerreport.org/what-does-career-readiness-look-like-in-middle-school/>

⁹ Portz, Stephen M. (2014) Project-Based Learning + Real-World Manufacturing + Industrial Partnerships = Powerful STEM Education. Tech Directions: Vol. 73(7) p. 11-14.

¹⁰ Griffi, Craig, Michelle Drew Rodriguez, and Sandeepan Mondal. (2017) How modern manufacturers can create positive perceptions with the US public. Deloitte Development LLC. Retrieved from: http://www.themanufacturinginstitute.org/~media/9607397D3AFC423AB68133505EE2C348/2017_US_Public_Perception_Manufacturing_Study.pdf

¹¹ West Monroe Partners (2019) How do young people in Minnesota perceive manufacturing careers. White Paper. Retrieved from: <https://www.westmonroepartners.com/Insights/White-Papers/Minnesota-perceive-manufacturing-careers>

¹² Barger, M., Gilbert, R., & Boyette, M. (2013) Impact of Student Tours of Manufacturing Facilities. Paper submitted to 120th ASEE Annual Conference. Retrieved from: <https://pdfs.semanticscholar.org/9bc2/b8c4ba1c85f7368d492193c5818a99c5e68f.pdf>

¹³ Raffo, C. & Reeves, M. (2000) Youth transitions and social exclusion: Developments in social capital theory. Journal of Youth Studies, 3(2), 147-166.

¹⁴ Mann, J. Stanley & L. Archer (Eds.), (2014) Understanding employer engagement in education: Theories and research (pp. 163-175). London: Routledge.




Evaluation Design and Methodology

NBT's Evaluation History, Theory of Change, and Impact Study Measures

NBT has collected evaluation data on camp participants and camp hosts consistently since 2015. However, without a formal evaluation system in place, NBT has only been able to provide the results of camp participant and camp host surveys. NBT has never analyzed the survey data or developed program outcomes.

Accordingly, NBT embarked on a formal impact study of their manufacturing camps in order to ascertain the effects that attending an NBT manufacturing camp can have on camp participants' decisions to pursue degrees and careers in manufacturing. As an initial step in the impact study process, NBT developed a theory of change and articulated short-, mid-, and long-term outcomes.

Theory of Change

What is the problem you are trying to solve? 	What steps are needed to bring about change? 	
<p>According to industry studies, indications are that manufacturing will continue to grow over the next decade and nearly 3.5 million jobs will be needed in the US.¹⁵</p> <p>There is a lack of exposure to manufacturing and manufacturing careers for middle, high school, and returning students.</p>  <p>Who is your key audience and entry point to reaching them?</p> <p>The target audience is middle-, high-school, and returning students.</p> <p>Reach them through:</p> <ul style="list-style-type: none"> • Middle schools • High schools • Parents and families • Teachers • Camp directors • Community college/tech schools & universities • Member companies • Employers • Scholarship website listings 	<p>Develop a sustainable financial structure with diversified funding sources</p> <p>Deepen relationships with educational institutions that have a manufacturing focus</p> <p>Develop partnerships with educational institutions to deliver NBT summer camp curriculum and promote manufacturing scholarships</p> <p>Create high quality program infrastructure and ensure that our educational partners provide developmentally appropriate teaching strategies, appropriate manufacturing resources and equipment, and pedagogical tools to best serve students</p> <p>Expose students to manufacturing career paths that may include CTE programs at camp hosts' schools</p>	<p>1. Summer Camps Programs contain:</p> <ul style="list-style-type: none"> • Hands-on learning • Visits to manufacturing facilities • Meet with manufacturing professionals • Skill development, for example basic machining, fabrication, welding, 3D printing, or additive manufacturing <p>2. Scholarships to students pursuing degrees in majors directly leading to manufacturing careers</p>

¹⁵ Deloitte LLP and The Manufacturing Institute (2015) The Skills Gap in U.S. Manufacturing, 2015 and Beyond.

SUMMER MANUFACTURING CAMP[®]

What is the measurable effect of your work to increase the number of students pursuing education and careers in manufacturing? (Short-term Outcomes)

By the end of the NBT camp:

- Camp participants increase their awareness of careers in manufacturing.
- Camp participants build skills in developing a product from start to finish using manufacturing tools and equipment.
- Camp participants increase their awareness of manufacturing jobs in their community.
- Camp participants increase their awareness of training needed for future manufacturing careers.
- Camp hosts build or strengthen their relationships with local manufacturers.
- Manufacturer sponsors build and strengthen relationships in the community and with the local high schools and community/vocational colleges.

After receiving a scholarship:

- Scholarship recipients are enrolled in a program that directly leads to manufacturing careers.
- Scholarship recipients refine skills in technologies related to manufacturing.
- Scholarship recipients increase their awareness of manufacturing positions/job opportunities.
- Scholarship recipients are better prepared to enter work force.

What are the wider benefits of your work for this population? (Mid-term Outcomes)

After attending an NBT camp:

- Camp participants select STEM & CTE courses in middle or high school.
- Camp participants take electives or dual-credit courses in high school that further their hands-on skill building (e.g. welding, 3D printing, etc.).
- Camp participants enroll in colleges, technical colleges, trade schools, or universities and major in a field of study that is related to manufacturing.
- Camp participants graduate from colleges, technical colleges, trade schools, or universities and major in a field of study that is related to manufacturing.

At graduation:

- Scholarship recipients are placed in internships and/or job related to manufacturing.
- Scholarship recipients graduate with a degree in field of study related to manufacturing.
- Scholarship recipients promote NBT scholarships and serve as mentors to other NBT scholarship recipients.

What is the long-term change you see as your goal?

The ultimate goal of NBT is to raise awareness of manufacturing careers in order to increase the number of people who pursue educational and career pathways related to manufacturing and work in manufacturing environments.

Outcomes were developed using existing evaluation tools as well as new measurements. Table 1 describes the measurements used in the impact study.

Table 1: NBT Impact Study Measurements

Evaluation Tool Name	Respondent Type	Number of Respondents	Data Collection Timeframe
Pre- and Post-Camp Participant Survey	Camp Participants	4803 (pre)/ 4089 (post)	2015-2020
Camp Host Final Evaluation Report	Camp Hosts	355	Summer 2015-2020
Manufacturer Interviews	Manufacturers	10	July-August 2020

The impact study focused on NBT evaluation data collected from 2015-2020. Some of the evaluation data has been collected continuously from 2015-2020. This data focuses on short-term outcomes such as raising awareness of manufacturing careers in camp participants and helping camp hosts build or strengthen relationships with local manufacturers. New information that was collected in 2020 examined camp participant mid- and long-term outcomes such as determining the extent to which camp participants are taking courses and pursuing degrees in manufacturing-related programs and/or are working in manufacturing jobs. Other new information collected in 2020 further examined the added value and benefits of NBT manufacturing camps for camp hosts and for the manufacturers that sponsor them. Table 2 below outlines the new and existing evaluation measurements, corresponding indicators, and methods of analyses used for the impact study.

Table 2: NBT Impact Study Measurements, Corresponding Indicators, and Methods of Analysis

Evaluation Tool	Indicators	Method of Analysis
Pre/Post-Camp Participant Surveys	<ul style="list-style-type: none"> - % of participants that raised their awareness of and interest in manufacturing careers - % of participants that developed new skills related to manufacturing - % of participants that raised their awareness of the types of manufacturing jobs in their community. - % of participants that raised their awareness of the training needed for a future manufacturing career 	Quantitative analysis
Camp Host Final Evaluation Reports	<ul style="list-style-type: none"> - % of camp hosts affirming new or strengthened relationships with local manufacturers - % of camp hosts promoting manufacturing careers - % of camp participants that enroll in STEM or CTE programs in middle/high school or college - % of participants that enroll in camp hosts' manufacturing-related programs - % of former camp participants to graduate with manufacturing-related degree or certification - student outcomes (success stories) 	Quantitative analysis
Manufacturer Interviews	<ul style="list-style-type: none"> - positive impact of camps on manufacturing industry in surrounding community - student benefits from attending camps - manufacturer benefits from sponsoring camps 	Qualitative analysis

A mixed-methods approach, utilizing both quantitative and qualitative data, was taken to evaluate NBT's manufacturing camps on camp participants' knowledge, awareness, and acquisition of new skills. The evaluation presented here is based on survey data collected from camp participants and camp hosts, as well as interview data collected from manufacturers. In order to explore areas of program impact and individual outcomes that the closed-question surveys did not cover, open-ended survey questions or interviews were utilized, and a qualitative study was conducted. The mixed-method study aimed to answer the following evaluation questions:

1. To what extent do NBT manufacturing camps raise camp participants' awareness of careers in manufacturing?
2. To what extent do NBT camp participants continue to pursue a skill or interest that they learned in camp by taking a CTE or dual-credit course in high school?
3. To what extent do NBT camp participants apply to, are accepted in, and graduate from the camp hosts' manufacturing programs?
4. How valuable are the manufacturing camps for the participating camp hosts and manufacturers? What works best for whom, under what conditions, and why/how?

Data Analyses

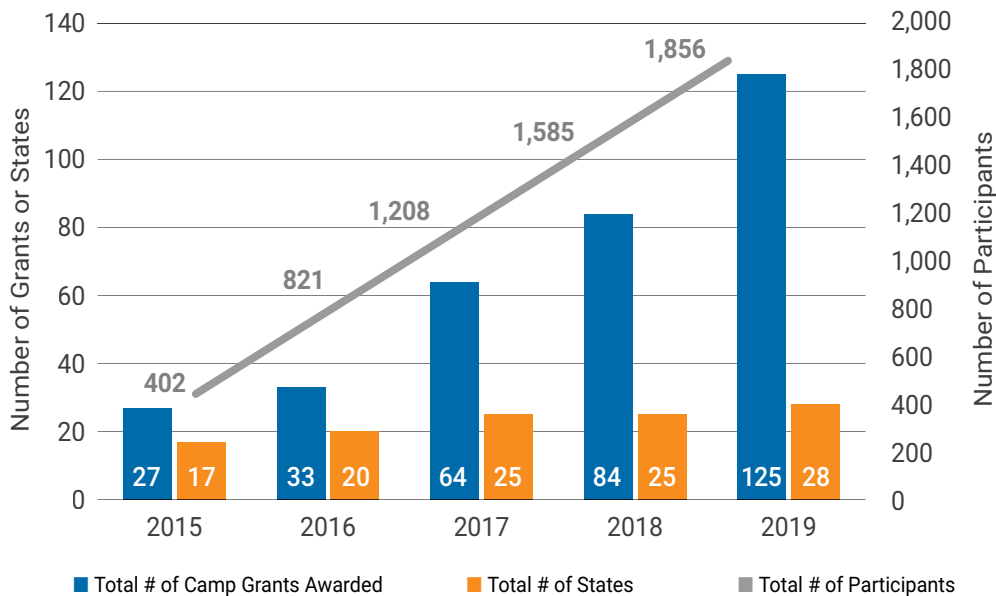
As mentioned above, a mixed-methods approach was employed for this evaluation. Camp participants and camp hosts completed surveys with both quantitative and qualitative questions via Qualtrics, an online survey management system. NBT staff downloaded and cleaned each dataset (i.e. checked for and removed any errors in data entry, such as duplicate responses) and both staff and the Evaluation Consultant conducted descriptive analyses (e.g. frequencies and percentages) of individual survey items pertinent to the evaluation questions.

Manufacturers completed short open-ended interviews about their experience providing financial and/or in-kind support to NBT manufacturing camps. The Evaluation Consultant uploaded interview transcripts to Excel and developed an iterative process for coding open-ended survey questions from camp participants, camp hosts, and manufacturer interviews, which resulted in two cycles of analyses: (1) pattern, and (2) conceptual model building. A categorized inventory of the open-ended survey questions' content was conducted and set the groundwork for thematic analysis. Pattern coding was used to organize thematic patterns that describe phenomena in the qualitative data that relate to specific evaluation questions. Following pattern coding, the evaluation consultant developed conceptual models by linking themes and emergent codes generated from the first cycle of analysis to create a higher-level understanding about the impact of NBT's manufacturing camps on camp participants, camp hosts, and manufacturers. ■



NBT's Manufacturing Camp Growth

Figure 1: NBT Manufacturing Camp Growth 2015-2019

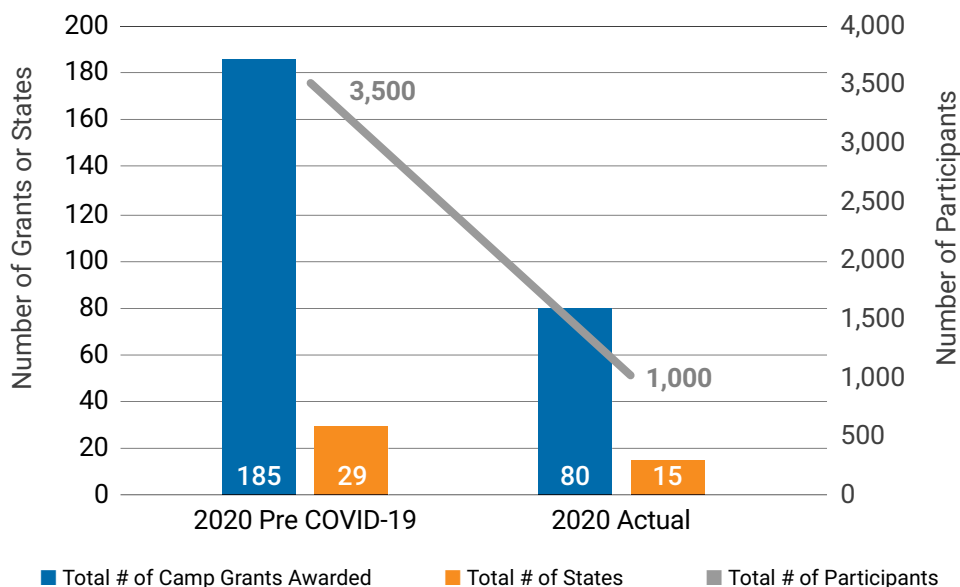


From 2015 to 2019, NBT experienced unprecedented growth in their manufacturing camp program. This growth came about from a concerted effort made by NBT board members to raise funds for the program and recruit schools to apply for grant funding. NBT expanded their reach to prospective host schools across 28 states and raised more money for the camps between 2017-2019 than in previous years. With more funds allocated to the program, NBT increased their marketing efforts to recruit more camp hosts during that time as well.

The accelerated growth experienced over the last three

years extended into 2020 as well. In February 2020, 185 camps received NBT grant awards, and approximately 3,500 youth were projected to attend the camps. Due to the COVID-19 pandemic, however, many 2020 camps were forced to cancel, postpone to the fall, or transition to a virtual format. All canceled camps were offered priority status for 2021 camp grant awards. NBT relaxed its camp requirements to accommodate exceptions for changes to camp formats, schedules, and age ranges. In addition, NBT presented a webinar for camp hosts on how to run a virtual camp. Of the 80 camps scheduled to be held in 2020, 55 transitioned to an online format. The 25 in-person camps limited attendance and/or adapted their camp activities to adhere to safe social distancing protocols.

Figure 2: NBT Manufacturing Camps (2020)
Pre-COVID-19 and Current Numbers



Evaluation findings from 2020 camps are reported separately from the 2015 to 2019 cumulative data due to this unforeseen change in programming and drop in total number of camps and estimated number of camp participants. ■

Impact Study Findings

Findings Related to Short-Term Outcomes

At every NBT manufacturing camp, participants were asked to complete a survey at the beginning and end of camp to capture changes in their awareness (e.g. of manufacturing career options and how STEM & CTE courses are used in manufacturing careers), skill development (e.g. in designing and constructing a product using manufacturing software and equipment/tools), and perceptions about manufacturing (e.g. knowing what jobs are available in the community and that the jobs are high paying, in demand, provide a stable lifestyle, etc.). The response rate for camp participant post surveys averaged 62% with a range of 50-76% between the years 2015-2019. Overall, the response rates are considered high and are well above the 30% threshold. Therefore, the data should be considered a representative sample of the overall number of camp participants.

Camp participant findings are organized by short term outcomes identified in the Theory of Change and show cumulative (2015-2019), as well as 2020 data. One caveat to the 2020 Camp Participant Survey Data should be considered when reviewing the findings presented below. When looking at the camp hosts that were able to hold their camp in 2020, almost fifty percent (48%) of camps were hosted by the same organization. Therefore, the 2020 data are presented with caution.



Camp participants' awareness of and interest in careers in manufacturing

Beginning in 2018, camp participants were asked questions on both the pre-camp and the post-camp surveys to gauge the extent to which participating in NBT manufacturing camps increased their awareness of careers in manufacturing and their interest in pursuing a manufacturing career. When looking at the survey data for 2018 and 2019 combined, 92% of participants reported that they were aware of career options in manufacturing by the end of camp. Additionally, 62% of camp participants reported that they were interested in a career in advanced manufacturing by the end of camp. When comparing the cumulative pre/post data, camp participants increased their awareness of career options in manufacturing by 20%, and camp participants increased their interest in a career in advanced manufacturing by 16% as shown in figures 3 and 5. The 2020 camp participant survey data shows a similar trend of an increase in awareness and interest as shown in figures 4 and 6.

Figure 3: Camp Participant Data (2018-2019)

Camp participants increase their awareness of manufacturing by the end of camp (2018-2019)

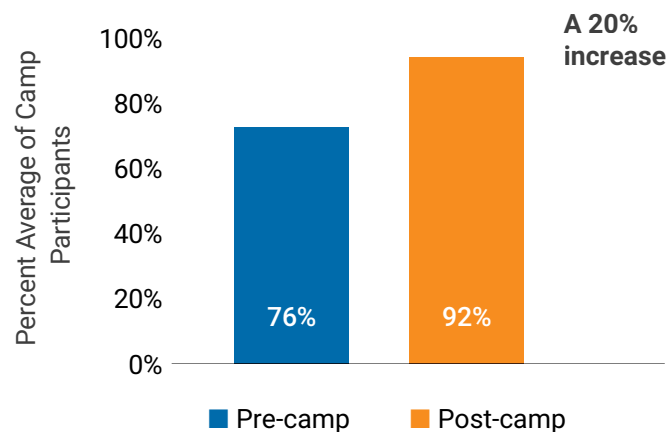


Figure 4: Camp Participant Data (2020)

Camp participants increase their awareness of manufacturing by the end of camp (2020)

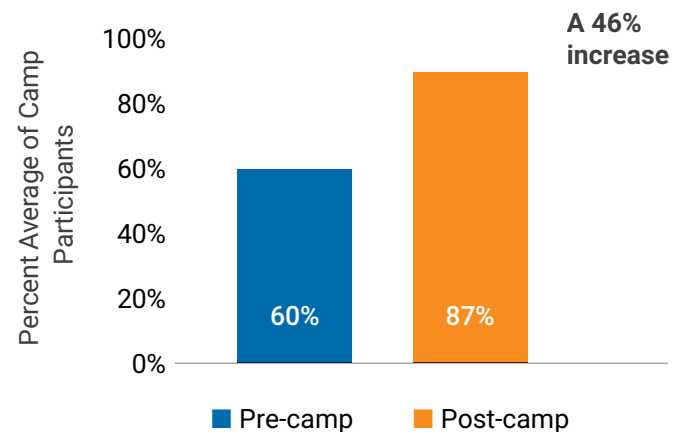


Figure 5: Camp Participant Data (2018-2019)

Camp participants increase their interest in careers in manufacturing (2018-2019)

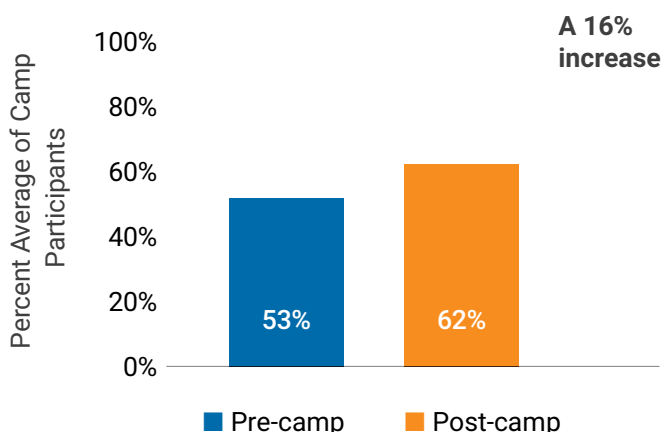
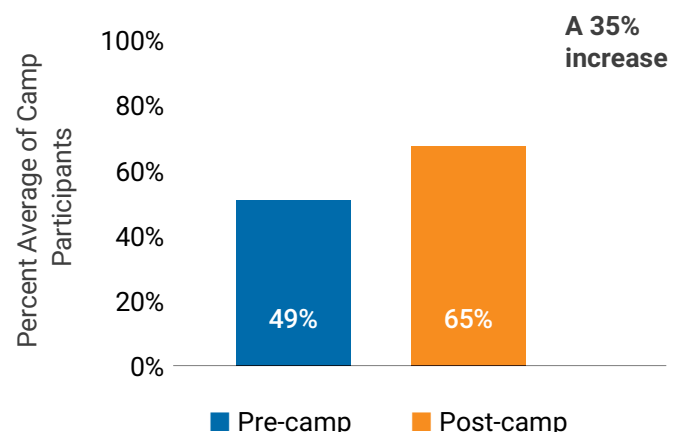


Figure 6: Camp Participant Data (2020)

Camp participants increase their interest in careers in manufacturing (2020)



Camp participants' awareness of local manufacturing jobs and the training needed

Camp participants were asked questions about their awareness in local manufacturing jobs and the training needed for a career in manufacturing on surveys from 2015-2019. Cumulative participant survey data shows that 68% of participants reported that they knew the types of manufacturing jobs available in their local community by the end of camp. Also, almost 80% of participants from 2015-2019 reported that they understood the training needed for a future manufacturing career by the end of camp. When comparing pre/post survey data, participants experienced an 82% increase in knowledge of local manufacturing jobs and a 43% increase in understanding the training needed for a manufacturing career as shown in figures 7 and 9. A similar trend is seen in 2020 camp participant data. Camp participants reported more awareness of local jobs and training needed for manufacturing careers as shown in figures 8 and 10.

Figure 7: Camp Participant Data (2015-2019)

Camp participants increase their awareness of local manufacturing jobs (2015-2019)

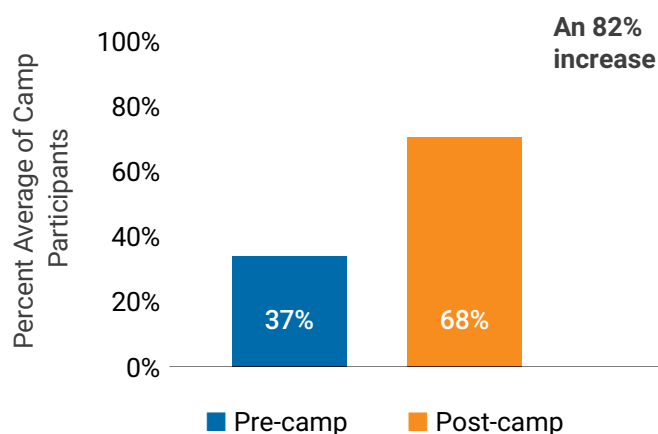


Figure 8: Camp Participant Data (2020)

Camp participants increase their awareness of local manufacturing jobs by the end of camp (2020)

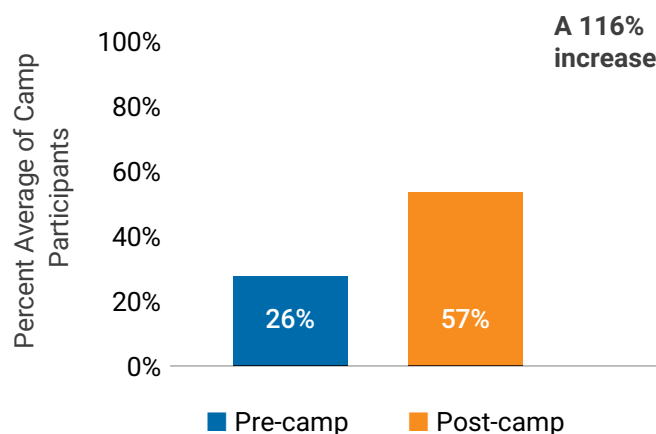


Figure 9: Camp Participant Data (2015-2019)

Camp participants increase their awareness of training needed for a manufacturing career (2015-2019)

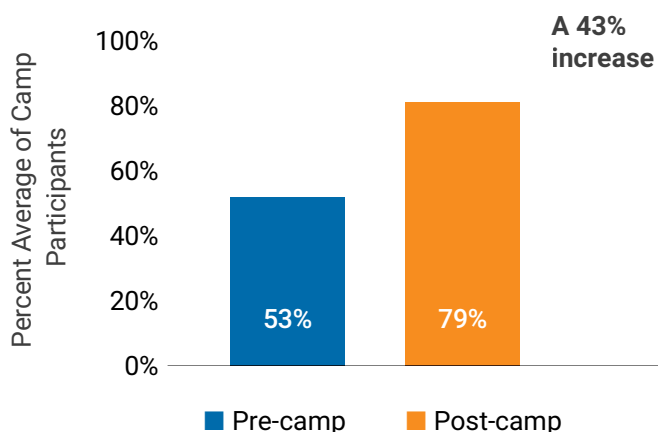
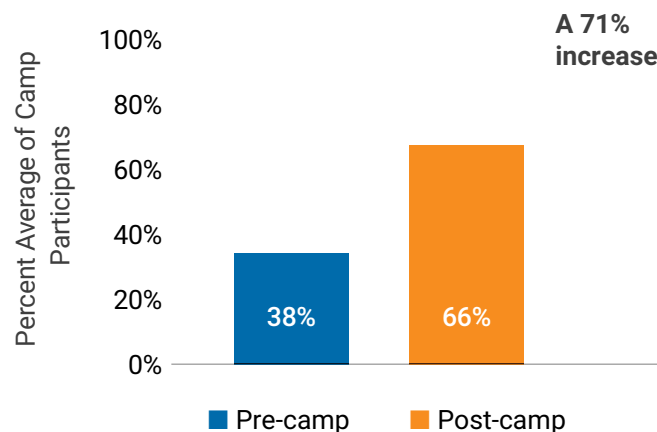


Figure 10: Camp Participant Data (2020)

Camp participants increase their awareness of training needed for a manufacturing career (2020)



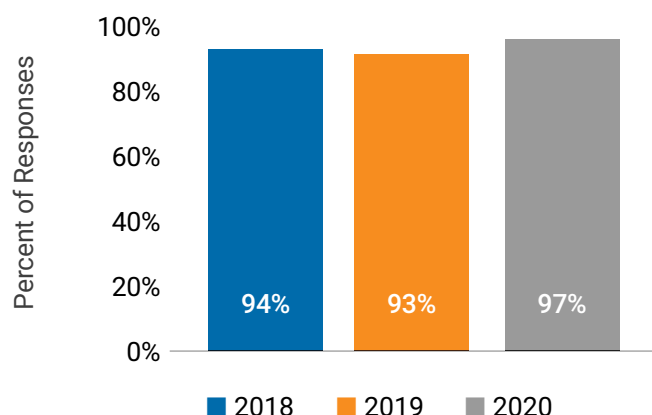
Camp participants' understanding of how STEM is used in manufacturing

Camp participants reported further awareness concerning how science, technology, engineering, and math (STEM) are used in manufacturing. A question to the post-camp participant survey was added in 2018: "This camp helped me better understand how science, technology, engineering, and math (STEM) are used in industry." For the three years this question's data was collected, almost all students reported increasing their understanding of how STEM is used in the industry as figure 11 shows.



Figure 11: Camp Participant Data (2018-2020)

Camp participants reported a better understanding of how STEM is used in the industry as a result of attending the camp





Camp participants' skills acquisition

On the pre-camp and post-camp surveys, camp participants were asked to what extent they agree with the statement: "I understand how to construct a product start to finish using manufacturing equipment and tools." Cumulative data from 2015-2019 shows that nearly eighty percent (78%) of camp participants reported that they understood how to construct a product using manufacturing equipment by the end of camps. Camp participants experienced a 53% increase in skill development as shown in figure 12.

Although 63% of the 2020 camps were held online, camp participants reported a similar trend in an increase in skill development as figure 13 shows.

Figure 12: Camp Participant Data (2015-2019)

Camp participants increase their skills in developing a product using manufacturing equipment (2015-2019)

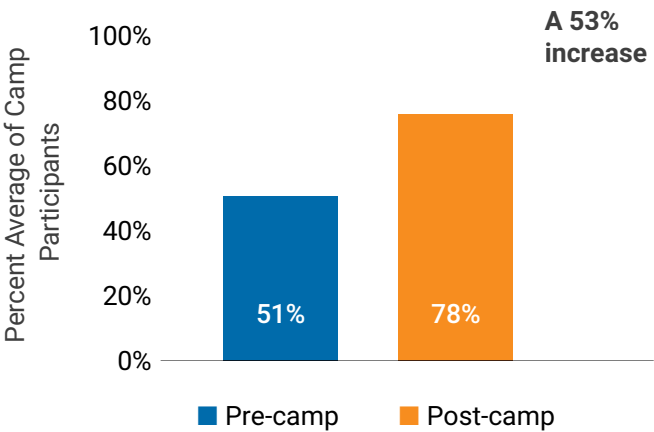
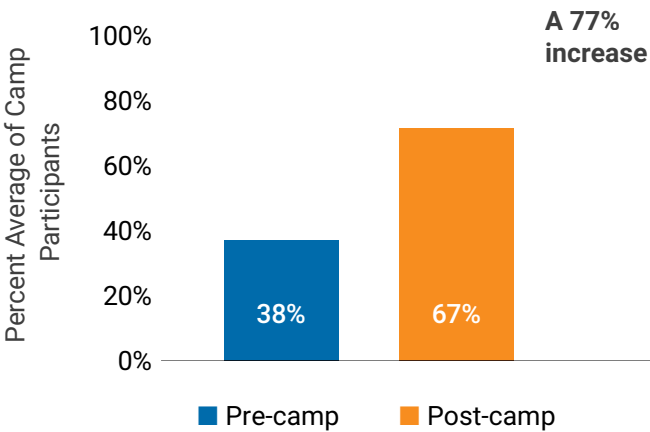


Figure 13: Camp Participant Data (2020)

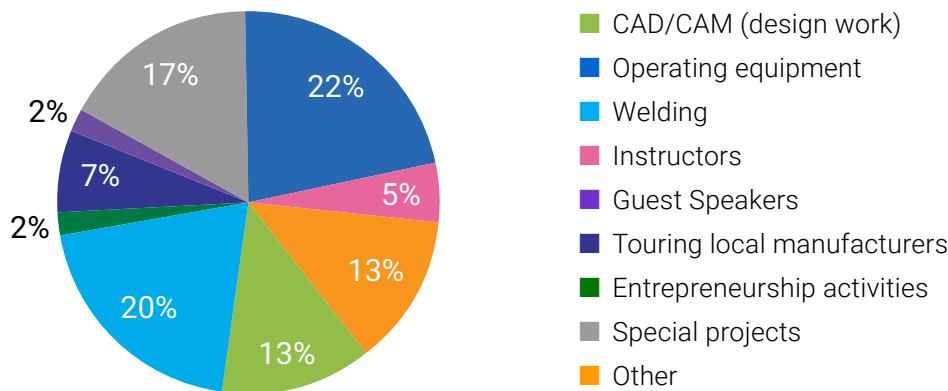
Camp participants increase their skills in developing a product using manufacturing equipment (2020)



Camp participants' favorite part of the camp experience

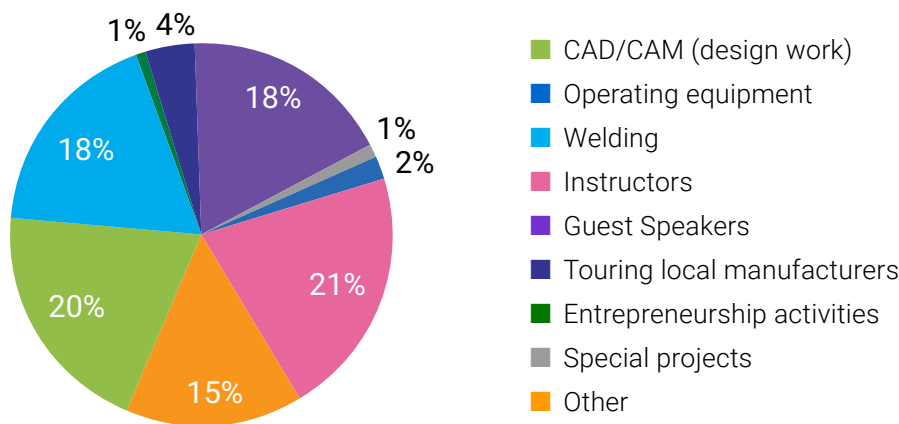
Camp participants were also asked to share their favorite part of camp. An overwhelming majority (72%) of camp participants from 2015-2019 shared that their favorite part of camp was some form of hands-on experience, i.e. operating equipment, welding, CAD design, or special projects. (figure 14).

Figure 14: Camp Participant Data (2015-2019)
Camp participant's favorite part of camp (2015-2019)



In 2020, that trend continued with 63% of camp participants reporting some form of hands-on experience being their favorite part of camp (figure 15).

Figure 15: Camp Participant Data (2020)
Camp participant's favorite part of camp (2020)



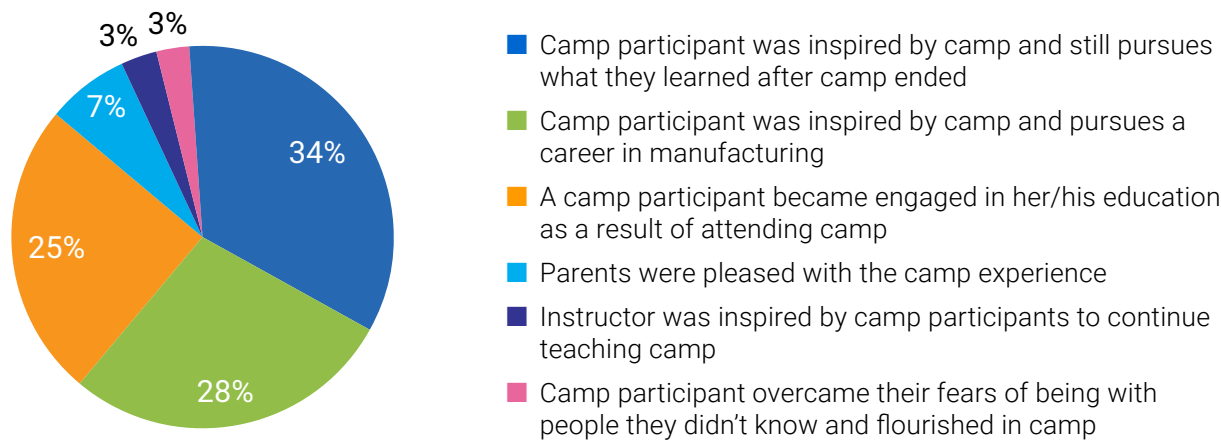
Indeed, many camp participants were inspired to continue their skill development and/or pursue a career in manufacturing due to the hands-on experience provided by camp. This point is emphasized in the camp hosts' stories of individual impact in the section that follows. Other findings included in the next section are ways in which camp hosts promote manufacturing careers to participants and the benefits to host schools from hosting an NBT camp.



Camp hosts’ stories of individual impact

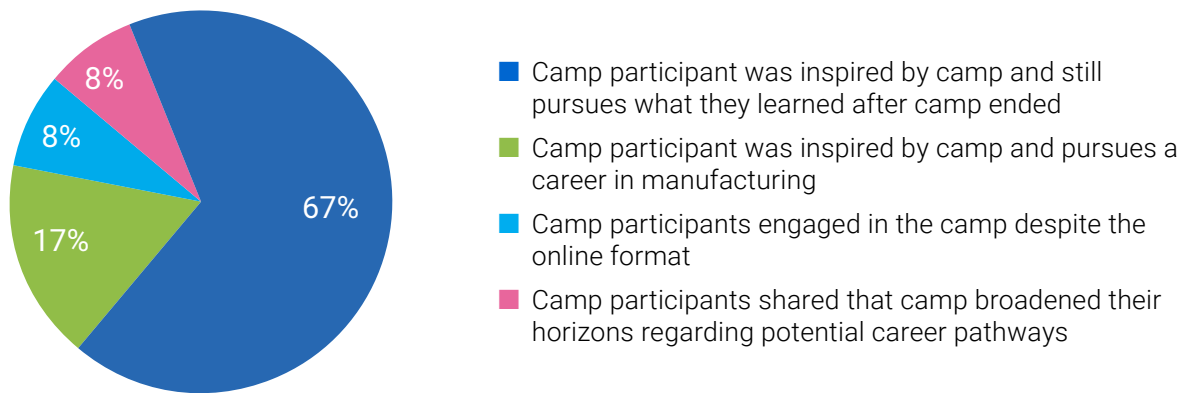
Camp hosts were asked to share at least one story of an individual who was directly impacted by the camp and how the camp experience made a difference in the individual's life. These stories were qualitatively analyzed for themes, and the percentage of responses per theme group are reported in the graphs below. While camp hosts could share a story of any individual that was impacted by the camp, 89% of camp hosts shared a story about a camp participant. Most camp host stories described an individual that was inspired to return to camp for a 2nd or 3rd year, join a STEM or robotics club at school, become a mentor for the camp (34%), or pursue a manufacturing career (28%). In addition, a large percentage (25%) of the success stories focused on a camp participant’s renewed or strengthened engagement in their overall education (figure 16).

Figure 16: Camp Host Data (2015-2019)
Camp hosts’ stories of individual impact (2015-2019)



In 2020, similar trends were noted such as 67% of camp hosts reported that camp participants were inspired to continue their learning after camp and 17% of the individual stories described camp participants being inspired to pursue careers in manufacturing as shown in figure 17.

Figure 17: Camp Host Data (2020)
Camp hosts’ stories of individual impact (2020)



Camp Hosts' promotion of manufacturing careers

In order to fully understand to what extent NBT camps raise awareness in camp participants regarding manufacturing careers, it was important to ask camp hosts how they promoted manufacturing careers in their camps. In 2020, a question was added to the Final Evaluation Report to capture this information. The graph in figure 18 shows that camp hosts use a variety of ways to promote manufacturing careers to camp participants. All camp participants learn what CTE courses are offered at the local high school and nearly all camp participants (96%) are informed about the programs and certifications that lead to manufacturing careers.



Figure 18: Camp Host Data

Camp Hosts promote manufacturing careers in a variety of ways to camp participants

Inform camp participants of CTE (Career and Technology Education) courses offered at local high schools.



Inform camp participants what programs/certifications lead to manufacturing careers.



Inform camp participants about NBT scholarships and promote scholarship opportunities to manufacturing program students.



Recruit camp participants to your educational institution.



Provide camp participants with opportunity to meet employers and tour manufacturing plants.



Involve camp participants' parents in camp by providing daily updates to parents and inviting them to team presentations, competitions, or last day celebrations.



Offer advanced camps and/or mentorships for returning camp participants.



Partner with local high school/community colleges to offer dual-credit courses.



Inform participants about apprenticeships/internships at local manufacturers.



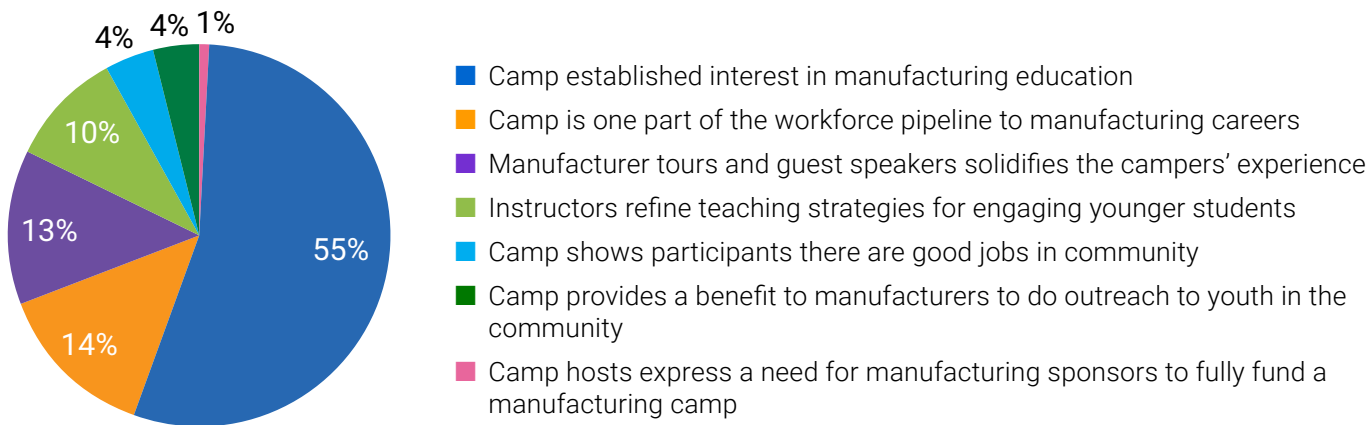
0% 20% 40% 60% 80% 100%
% of respondents



Benefits of hosting a manufacturing camp to Camp Hosts

Camp hosts were asked to share what they learned from hosting a camp. Camp hosts’ answers were qualitatively analyzed and grouped into themes. The percent of camp hosts whose answers fell within a given theme are depicted in figure 19. Cumulative data show that a majority of camp hosts (55%) reported that the success of the manufacturing camp established that there was indeed an interest in manufacturing education in their community. Another 14% of camp hosts shared that they felt manufacturing camps were an integral part of filling the workforce pipeline by creating pathways to manufacturing careers.

Figure 19: Camp Host Data (2015-2019)
Camp Hosts reported on benefits of hosting camps (2015-2019)



Camp hosts were also asked “Did the camp program help your organization to build or strengthen relationships in the local manufacturing community?” Cumulative data from all years through 2020 show 90% of camp hosts reported that they made new connections and strengthened relationships with local manufacturers because of the NBT manufacturing camp.

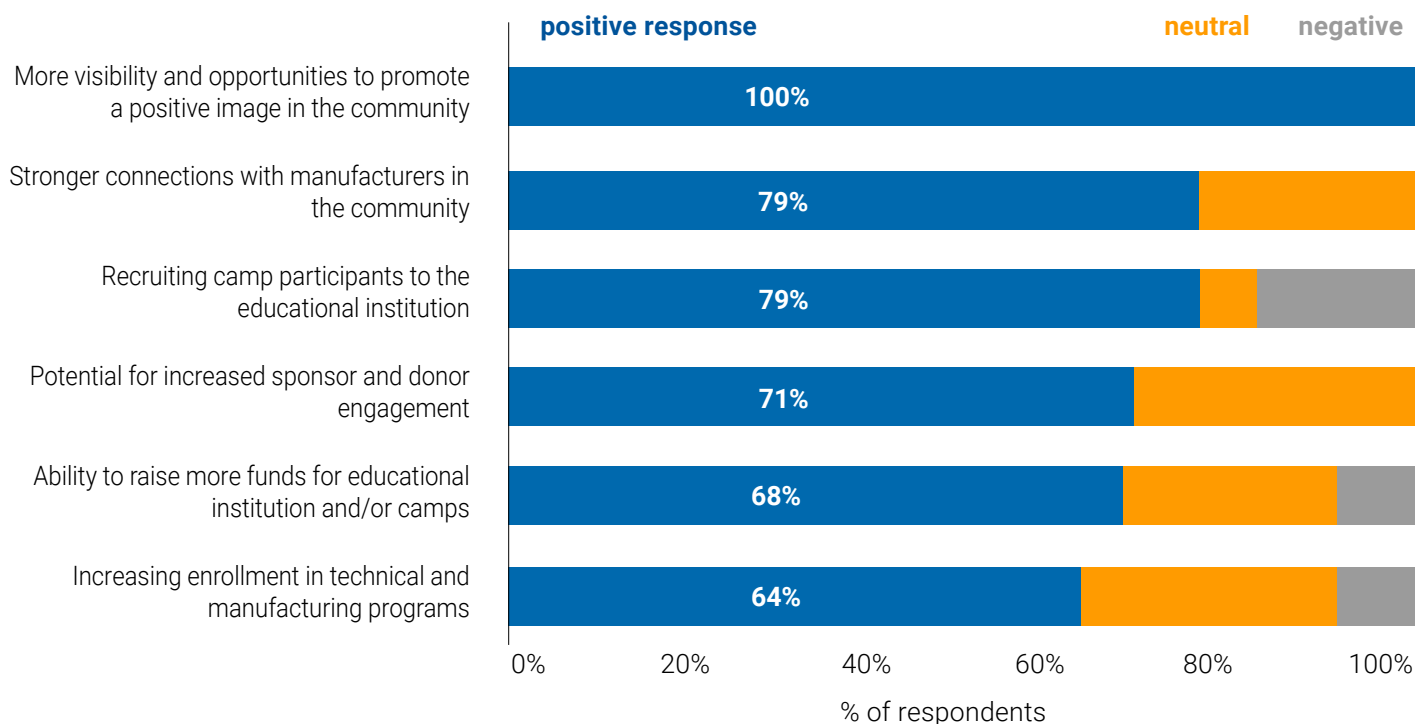
In 2020, a question was added to the Camp Host Final Evaluation Report to explore what benefits camp hosts experience as a result of hosting an NBT camp. As shown in figure 20, almost 80% of camp hosts reported that they had a stronger connection with manufacturers in the community. All camp hosts reported that their educational institution experienced more visibility and opportunities to promote a positive image in the community. Furthermore, almost 80% of camp hosts reported that they used the camp to recruit camp participants to their educational institution.



90% of camp hosts reported that they made new connections and strengthened relationships with local manufacturers because of the NBT manufacturing camp.

Figure 20: Camp Host Data (2020)

Camp hosts reported that hosting an NBT camp was **overwhelmingly beneficial** to their educational institutions



Manufacturer benefits from sponsoring a manufacturing camp

While the benefits of NBT manufacturing camps to participants and host schools are described above, this section explores the positive results that manufacturers experience from their involvement with NBT camps. A sample group (10) of manufacturing companies that support camps in their area by providing sponsorships, plant tours, guest speakers, and/or material donations were interviewed by phone. Manufacturers were asked to reflect on any benefits they have experienced as a result of sponsoring an NBT camp. All 10 manufacturers interviewed described that a major benefit of sponsoring camps was the opportunity to grow the workforce in their communities. Seventy percent (70%) of manufacturers saw the manufacturing camps as a means to build relationships with local schools and/or colleges and a way to reach a younger population in the community to inform them about jobs in the industry. A small number of manufacturers, mostly large corporations, have staff devoted to education/outreach and workforce development, and already had relationships with local schools and colleges. However, they saw the manufacturing camps as yet another way to raise awareness of manufacturing careers to local youth. One manufacturer interviewed summed up the benefit of sponsoring a manufacturing camp as such: ***"How cool is that to grow your workforce in your own backyard!"***

Fifty percent (50%) of manufacturers remarked that there was a lack of a coordinated effort to grow the workforce in their community and saw the manufacturing camps as a way to network with local colleges to recruit students for open positions. Indeed, for some, the manufacturing camp was the manufacturers' best way to get their foot in the door at the local college. Building a relationship with local community or technical colleges takes time and effort. Some manufacturers commented that having a contact within the community or local college whose job was focused on coordinating workforce development efforts throughout the region took some of the pressure off of them to develop workforce growth plans. Several manufacturers that had long-standing relationships with local colleges spoke about the benefits of that relationship that extended beyond the NBT camps. These manufacturers described partnering with local colleges and high schools to develop dual-course credits, certification programs, and apprenticeship programs that are specific to their company's needs.



All manufacturers interviewed recognized that most youth in their community are unaware of careers in the industry and there is a lack of publicity to parents and K-12 schools to raise awareness of manufacturing careers. Half of the manufacturers remarked that NBT's focus on reaching middle school aged youth was what first attracted them to support the camp. These manufacturers valued the opportunity to introduce a younger population of community members to their companies and the work that they do. One manufacturer shared why they thought targeting middle school youth was so important by saying: *"By the time they get to high school it is almost too late. They want students to choose their classes when they are freshman. If you can identify their interests before then, you can guide them in the right direction. They start forming ideas in their head while they are in middle school, and it's our job to help them figure out what career path they are interested in."*

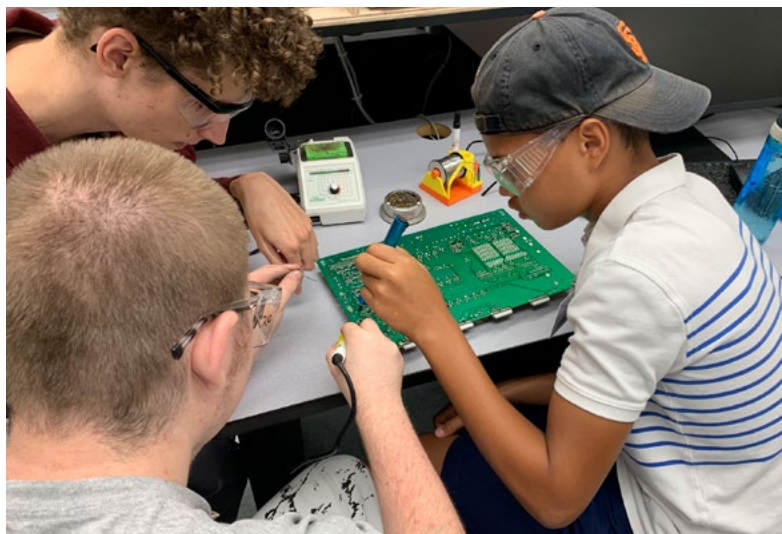
Manufacturers interviewed saw that it was their responsibility to show youth what it was like to work in their company by providing tours, hands-on activities on-site, and a chance to talk with workers about what they do. Several manufacturers also mentioned that it was important to have employees from underrepresented groups (e.g. women and minorities) talk with youth about their experiences pursuing careers in manufacturing in order to help diversify the workforce. Because of the camps' efforts to bring in women and minority speakers, manufacturers remarked that they have seen more interest from girls and minority students in the camps. The most rewarding benefit of being an NBT camp sponsor that 70% of manufacturers shared was the ability to inspire youth to get excited about a manufacturing career and see youth from the camp go on to pursue their interests. ■

"By the time [students] get to high school it is almost too late. [High schools] want students to choose their classes when they are freshman. If you can identify their interests before then, you can guide them in the right direction. They start forming ideas in their head while they are in middle school, and it's our job to help them figure out what career path they are interested in."



Findings Related to Mid-term Outcomes

In 2020, NBT explored mid-term outcomes by surveying camp hosts and camp alumni or their parents to report on the extent to which former campers continued to pursue what they learned in camp after the camp concluded. To that end, NBT added questions pertaining to mid-term outcomes to the Camp Host Final Evaluation Survey. Given that a number of 2020 camps were cancelled due to COVID-19, NBT sent these questions to two separate groups. A historical data survey that asked mid-term outcome questions was sent to camp hosts that held camps between 2015 and 2019. Camp hosts that held camps in 2020 received the Camp Host Final Evaluation Survey, which included those questions.



Camp participant outcomes from historical data survey

As 2020 was the first year of collecting this data, camp hosts were asked to provide an estimated total number of past camp participants since they first began hosting camps and an estimated percentage of camp participants for each outcome. The historical data survey was sent to 103 camp hosts who held camps between 2015 and 2019, and another 22 camp hosts received the 2020 Final Evaluation Survey containing the historical data questions. At the time of publication of this report, a total of 42 camp hosts reported historical data for a response rate of 41%. The findings presented in the table below echo camp hosts' stories of individual impact. Most camp hosts reported camp participants going on to take CTE or dual-credit courses.

Table 3: Historical Data on Camp Participants (2015-2020)

Camp Participant Outcome	Estimated Percent of Campers that Achieved Outcome
Campers that enrolled in STEM or CTE courses in their middle school or high school following your camp	43%
Campers that enrolled in dual-credit or college-level manufacturing-related courses following your camp	40%
Campers that enrolled in your educational institution's manufacturing programs	27%
Campers that graduated from your educational institution's manufacturing programs	18%
Campers that are currently employed in manufacturing jobs	13%

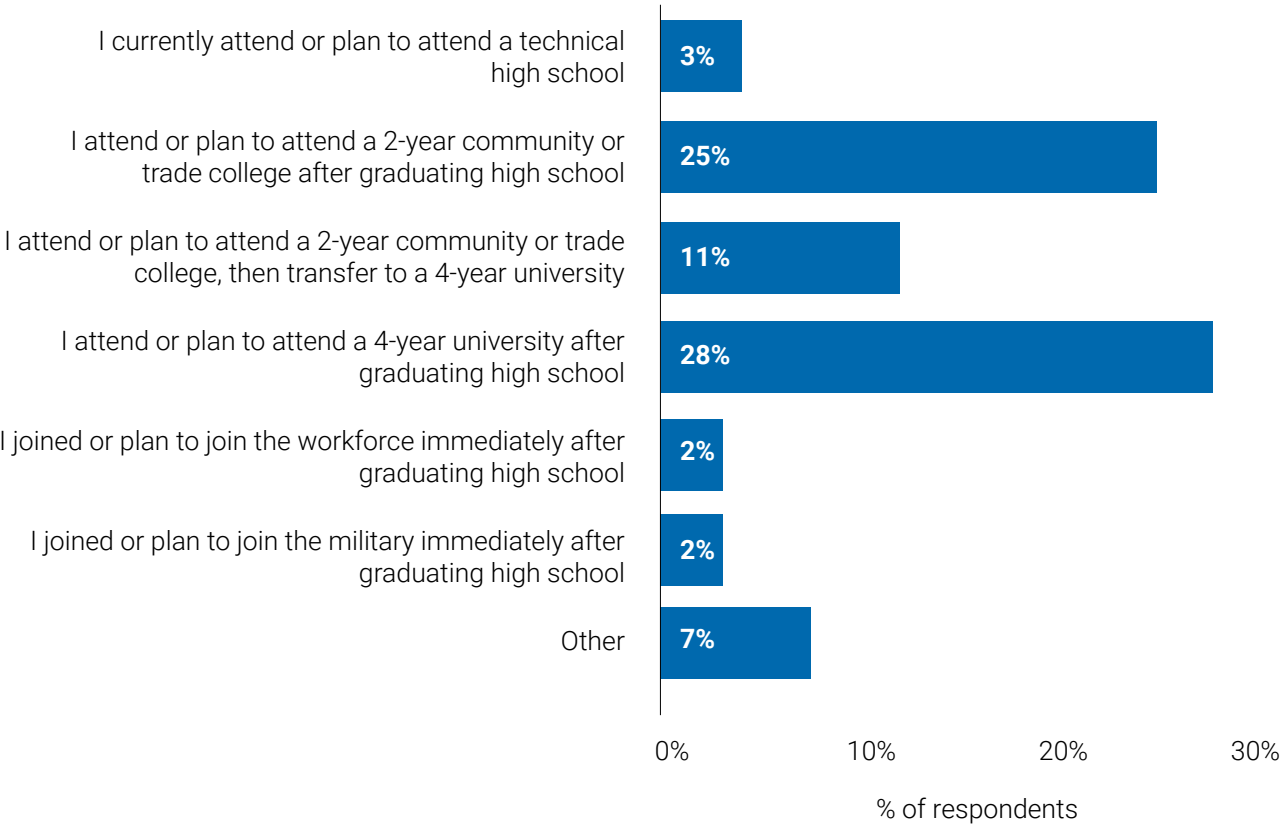


Camp participant outcomes from alumni/parent survey

As mentioned above, another survey was created for camp alumni and their parents. Camp hosts were asked to distribute this survey to former camp participants and their parents on NBT’s behalf. The survey data is comprised of 55 responses from alumni of ten camp hosts. While the data presented below is not a representative sample of former NBT camp participants, it does show that many respondents were inspired by camp to continue learning and/or pursue a career in manufacturing. More research is needed to track these trends with former camp participants over time.

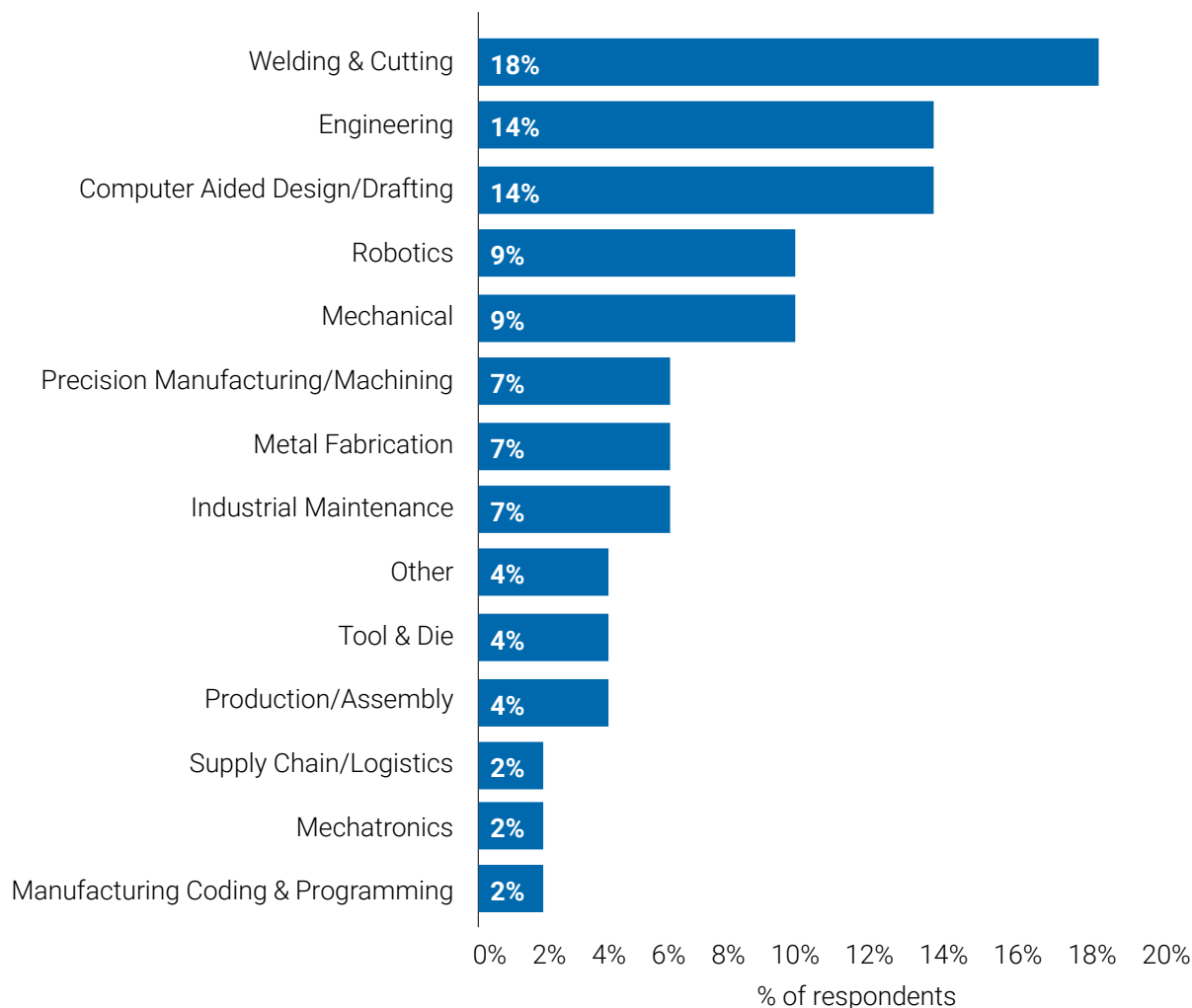
An overwhelming majority of respondents (82%) were parents of former camp participants completing the survey on behalf of their child(ren). Most respondents (73%) reported attending an NBT camp within the last 2 years, with the remaining 27% of respondents attending camp between 2016 and 2018. Ten former campers attended NBT manufacturing camps in multiple years. Over half of respondents (55%) are current high school students, and a third of respondents (33%) are currently in middle school. Almost half of respondents (49%) reported that they have close relatives that are working or previously worked in the manufacturing industry. Respondents were asked to report on their current or future education plans with most (36%) reporting they planned to attend a two-year community or trade college, a portion (11%) of which also plan to transfer to a four-year university, as shown in figure 21.

Figure 21: Camp Alumni Data - Educational Plans



Several findings from the survey responses point to an NBT camp's impact on former participants' decisions to continue pursuing what they learned in camp after camp ended. Seventy-one percent (71%) of former camp participants reported that attending a manufacturing camp influenced them to consider enrolling in STEM-related courses or CTE field of study at the school where they attended the camp. Forty-five percent (45%) of former camp participants reported that they were influenced to pursue a manufacturing career pathway as a result of attending an NBT camp. Respondents who intend on pursuing a manufacturing career pathway were also asked to select from a list of technical study programs to specify which one(s) they intended to pursue. Figure 22 shows that 18% of respondents were interested in a career in welding and cutting, the most popular choice.

Figure 22: Camp Alumni Data - Career Areas of Interest



Finally, respondents were asked to share testimonials about their experiences with summer manufacturing camps. Fifty-six percent (56%) of those who completed the survey replied, and all their comments described that the camp was a positive experience for the participant. Several respondents shared that camps were an opportunity to learn about manufacturing careers and skills training options, most of which youth are not normally exposed to as the comments illustrate.

"I believe it was a once in a lifetime opportunity. I think anyone who gets the chance should go [to a manufacturing camp]. It teaches you a lot and helps you to better shape your future."

"I learned about careers and technology that I had never considered before."

"[The NBT camp] was a wonderful intro to tech systems, jobs, and skills. It encouraged [my son] to pursue his love of engines and all things mechanical. He might otherwise have been persuaded to take a more academic science route and not have been as happy as he is [working] with his hands in machines all day."

Limitations

Several limitations were noted at the start of the impact evaluation that centered around gathering camp participant mid-term outcomes. One limitation was that camp hosts were not required to track camp participants following the conclusion of the camp as a condition for receiving an NBT grant. Therefore, the data presented above are camp host's estimates rather than actual numbers. Another limitation to tracking mid-term outcomes is that NBT did not require camp hosts to provide NBT with camp participants' contact information. Accordingly, a follow-up study on camp participants had never been conducted. Finally, COVID-19 severely impacted the ability of 2020 camp hosts to hold NBT camps as intended. Therefore, 2020 camp participant data could not be compared to previous years' data to glean trends across 6 years. ■

Recommendations

NBT should be commended on the amount of evaluation data they have been able to collect over 5 years with no formal evaluation system in place. Recommendations presented here cover steps to ensure that evaluation is embedded in the organization and is sustainable for years to come. Ideally, these recommendations would be developed into a three to five-year evaluation plan that outlines the following recommendations in detail with an implementation plan and action steps to guide NBT staff.

- 1. Take steps to embed program evaluation into NBT's organizational culture.** By doing so, NBT will create a sustainable model for tracking camp outcomes and ensuring continuous program improvement. Common steps for embedding program evaluation into an organization's culture are writing program evaluation tasks and job duties into current job descriptions and/or hiring an internal evaluator, setting aside time during internal staff meetings to discuss evaluation data and using these data to inform programmatic changes, and creating a communication plan to regularly report evaluation data to a variety of audiences.
- 2. Use results from the impact study to refine existing evaluation tools and inform the development of new tools.** Now that six years worth of evaluation data have been analyzed and summarized in one place, it is important to reflect on how existing evaluation tools can be revised to capture camp participant and camp host outcomes most efficiently and thoroughly. It is also important to reflect on whether the evaluation is capturing all intended outcomes or if there is a need for more outcomes to be developed. While conducting the impact study, NBT realized they had never surveyed camp sponsors and supporters, nor had they tracked any outcomes for manufacturers. Therefore, a small sample of manufacturers were interviewed for the study, and data will later be used to develop a survey to capture manufacturers' outcomes.
- 3. Consider future studies to measure the long-term impact of NBT manufacturing camps.** Now that NBT has articulated short- and mid-term outcomes through a Theory of Change and completed a formal evaluation of its manufacturing camps that spans 6 years, it has demonstrated strong results for camp participants, and therefore should consider ways to further measure the impact that raising awareness of manufacturing careers can have on youth who attend the camps. One option would be to conduct a research study to compare awareness of and interest in manufacturing careers between youth that attend camps and those that do not. Another option for a future study would be to recruit camp participants while they are attending camp to commit to participating in a follow-up study 3 to 5 years after the camp in order to track outcomes over time.

NBT has demonstrated evidence that it is living up to its mission – to raise awareness of manufacturing careers. The recommended next steps will provide the data and further evidence that NBT's programs are effective in increasing the number of people pursuing educational and career pathways related to manufacturing and, ultimately, working in manufacturing environments. ■

Conclusion

This report highlights the first formal impact evaluation of NBT's manufacturing camps. Findings demonstrate positive impact for manufacturers, camp hosts, and camp participants. Manufacturers and camp hosts alike reported added value to their company or educational institution as a result of sponsoring or hosting an NBT camp. Manufacturers described opportunities to build or strengthen relationships with local colleges, increasing their company's visibility and involvement in the community, and an ability to grow their workforce locally as benefits to sponsoring manufacturing camps. Camp hosts also spoke about the benefits of hosting a camp as increasing their school's visibility in the community, building or strengthening relationships with local manufacturers, and using the camp as an opportunity for recruiting students to programs at their educational institution.

Camp hosts and manufacturers saw NBT camps as fulfilling a gap in opportunities to expose middle and early high school youth to manufacturing careers. Indeed, when looking at research and best practices literature, NBT camps excel at exposing youth to the world of manufacturing through incorporating many best practices such as targeting middle school youth, providing hands-on, project-based learning, and exposing youth to real-world experiences of touring a manufacturing plant or speaking to a skilled worker or entrepreneur. While findings show that NBT camps raise camp participants' awareness, they also show promising results that early exposure leads to an interest in manufacturing careers.

Overall, NBT has made a unique contribution to raising awareness of manufacturing careers in youth ages 12 to 16 by using curriculum designed to lead a student through the manufacturing process by following a product from its original concept development to design, production, and to the marketplace. The NBT camp experience, taken as a whole, provides hands-on, project-based learning focused on a variety of manufacturing careers as well as manufacturing tours and guest speakers to help ground camp participant learning in real-world experiences. NBT has demonstrated evidence that it is living up to its mission – to raise awareness of manufacturing careers in order to increase the number of people pursuing educational and career pathways related to manufacturing and working in manufacturing environments. ■





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Holly Lewandowski, president of Evaluation for Change, Inc., has worked in program evaluation for over 20 years and founded her program evaluation and research consulting firm 12 years ago. Holly's program evaluation work has primarily centered on education spanning from early childhood to post-secondary with institutions such as the Ounce of Prevention Fund, Illinois Education Research Council, City Colleges of Chicago, Westat, Roosevelt University and University of Illinois at Chicago. In addition to conducting program evaluations and small research studies, she has provided capacity building on creating evaluation systems with nonprofits, foundations, and educational institutions such as the National Philanthropic Collaborative of Young Women's Initiatives, Little Brothers – Friends of the Elderly, Robert Crown Center for Health Education, and University of Illinois at Chicago. Additionally, she has held positions in evaluation and research at DePaul and Northwestern Universities. She earned her MA in Sociology at DePaul University and BA in Anthropology at Antioch College.

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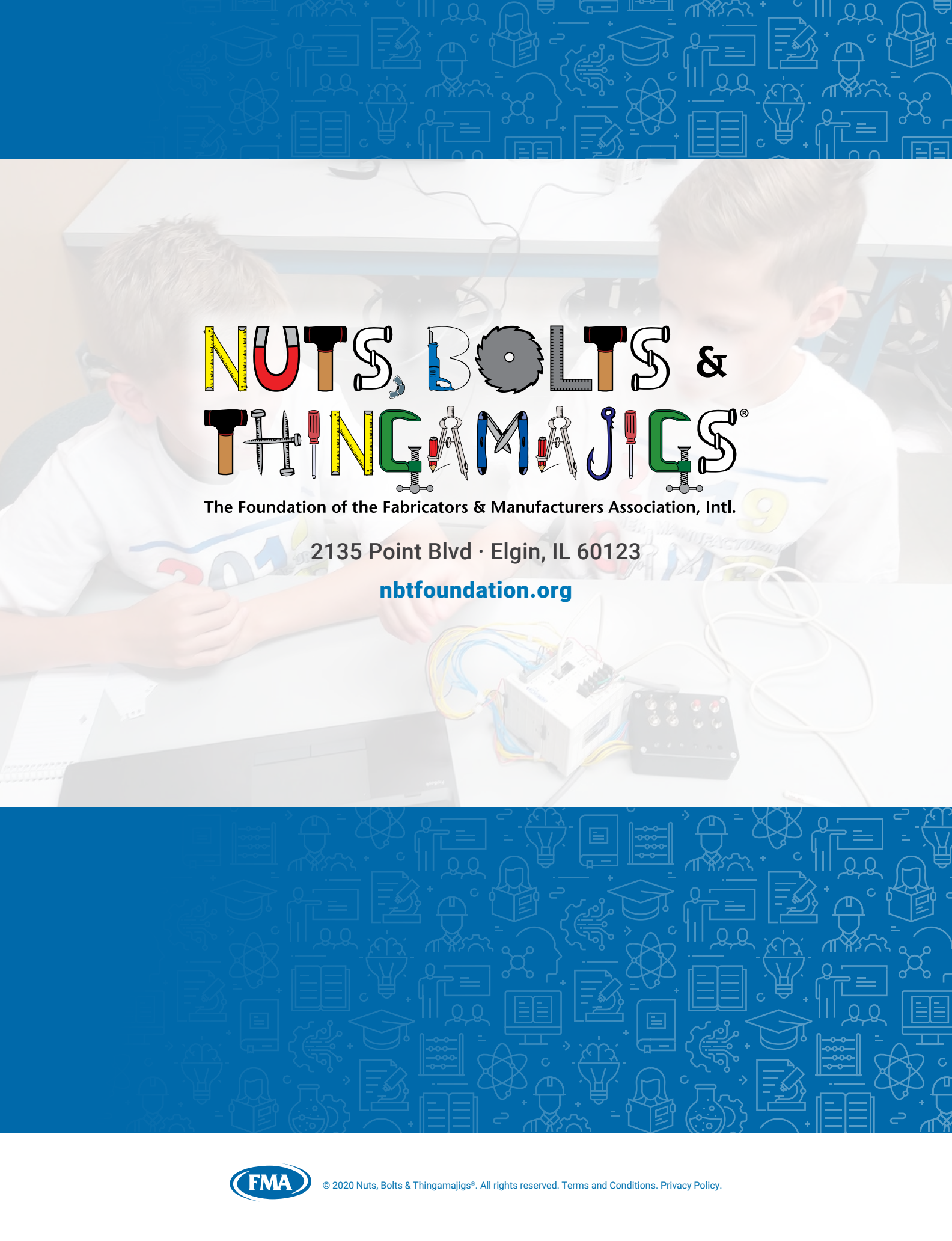
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