

Small and Medium Manufacturing Study:



Robotics and Technology ENGAGEMENT



CATALYST CONNECTION™
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Introduction

Small and Medium Manufacturing Study: Robotics and Technology Engagement

154 RESPONSES/13+ SEGMENTS

19% from Food and Beverage

18% from Aerospace

16% from Fabricated Metal Products



Catalyst Connection launched the Small and Medium Manufacturing Study: Robotics and Technology Engagement with the goal of guiding future initiatives to accelerate technology adoption.

Advanced technologies, such as robotics and automation, are effective means to improve efficiencies and alleviate pain points experienced in manufacturing operations, but is manufacturing automation as widely utilized as it could or should be? And if not, how can the Manufacturing Extension Partnership (MEP)² and other manufacturing support organizations more effectively accelerate technology exploration and adoption efforts? This is especially critical for the SMM¹ segment, which makes up 99%³ of manufacturing organizations across the nation.

A team of four MEP centers conducted the study in collaboration with ARM – Advanced Robotics for Manufacturing, a Manufacturing USA institute. The contributing MEP Centers and associated geographic regions are:

- California Manufacturing Technology Center (CMTC) — California
- Catalyst Connection — SW Pennsylvania
- FuzeHub — New York
- Impact Washington — Washington

The collection of organizations is no coincidence; they are the same organizations who were part of a project to embed MEP center staff at ARM. The goal of the project was to ensure both the impact from the institute advances and the technology itself reaches SMMs.

The SMM Study was conducted from December 2019 – January 2020 and collected 154 responses across a diverse mix of industries and companies. Over 13 industry segments are represented with the largest share of respondents from Food & Beverage at 19%, Aerospace at 18%, and Fabricated Metal Products at 16%.

The geographic scope focuses on the states of California, New York, Pennsylvania (SW), and Washington. It offers a valuable snapshot of manufacturing challenges, views on advanced technologies, and robotics adoption and implementation practices.

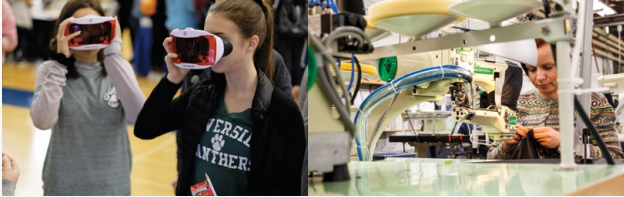
¹ Small and Medium Manufacturer (SMM). Manufacturer with less than 500 employees

² Manufacturing Extension Partnership. Network of public-private partnerships focused on supporting small and medium-sized manufacturers with the resources needed to grow and thrive. [NIST.gov/MEP](https://www.nist.gov/MEP)

³ Source: US Census Bureau

Executive Summary

Small and Medium Manufacturing Study:



The goal of the study was to guide future technology initiatives to accelerate adoption at SMMs across the country. The following study objectives achieved that aim:

- **Validate the key challenges and drivers for technology adoption at small and medium manufacturers**
- **Assess technology knowledge/comfort level, adoption, historical and future investment plans, project success rate, implementation preferences, and workforce development**
- **Identify geography, company demographics, and industry trends and gaps**

A clear picture emerges from the study of a manufacturing landscape transitioning toward the adoption of new advanced technologies. In order to make steady progress on the holistic goal of elevating U.S. manufacturing through accelerating adoption of these advanced technologies, the key is to recognize the current state, identify the gaps to reach the desired future state, and build the right bridges to get there.

The study confirmed that the top organizational challenges faced by manufacturers today are labor costs and problems hiring and retaining production workers. Although every manufacturer is unique, implementation of robotics and technology can often directly address these challenges. However, once the need is established and despite the downward price trends for robots and improved ease of implementation, upfront costs are still the leading barrier to adopting automation technology.

The team conducted the study in four states: Pennsylvania (SW), New York, Washington and California. Results were quite similar for all the states, with some minor differences. Organizational and production related challenges highlight the same story echoed around U.S. manufacturing — workforce is the top concern. However, an important distinction was identified in the workforce segments, as it is specifically the production workforce that drives the greatest concern, not management, office, or engineering staff. We see regional differences emerge when looking at labor costs, as West coast manufacturers are significantly more likely to have challenges than East coast manufacturers.

Robotics and Technology ENGAGEMENT

TOP DRIVERS = KEY CHALLENGES

Increase production
Improve efficiencies
Reduce labor costs



Dull, dirty and dangerous tasks are typically considered ideal applications for automation, as such it would be expected to see Health/Safety as a top driver for technology adoption. However, Health/Safety concerns came in last of the seven possible Production Challenges, and only 10% of manufacturers selected *Address Health & Safety Concerns* as a key driver for technology investment.

Increasing production and reducing labor costs consistently emerged as key concerns for all manufacturers. The Top Drivers to adopting technology align with key challenges: increase production, improve efficiencies, and reduce labor costs. The combination of core MEP capabilities like Continuous Improvement (CI), Lean, 5S, and KATA along with a growing toolbox of advanced technologies, automation and robotics in particular, can directly address all of these challenges.

Investment in technology has been lagging behind facility investments. However, increasing plans for investments over the coming 12-18 months, especially in Robotics and Machine Vision, means organizations like MEP, integrators, and vendors alike should be prepared to support the increased demand from manufacturers.

Despite this perceived wave of investment, the top barriers to adoption of robotics and technology still need to be addressed. The leading barrier was *Upfront Cost*, followed by *Poor Fit for My Manufacturing Environment* and *Insufficient ROI*. Interestingly, also among the top barriers was *Limited Familiarity with Current Technology* and *Lack of Time to Investigate Solutions*.

The primary recommendations include growing outreach and support programs to address lack of awareness and time constraints, building services to support technology projects on the front end and connect end users to providers, and focus efforts on applications most targeted by manufacturers.

These efforts take time to develop and take hold. In the interim, the development of grant funds that target SMMs would be a good starting point. There is also work needed to demonstrate the value and payback that adoption of Industry 4.0 technologies would provide.

Finally, working with SMMs and technology firms to find common ground, prove production and operations value while reducing upfront costs, will move these firms closer to advanced technology adoption.

Key Findings



Workforce related issues lead both organizational and production challenge rankings. Close behind are issues with efficiency, production rates, labor costs, quality, and bottlenecks.

All of these issues are prime candidates to address with robotics and technology as well as traditional operational improvement tools.

INVESTMENT EXPECTATIONS

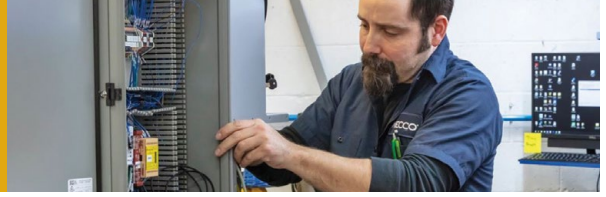
- Investment related barriers, *Upfront Cost* and *Insufficient ROI*, were two of the top three factors preventing the adoption of technology.
- The other top barriers were mixed between technology driven (ex. Poor fit for my manufacturing environment) and awareness/resources (ex. Limited familiarity with current technology solutions).
- The number of manufacturers planning investments in the coming 12-18 months, compared with the previous period, increased by 67% for robotics and 58% for machine vision technologies.
- Top target application by manufacturer type: Process -> In-Process Material Movement at 44%, Discrete Product -> CNC Machine Tending at 39%.

4% did not meet expectations
59% met expectations
37% have not yet met expectations

- A significant group of manufacturers, 34%, relies exclusively on their own internal teams for automation and technology implementation. Providing a range of support options to account for various project approaches was identified as an important factor for success with these manufacturers.
- Despite concerns over upfront cost and ROI, only 4% of manufacturers who have implemented robotics and technology indicate their investment did not meet their expectations. Fifty-nine percent said it met their expectations with the remaining 37% indicating it had not yet.



Recommendations



Amplify outreach to manufacturers to build awareness of the latest robotics and technology solutions for common challenges.

Although health and safety impacts from robotics is significant, the data shows that that a theme related to health and safety does not resonate with typical manufacturers. Instead, target their top concerns by leading with productivity and efficiency gains.

Build use cases/success stories to change the perception that robotics is a risky, out of reach technology.

- Build tools/resources to help manufacturers see the complete picture of benefits from robotics and technology implementation — help change the discussion from one of upfront cost to the return they can expect. Manufacturers regularly invest in capital-intensive equipment — CNC machines, presses, assembly cells, etc. — because they have a clear line of sight to the benefits and payoff. Robotics and technology projects should be no different.
- Reinforce use of operational improvement services (CI, Lean, KATA, etc) to address efficiency and production improvement needs where appropriate.

THEN SUPPORT:

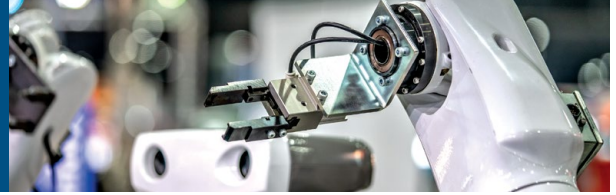
- MEP to develop and expand service offerings designed to help manufacturers overcome current adoption barriers and assist with assessment, research to be conducted, project management, connection with implementation resources, and integrator selection.

A wave of investment is coming, particularly around robotics and machine vision, and MEP needs to be ready.

- Increase development of outreach, support, tools and techniques to facilitate implementation of robotics in CNC machine tending applications.
- Increase MEP technology presence on the web and at national trade shows to engage manufacturers where they are — 71% use web research and 48% attend national trade shows when researching technology projects.
- Create grant programs to encourage adoption of robotics and technology by manufacturers, particularly their first implementation project. The biggest impact is when technology hits the factory floor and the top hurdle to adoption is upfront cost. Grant programs help directly lower that hurdle.



Results by Section



Company Demographics and Key Challenges

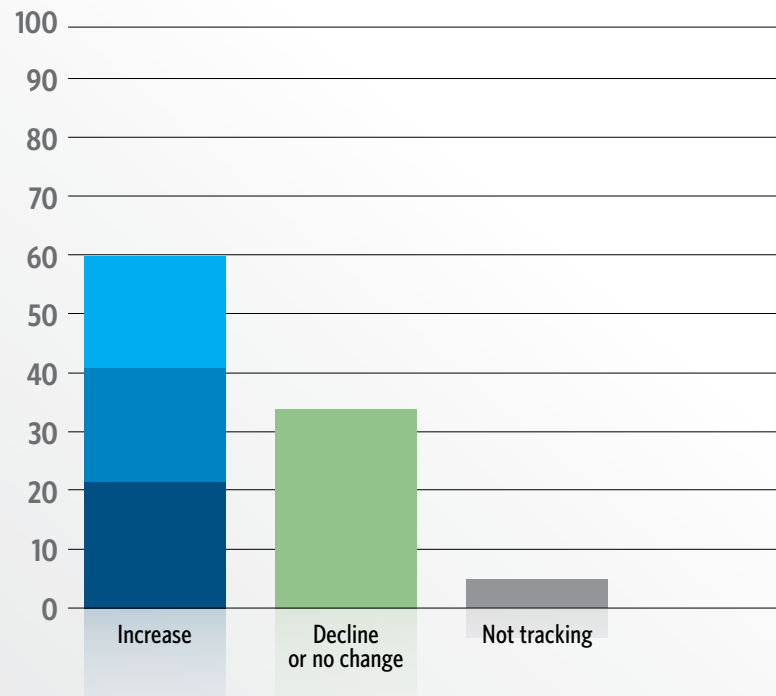
1. Revenue Trend:

Largely positive business growth trends at surveyed manufacturers with over 60% reporting increases in revenue compared to the previous year, 34% reporting no change or a decline, and 5% not tracking.

- Increased by greater than 10%
- Increased by 5-10%
- Increased by 1-5%
- Decline or no change

Revenue Trend Compared to Previous Year

% of Manufacturers

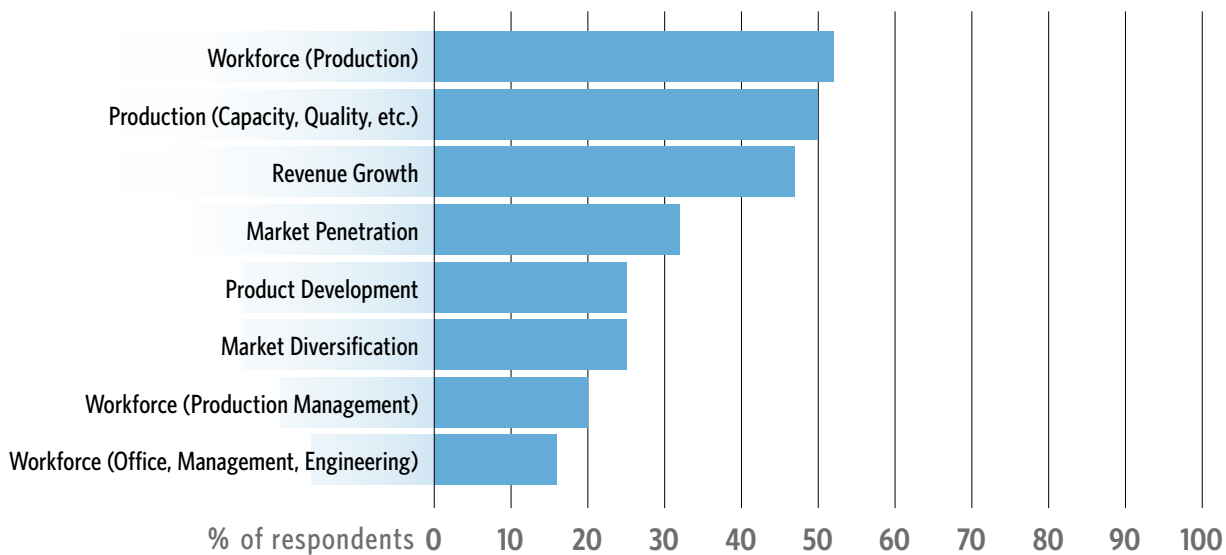


2. Top Organizational Challenges relate to Production workforce at 52% and Production at 50%.

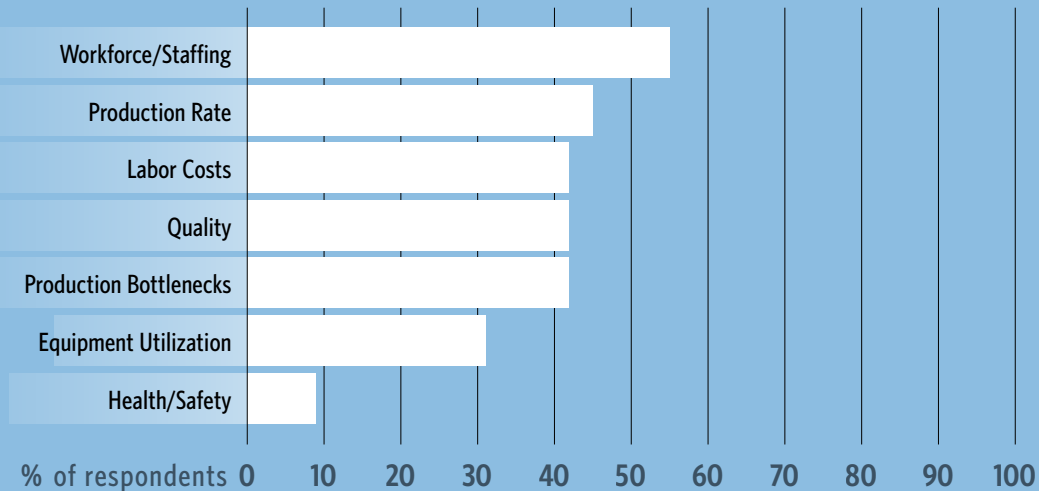
Technology implementation has the potential to address, at least in part, both of these challenges.

Also note, production management and office/management/engineering workforce ranked at the bottom of challenges.

Top Organizational Challenges



Top Production Challenges



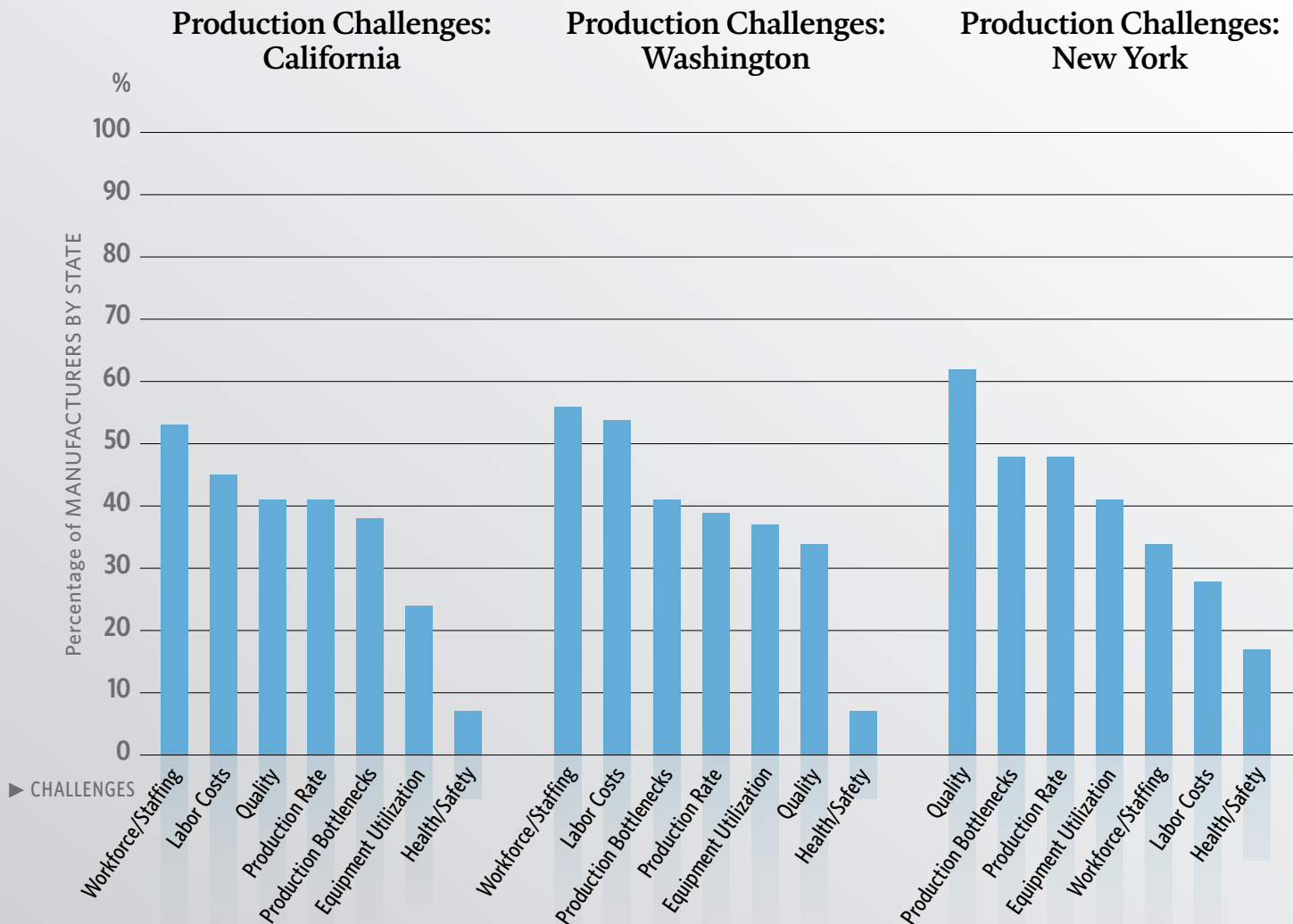
3. Diving deeper into Production Challenges, Workforce/Staffing again is the top challenge, selected by 55% of manufacturers, with Production Rate at 45%, and close behind — Quality at 42%, Labor Costs at 42%, and Production Bottlenecks at 42%.

4. Notably, Health/Safety came in last of seven possible Production Challenges, with only 9% of manufacturers selecting it as a “Top 3” production challenge. Logically, this also translated into a low rating for *Address Health and Safety Concerns* in drivers for technology investment, as noted in the section on Robotics and Technology Engagement.

Company Demographics and Key Challenges

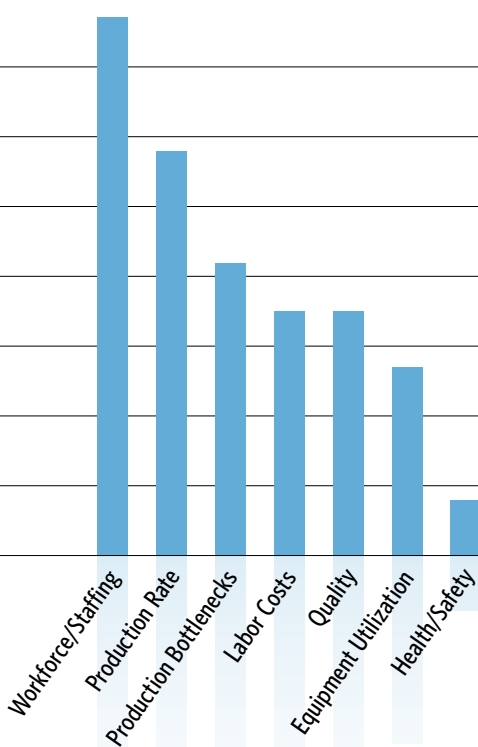
5. Some regional differences emerged when considering Production Challenges:

- A. WORKFORCE/STAFFING was the leading issue in CA, PA and WA.
- B. LABOR COSTS were 2nd in CA and WA, but came in 4th and 6th in PA and NY, respectively.
- C. QUALITY was the leading issue in NY, with PRODUCTION RATE AND BOTTLENECKS tied for 2nd.
- D. PRODUCTION RATE AND BOTTLENECKS also occupied the 2nd and 3rd spots for PA manufacturers.





Production Challenges: Pennsylvania

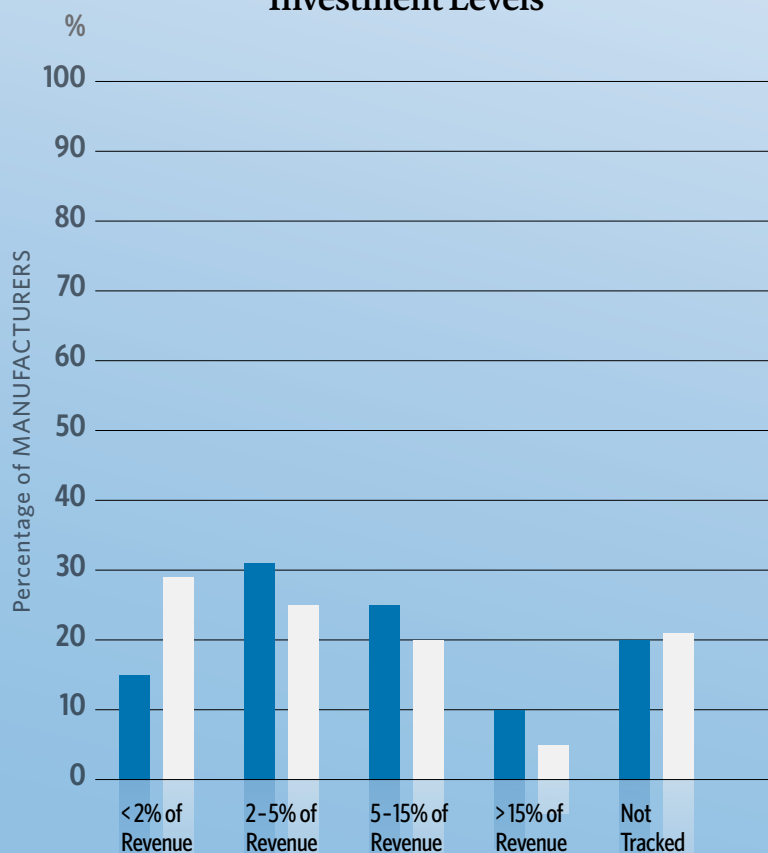


6. Investment levels for technology are shown to be lagging behind general facility investment, however appear primed to increase as manufacturers eye new technology, particularly robotics and machine vision.

(SEE: Engagement Section, Finding 8)

■ Facility Investment Level
 ■ Technology Investment Level

Facility and Technology Investment Levels



Robotics and Technology Engagement

1. Comfort level with technologies had a noticeable decline with more advanced digital technologies such as big data/analytics, simulation, and augmented/virtual reality.

Technology Comfort Level

Note the scale on the chart below.

- 1 = Very uncomfortable and disengaged
- 3 = Comfortable and investigating
- 5 = Completely comfortable and engaged



Robotics Adoption by Key Industries

Types of Robotics Technologies Employed	Overall Response	Fabricated Metal Products	Plastics and Rubber Products	Food and Beverage Manufacturing	Electrical Equipment, Appliance	Defense	Computer and Electronic Product	Automotive Manufacturing	Aerospace
No Robotics Technologies	78	9	7	19	4	8	6	2	7
One or More Types	62	12	9	8	13	6	6	13	15
No Robotics Implemented	56%	43%	44%	70%	24%	57%	57%	13%	32%
One or More Types Reported	44%	57%	68%	30%	76%	43%	43%	87%	68%



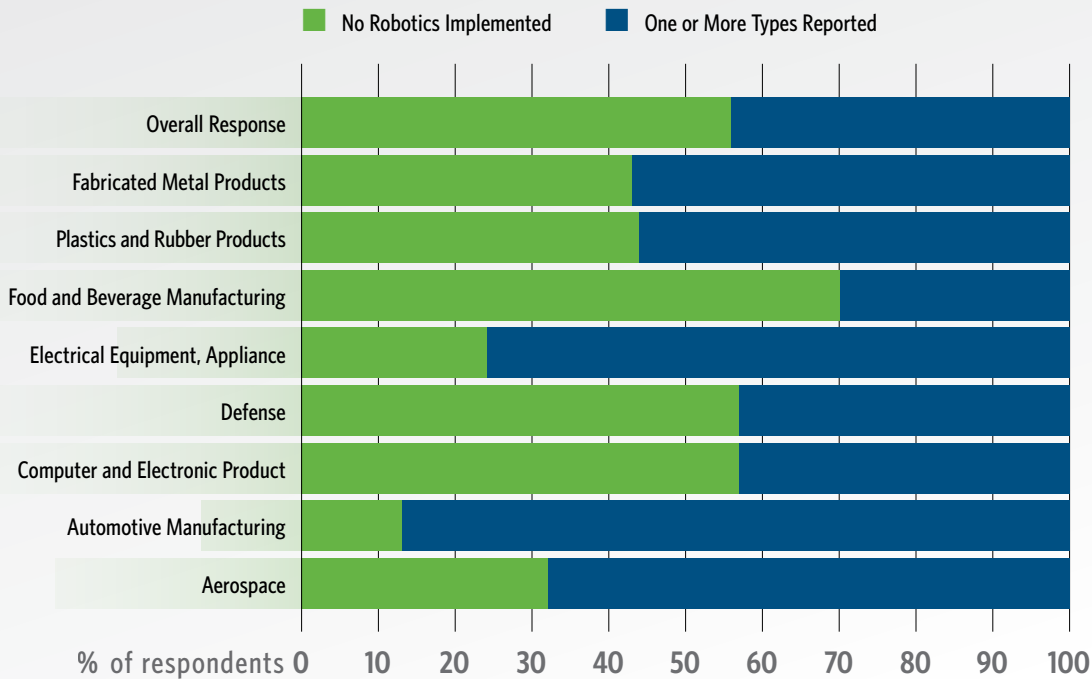
2. While no single category of manufacturing had enough respondents for definitive conclusions about the industry, the results were not surprising.

Of the eight industries most heavily represented in the study, Automotive had the highest adoption of robotics, with 87% of respondents indicating they owned one or more types of technologies.

Electrical Equipment/Appliance and Component Manufacturing responded with 76% adoption, and Aerospace showed 68% adoption.

(Note that about 20% of respondents selected more than one industry)

Robotics Adoption by Key Industries



Robotics and Technology Engagement

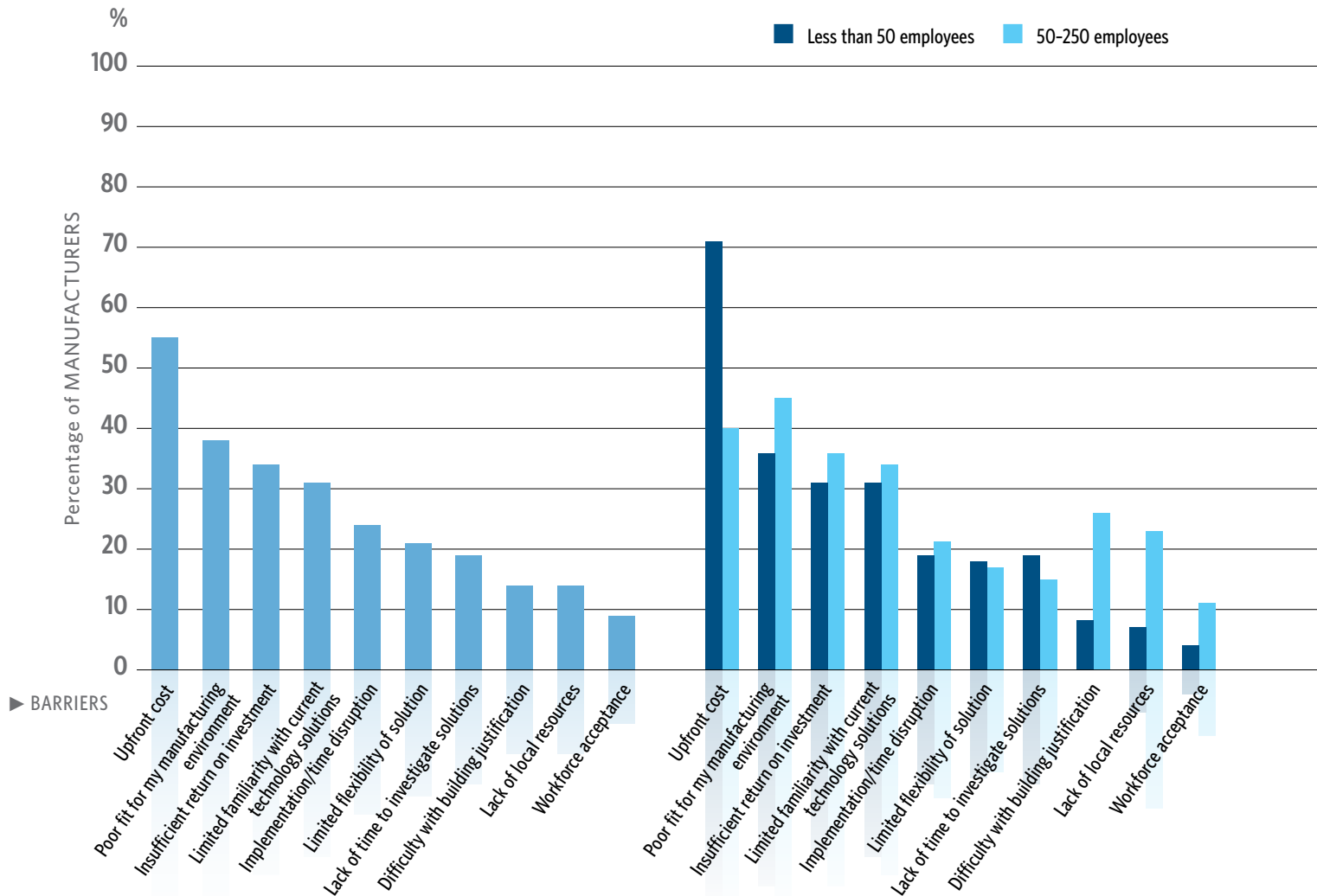
- 3.** A majority of companies are experiencing revenue growth at 62% — but over half, at 55%, still see upfront cost as a key barrier to technology adoption. Interestingly, respondents see UPFRONT COST as a more significant barrier than POOR FIT for their manufacturing environment at 38% — or insufficient ROI at 34%.

It appears the path to a return on the investment is not clearly seen when the upfront cost is a bigger barrier than ROI, or the technology isn't trusted to deliver on that promise.

- 4.** Upfront cost is the top barrier to adoption for the smallest two company segments — less than 10 employees, 10 - 50 employees — and the second leading barrier for the next company segment of 50 - 250 employees.

Barriers to Tech Adoption

Barriers to Tech Adoption by Company Size





5. Top drivers to adopting technology align with key challenges: *Increase Production* at 51%, *Improve Efficiencies* at 50%, and *Reduce Labor Costs* at 41%.

All these factors can be directly addressed with automation technology implementation.

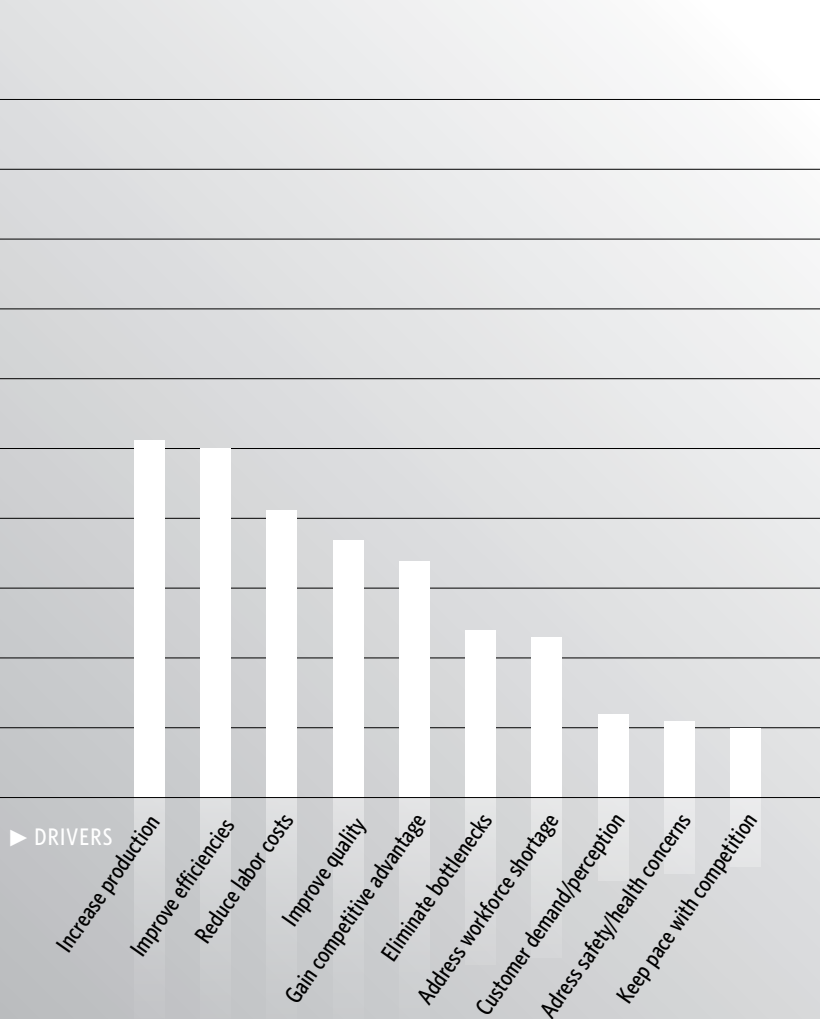
6. Only 11% of companies identified *Addressing Health & Safety* as a top driver for technology investment, ranking it near the bottom of drivers for technology adoption. (#9 of 10 response options.)

This area is typically an ideal application of robotics.

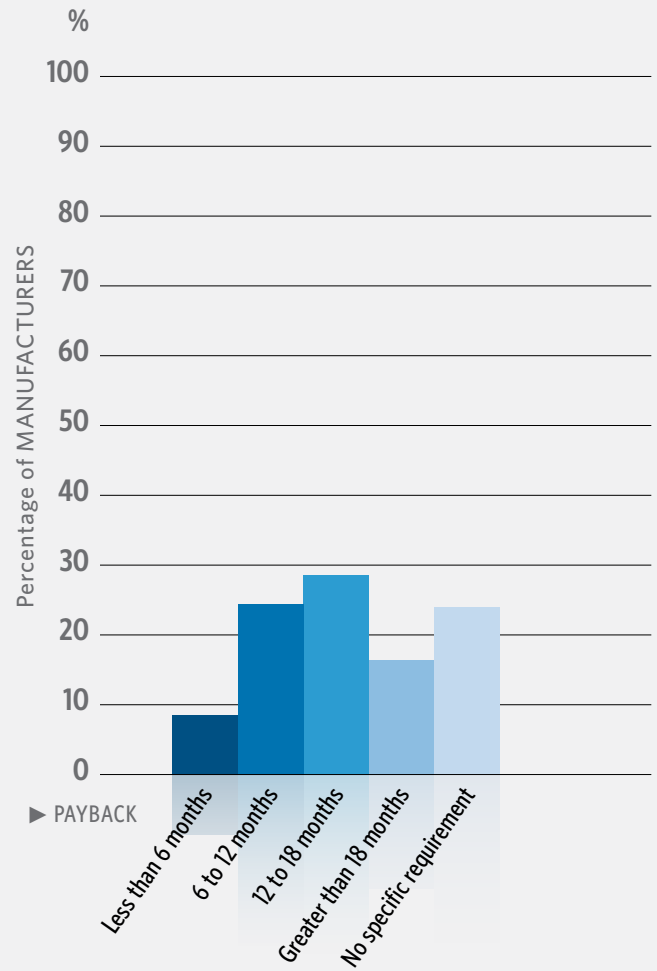
7. Manufacturers typically have very conservative, achievable expectations when it comes to payback periods.

ROI for technology investments: over 67% expect payback in 12 months or more, or have no specific requirements, while less than 10% require a payback in under 6 months.

Technology Investment Drivers



Technology Payback Period Required



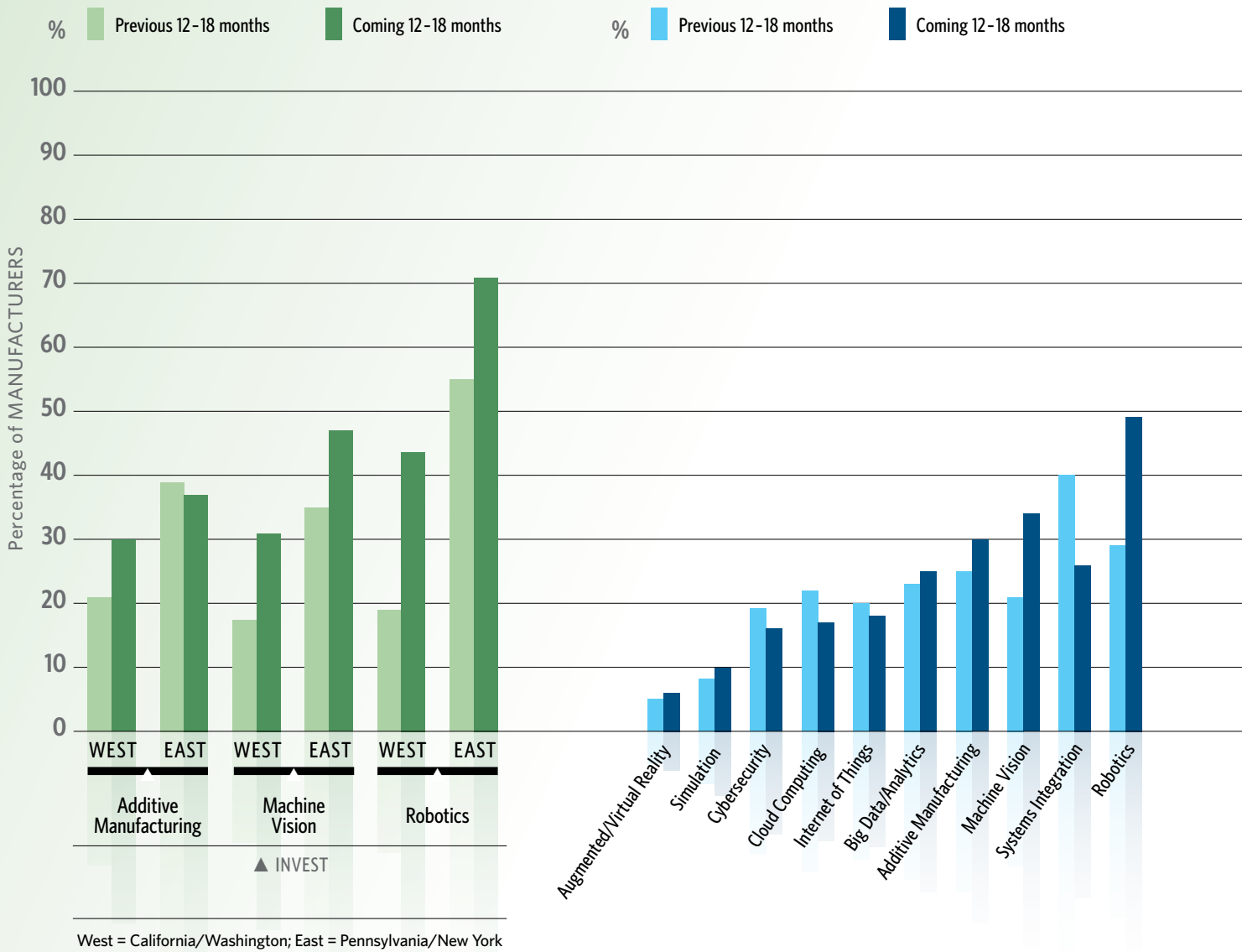
Robotics and Technology Engagement

8. Manufacturers have increased their plans to initiate advanced technology investments over the coming 12-18 month period as compared with the previous period.

This is good news for robotics and machine vision, pointing toward continued acceleration in adoption by manufacturers.

Physical Technology Investments by Region and % of Manufacturers

Technology Investment Plans by Period

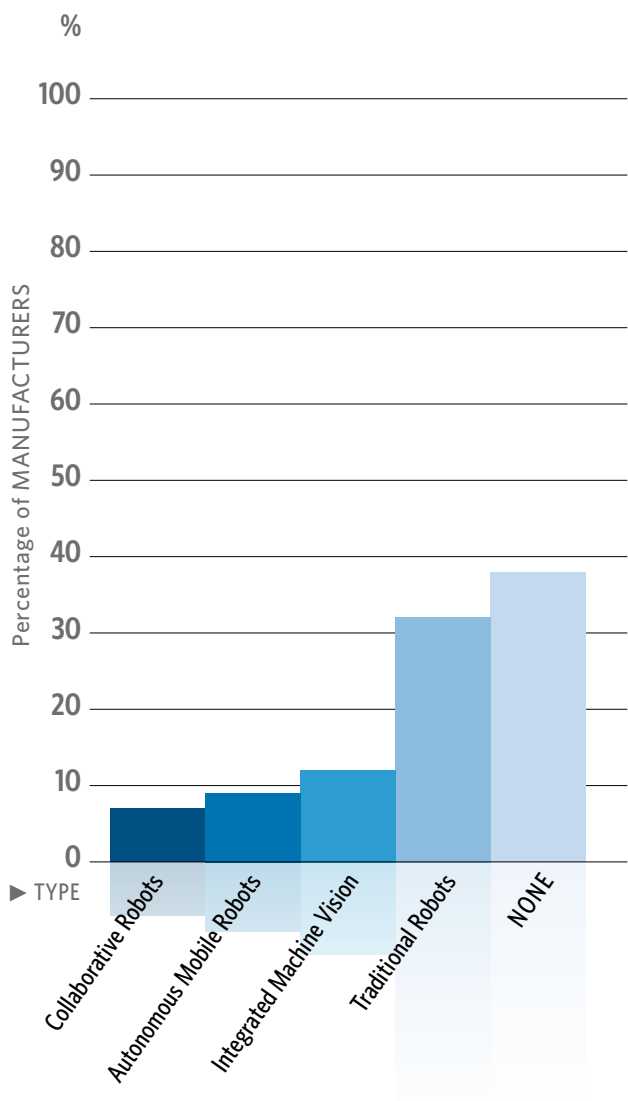




9. Traditional robots have the highest rate of implementation by far, however, significant opportunity remains to support manufacturers in the exploration of robotics.

10. Although adoption of collaborative robots, or cobots, continues to grow at rates far exceeding traditional industrial robots⁴, only a small segment of manufacturers at 7% are currently utilizing cobots. This aligns with findings from the International Federation of Robotics and other similar organizations.

Robotics Tech in Manufacturing

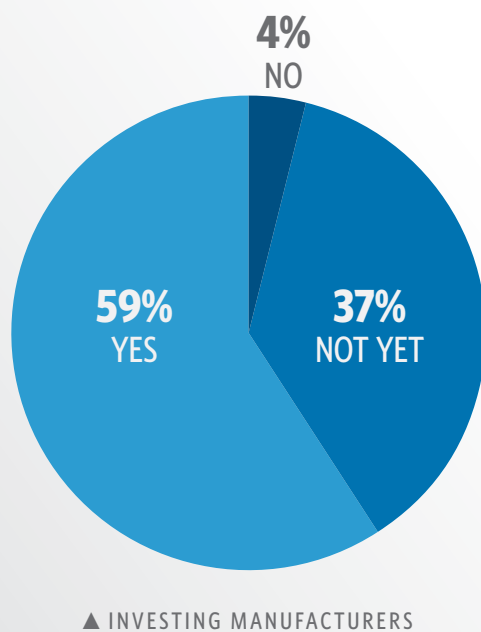


⁴<https://ifr.org/ifr-press-releases/news/robot-investment-reaches-record-16.5-billion-usd>

11. Investments in Robotics are largely meeting the expectations set by manufacturers — only 4% of manufacturers say their investments did not deliver expected results while 59% of manufacturers are satisfied with results.

The remaining 37% need more time to quantify results.

Expectations Met by Robotics Investments?

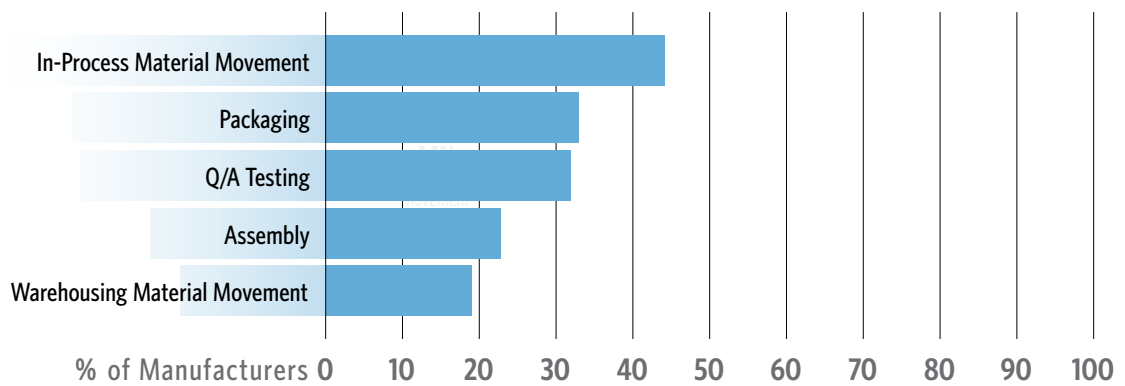


Robotics and Technology Engagement

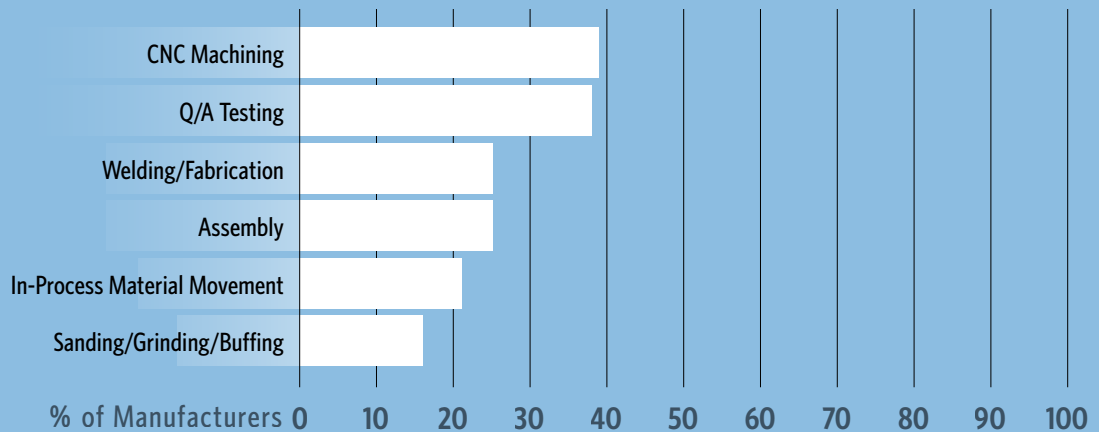
12. The top manufacturing processes/areas targeted for technology application, logically, vary between process-oriented manufacturing and job shop/discrete product manufacturing.

Process manufacturers, with 57 respondents, are targeting In-Process Material Movement at 44%, Packaging at 33%, and QA/Testing at 32%, whereas job shops and discrete product manufacturers, with 97 respondents, are targeting CNC Machining at 39%, QA/Testing at 30%, Assembly at 25%, and Welding/Fabrication at 25%.

Target Areas: Process Manufacturers – 57 RESPONSES –



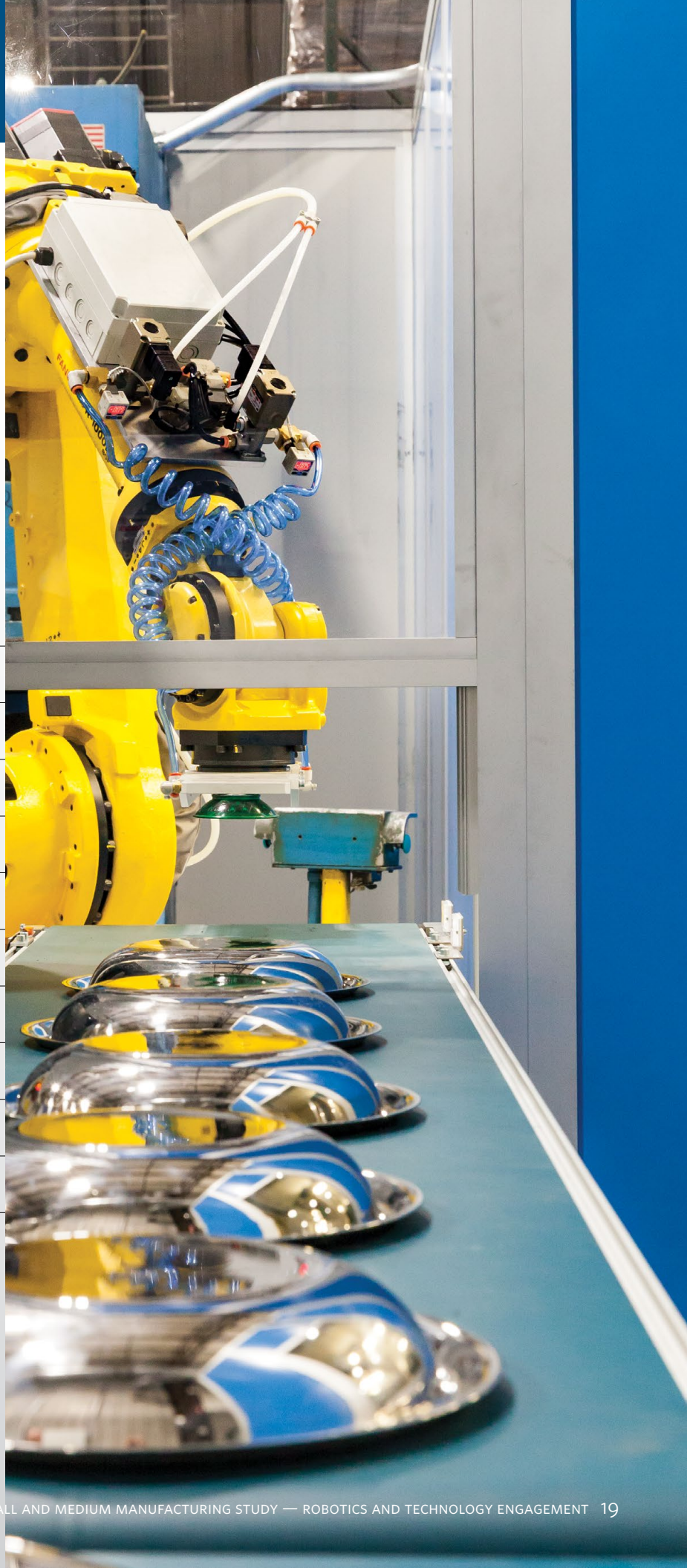
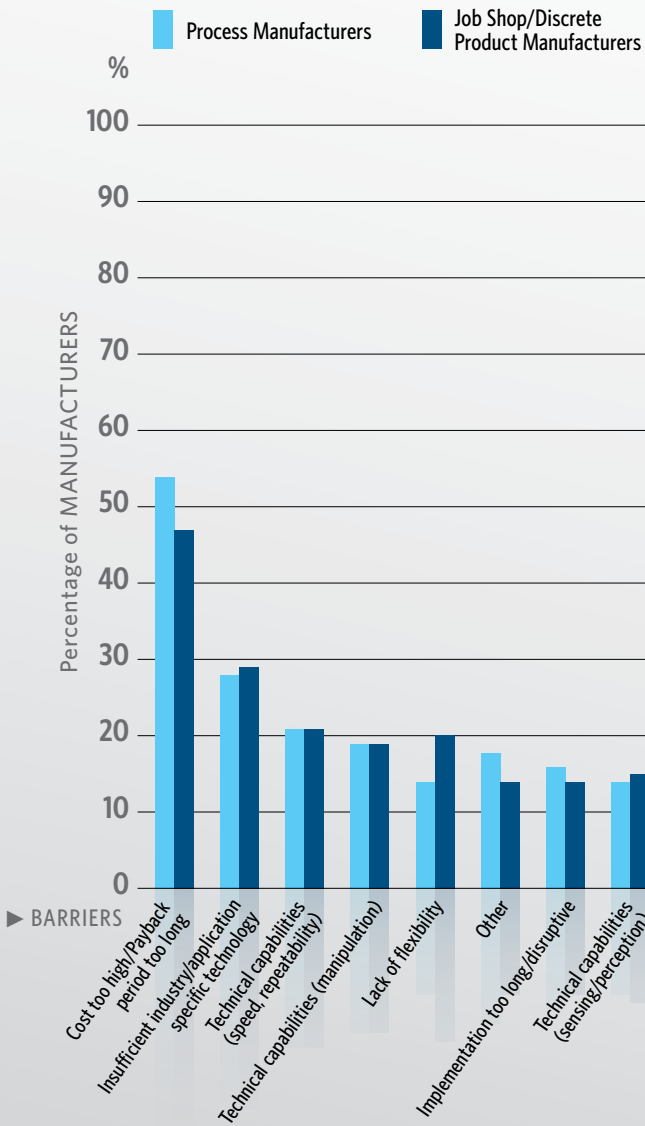
Target Areas: Job Shop/Discrete Product Manufacturers – 97 RESPONSES –



13. While the target areas vary by manufacturer type (process vs. discrete), they are closely aligned when it comes to the primary barriers to implementing robotics in these areas:

Cost too high/Payback period too long, Insufficient industry/application specific technology, followed by Technical capabilities (speed/repeatability).

Barriers to Implementing Robotics in Target Areas





Technology Resources — Implementation

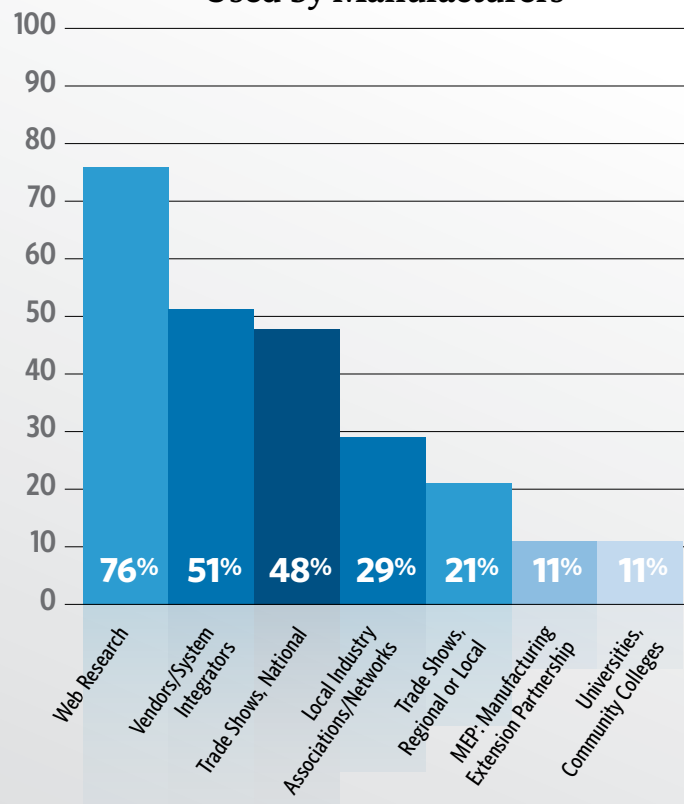
1. When it comes to conducting research on technology projects, manufacturers largely rely on their own efforts and



relationships to drive the exploration process by conducting web research at 76%, engaging with vendors/systems integrators at 51%, and attending national trade shows at 48%....

1.Considering that over 30% of manufacturers still cite *Limited Familiarity with Current Technology Solutions* as a primary barrier to technology adoption, it is evident that an adjustment to more effective research processes and resources is warranted. As the 4th leading barrier to adoption, this warrants further attention. MEPs are uniquely positioned to address this issue.

Technology Research Resources Used by Manufacturers



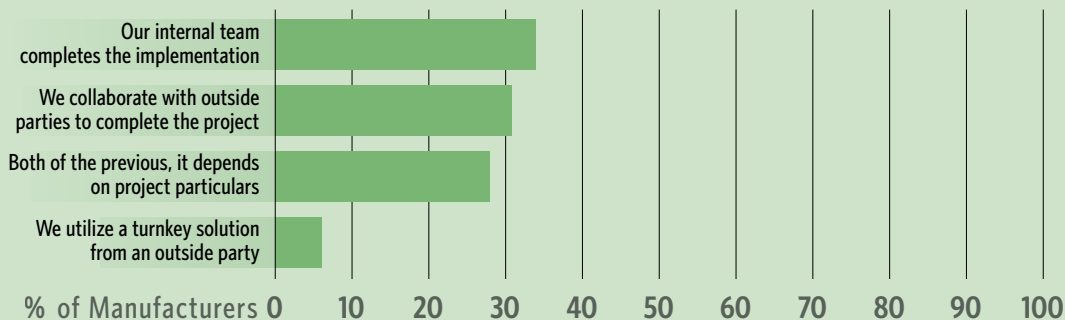
▲ RESOURCES USED BY MANUFACTURERS

2. ►Right Top — Manufacturers tend to prefer a higher level of direct engagement in their technology projects as they are largely split on their internal team completing the implementation at 31%, collaborating with outside parties to complete the project at 29%, or letting project particulars dictate between all options at 25%. Only 5% of manufacturers indicated their preferred method to be a turnkey solution from an outside party.

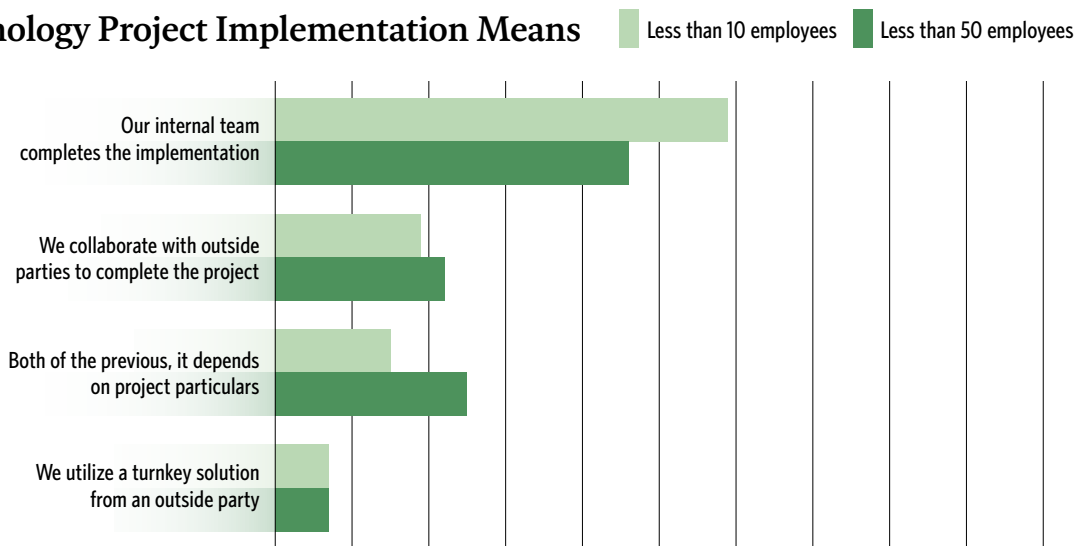


2-A. Interestingly, but perhaps not surprisingly, it was the smallest manufacturers who had the strongest preference for completing the projects internally: 46% of manufacturers under 50 employees and 59% of manufacturers under 10 employees implement technology projects in-house.

Technology Project Implementation Means



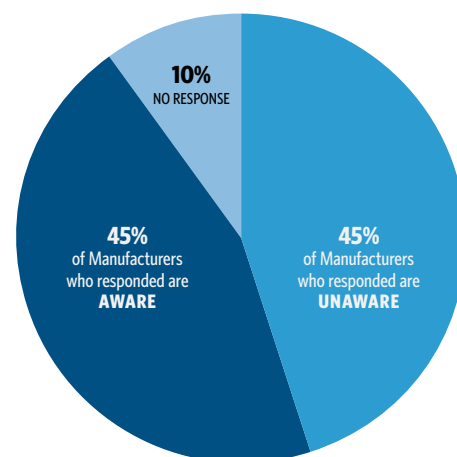
Technology Project Implementation Means



Awareness of MEP and Technology Support

- 3. **Awareness of MEP and technology services is an opportunity — data shows just as many companies are aware of MEP technology services as are unaware. One marketing related factor that may skew this data point is name recognition of MEP versus the local center name.**

It is important to note that none of the centers included in this study have “MEP” in their name, possibly leading to some confusion over the MEP familiarity question.



▲ MANUFACTURERS



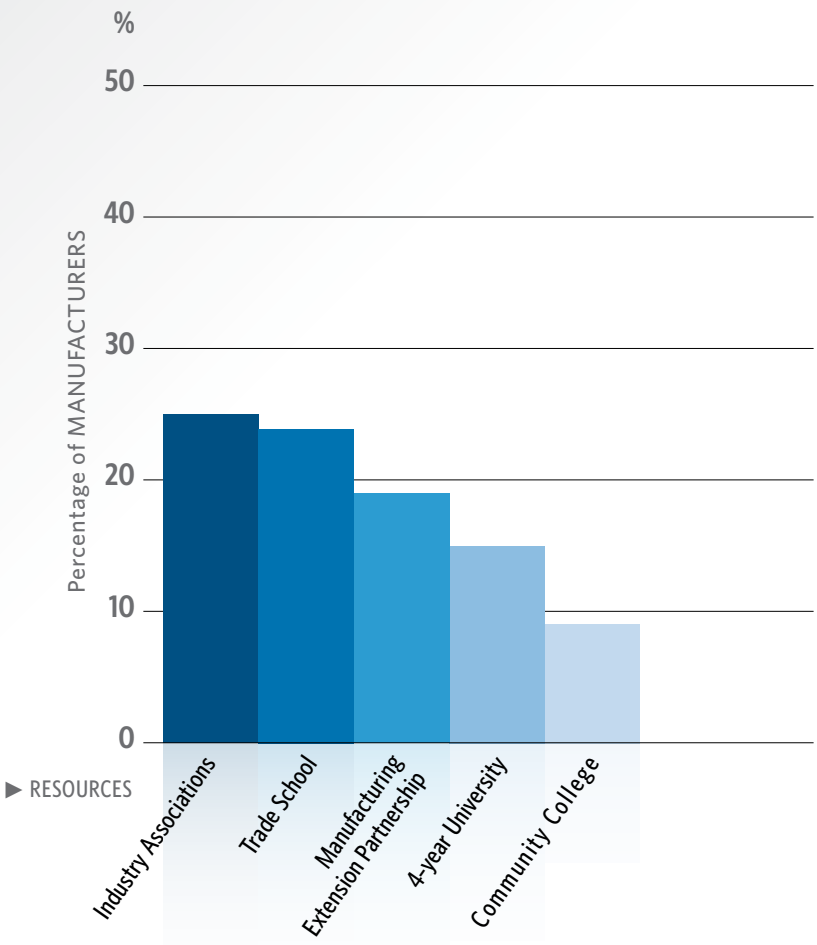
Technology Resources—Workforce

1. There was not a significant preference for any one external resource for workforce technology training among small manufacturers under 250 employees.

The highest engagement with resources for workforce technology training was Industry Associations at 25%, Trade Schools at 24%, and MEP at 19%.

Primary Workforce Technology Training Resources

— SMALL MANUFACTURERS AT <250 EMPLOYEES —







CMTC
310-263-3060
www.cmtc.com



Catalyst Connection
412-918-4300
www.catalystconnection.org



Fuze Hub
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www.fuzehub.com



Impact Washington
425-287-6808
www.impactwashington.org

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