



FUTURE SKILL NEEDS IN MANUFACTURING: A DEEP DIVE

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DIGITAL TRANSFORMS PHYSICAL



**Rockwell
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1. INTRODUCTION/EXECUTIVE SUMMARY

Manufacturers have for many years made significant efforts to digitize and revolutionize as both the world and the manufacturing sector have become increasingly digitized. However, the COVID-19 pandemic and other developments have accelerated many of these initiatives. A greater number of manufacturers are now devoting time and resources to upskilling their current employees with the skills they will need in the future, as well as boosting endeavors in hiring. Indeed, as the manufacturing sector has become more technologically advanced, some skill needs have shifted, most notably in data analytics and digitization. Still, some skill needs will stay the same, particularly interpersonal skills.

Through a series of interviews with future-leaning manufacturing leaders focused on human resources, workforce development and strategic planning, The Manufacturing Institute—the workforce development and education partner of the National Association of Manufacturers—sought to identify the skills that will be needed over the coming five to ten years in the sector, paying close attention to four different industries and one initiative. The four industries given a deep dive in this analysis are: (1) electric vehicles and battery production, (2) semiconductors, (3) pharmaceuticals and (4) logistics. Additionally, this analysis includes sustainability efforts as an initiative that many manufacturing industries are incorporating into their businesses. This report distills the interviews and seeks to answer, among other questions: (1) how manufacturing will change in the future, (2) how technological and operational change will impact the future of manufacturing work and (3) how skill needs will evolve, both in terms of hiring new employees and upskilling current employees.

To this end, Section 2 of this report provides an overview of the state of skills in manufacturing. Section 3 uses interview findings to determine the types of skills needed in the future in the four specific industries and one initiative—as well as manufacturing as a whole. Section 4 aggregates common themes found in the interviews, and Section 5 highlights best practices and recommendations that companies should consider both to plan for the future and to fill the skills gap.

Key findings of the report include the following:

- Across all four researched industries and one researched initiative, as technology advances and data accumulates, companies are finding greater need for individuals with data analysis skills.
- Despite advances in automation, companies still see the value in interpersonal skills, particularly communication and collaboration skills.
- Critical thinking, problem-solving and an agile mindset are skill sets that manufacturers will need more and more in the future, as technology advancements occur.
- Companies are looking to invest more heavily in training programs to develop and grow employees in the skills that are needed.

Overall, manufacturing firms interviewed across all four industries and one initiative highlighted very similar skill needs for the future, with some skills varying in level of importance depending on industry type. When it comes to fulfilling these needs, companies are investing in training programs for their current employees, as well as trying to increase their talent pools through educational partnerships. As data skill needs increase within the manufacturing industry, firms will need to put more effort into competing for talent against other industries.

1.1 MAJOR THEMES

KEY THEME	DESCRIPTION
Necessary Shift in Future Planning	Manufacturers report a growing need to make their organizations more resilient and responsive to industry-level and macroeconomic trends, especially when it comes to filling skill needs.
Need to Educate Students about Manufacturing	Manufacturers are preparing for upcoming skill needs by connecting now with youth, parents and underrepresented groups, with investments in various pipelines and media.
Importance of Company Values and Culture	Manufacturers are looking to remain competitive, especially when hiring younger workers, by emphasizing organizational impact (i.e., ways of “making a difference”) and values (e.g., inclusivity).
Value of Diversity, Equity and Inclusion	Manufacturers are taking steps to hire and retain more diverse teams—and see doing so as beneficial to their businesses.
Role of Upskilling and Training	Manufacturers value continuous training for current employees, especially in the face of skills shortages and other disruptions, and some have made investments in related platforms or reimbursement programs.

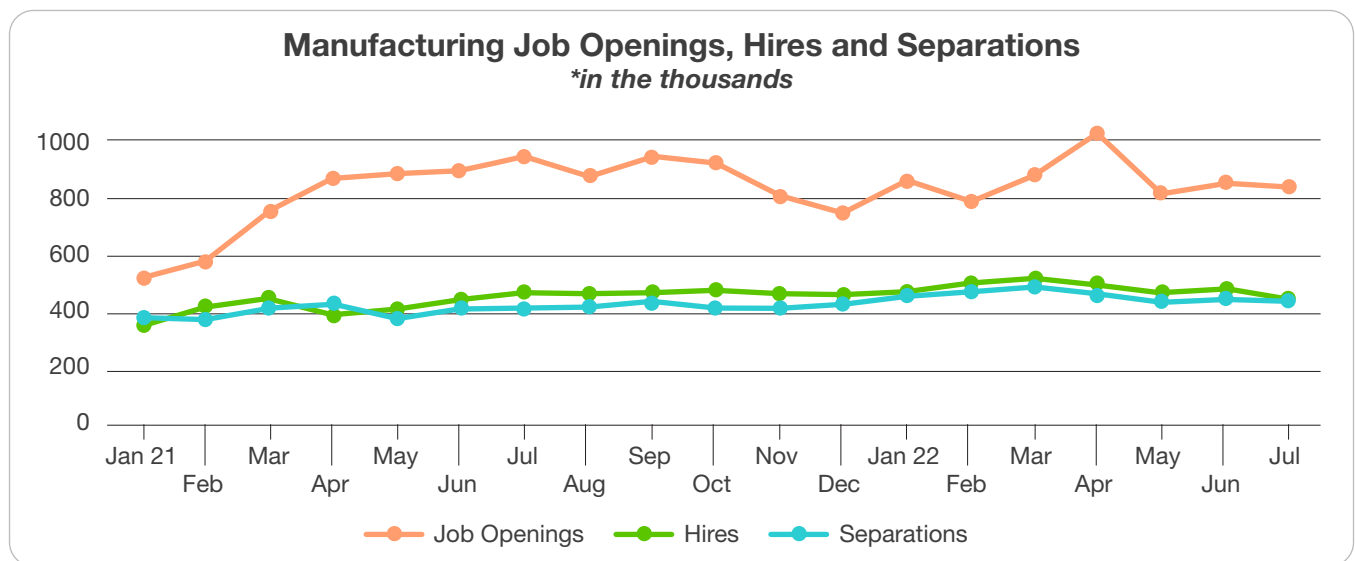
1.2 KEY INSIGHTS AND RECOMMENDATIONS

RECOMMENDATION	EXAMPLES
Inventory Skills of Current Workers	<ul style="list-style-type: none">• Questionnaires or semi-structured conversations about skills employees have but do not utilize in their current role• Reciprocal mentoring (i.e., junior employees sharing niche knowledge or skills with more senior employees and vice versa)
Consider Updating Position Descriptions	<ul style="list-style-type: none">• Specific language in lists of required soft skills (e.g., strong written communication abilities versus strong verbal communication abilities)• Equivalent experience and certifications as an alternative to undergraduate or graduate degrees, where appropriate• Up-to-date descriptions of technologies used in roles
Offer Apprenticeships	<ul style="list-style-type: none">• Programs that hire for aptitude in areas that can be harder to train (e.g., critical thinking) and then train for specific, often more technical, skills
Foster Inclusivity and Train Company Leaders	<ul style="list-style-type: none">• Creation of employee resource groups• Training on DEI for managers, potentially with the help of outside contractors
Work with Curricula Developers	<ul style="list-style-type: none">• Partnerships with schools to integrate classroom instruction and relevant work experience• Collaboration with local certification programs• Hiring through a wide range of pipelines including, but not limited to, high schools, local community colleges and universities

2. OVERVIEW

2.1 THE CURRENT SKILLS GAP IN MANUFACTURING

Over the last decade, the manufacturing industry in the United States has struggled to fill open positions due to numerous factors, including increased competition for workers, outdated perceptions about the industry and new technologies requiring more technical skills.¹ As of August 2022, there were 795,000 job openings in the manufacturing industry.² According to study findings by the MI and Deloitte, a structural skills mismatch persists in the manufacturing sector, with demographics and outdated perceptions challenging the attraction of more Americans into the sector. Manufacturing companies are increasingly competing with other sectors for skilled labor. Yet manufacturing ranks low among prospective job candidates as a preferred career option.³ All things considered, the manufacturing industry will continue to struggle to fill positions unless action is taken. Indeed, the inability to attract and retain more workers in the sector has remained one of the top issues in the NAM Manufacturers' Outlook Survey each quarter for the last ten years.⁴



Filling current and future job openings will hinge upon the manufacturing sector's ability to link degrees, certifications and other educational offerings with skill needs, as well as training current employees with relevant skills. In doing so, the manufacturing sector can continue changing any perceptions that manufacturing is outdated or technologically behind. In addition, educational offerings and curricula should better reflect where the manufacturing sector is moving into the future. Because in-demand skills within the manufacturing sector now overlap with other sectors such as retail and health care, manufacturing companies must examine how to best sway skilled workers amid stiff competition. As new technology is incorporated into factories, companies will need to hire for more specialized operational skills; until then, greater investment is needed in training up current employees. Lastly, manufacturing companies should consider how they can better pitch themselves to prospective candidates to change the outdated perceptions that individuals may have about manufacturing.

¹ "Labor Constraints Remain Greatest Challenge for Resurgent Manufacturing Sector." Federal Reserve Bank of St. Louis. 13 July 2022.

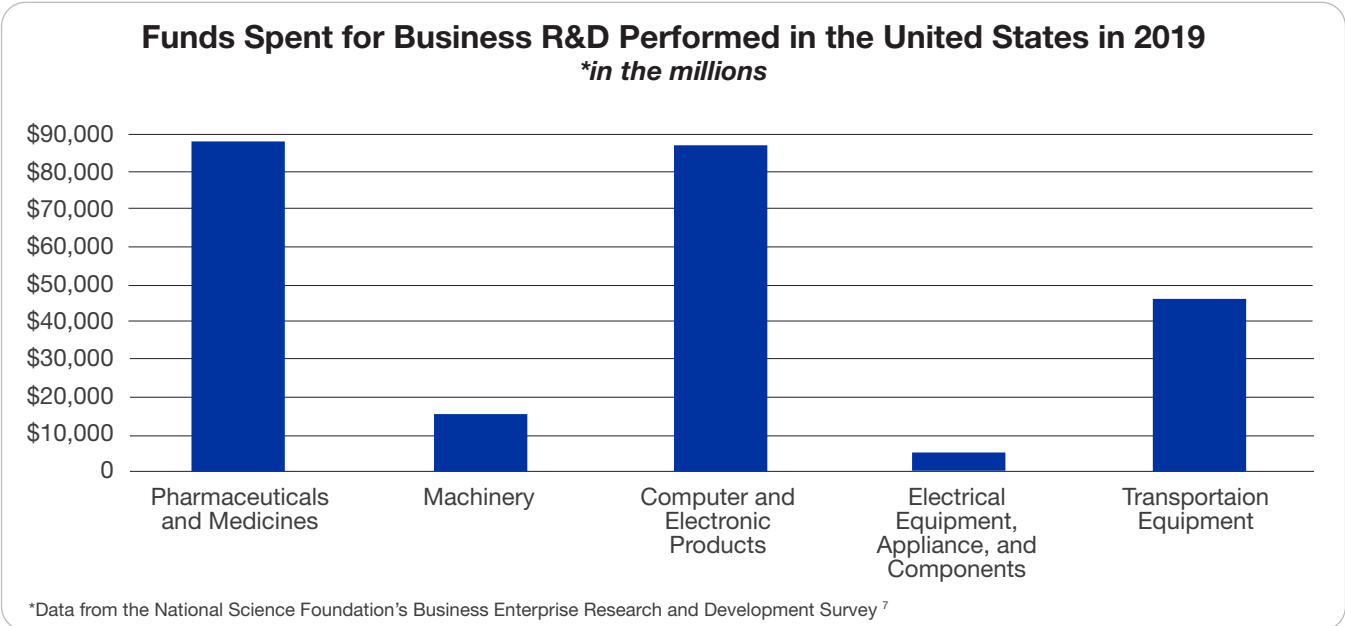
² Job Openings and Labor Turnover Survey, U.S. Bureau of Labor Statistics.

³ "Deloitte and The Manufacturing Institute: Big Gains in Perceptions of US Manufacturing as Innovative, Critical and High Tech." Deloitte. 30 March 2022.

⁴ See <https://www.nam.org/manufacturers-outlook-survey/>.

2.2 WORKFORCE PROJECTIONS

Over the next decade, 4 million manufacturing jobs will likely be needed and 2.1 million are expected to go unfulfilled if people are not inspired to pursue modern manufacturing careers.⁵ The increases in employment can be attributed to a multitude of factors, including rapidly advancing technologies that improve innovation and quality while enhancing overall productivity and competitiveness. Even during recent periods of tremendous disruptions from the COVID-19 pandemic and supply chain issues, firms continued to make smart investments in technologies that will pay off for years to come. In a 2021 survey from the MI and BKD,⁶ a national consulting firm, more than 77% of manufacturers reported making technological investments to achieve cost efficiencies in the production process, with 73.4% doing so to improve their operational performance. Such commitments have changed and enhanced the nature of work, including the skill sets that are required for manufacturing employees.



Because the manufacturing sector continues to struggle to fill current job openings, unless concerted efforts are made to address the skills needed to fill these roles, the challenge of attracting more workers and upskilling current workers will persist or worsen for the sector.

The industries and initiative included in this study are: (1) electric vehicles and battery production, (2) logistics, (3) semiconductors, (4) pharmaceuticals and (5) sustainability efforts. This study focuses on these four industries and one initiative because they are representative of areas in which the manufacturing sector will continue to grow in new ways. They are fast-changing and topical, either due to technological advances or increased product demand; these industries will continue to play an increasingly important role in the economy and are likely to evolve and expand in the coming years. Of the four industries and one initiative included in this study, all are encapsulated in the U.S. government's Cybersecurity & Infrastructure Security Agency's 16 critical infrastructure sectors. These sectors' assets, systems and networks are considered so vital to the U.S. that their incapacitation or elimination would have a debilitating impact on national and economic security, public health and safety.⁸ Three of the four industries examined (electric vehicles and battery production, semiconductors and pharmaceuticals) are also on McKinsey & Company's list of manufacturing industries that can advance (1) productivity and economic growth, (2) job and incomes, (3) innovation and competitiveness or (4) national resilience.⁹ The other two—logistics and sustainability—play vital supporting roles, ultimately highlighting the importance of gaining knowledge from all five increasingly critical areas represented in this study's interviews.

⁵ ["2.1 Million Manufacturing Jobs Could Go Unfilled by 2030."](#) National Association of Manufacturers. 4 May 2021.

⁶ Following a merger with Dixon Hedges Goodman, BKD is now called FORVIS.

⁷ ["Business Enterprise Research and Development: 2019."](#) National Science Foundation. 28 April 2022.

⁸ ["Critical Infrastructure Sectors."](#) Cybersecurity & Infrastructure Security Agency. 21 October 2020.

⁹ ["Building a more competitive US manufacturing sector."](#) McKinsey & Company. 21 April 2021.

2.2.1 Electric Vehicles and Battery Production

Many traditional automakers are shifting away from internal combustion engines (ICEs) towards battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs), which derive power from hydrogen, due to customer demand and concerns about climate change. New political action, namely, the Inflation Reduction Act, has renewed attention to and investment in all types of clean vehicles, including hydrogen fuel cells and battery electric vehicles. Consequently, the electric vehicle and battery industries are poised to experience an increase in product demand and job openings. According to the Economic Policy Institute, the shift to all-electric vehicles could create more than 150,000 jobs by 2030 in the U.S., as long as: (1) 50% of domestic auto sales by 2030 are BEVs and, perhaps more importantly, (2) the U.S. invests in the auto sector to ensure batteries and drivetrains can be produced within the country.¹⁰

The skills needed to move the electric vehicle and battery industry forward will also need to shift, particularly as demand for electric vehicles increases. According to one paper, as companies make the transition towards electric vehicles, positions in software and data analytics will grow exponentially. Because electric vehicle and battery production and assembly will require more technical skills, to maintain existing workforce employment, these workers will likely need to be reskilled to help meet the increased demands for data analytics and software competencies.

“Challenges associated with transforming the automotive industry from internal combustion engines to electric have driven skills shortages. We always need engineers, but we also need people who understand data and how it feeds improvements.”

—Jacqueline Floro-Forde, Vice President of Human Resources and General Affairs & Carl Walton, Vice President of Strategic Initiatives and Facilities, Panasonic

Additionally, as robotics in the automotive industry become increasingly advanced, workers will need to be trained how to maintain and troubleshoot these machines. One large automotive firm, anticipating a major expansion of the electric vehicle market, planned out its own electric vehicle factory with the projection that the expansion of electric vehicles would increase the demand for more customized products to meet customer demand. The planned electric vehicle factory will make use of technologies that facilitate connectivity on the plant floor and quick adjustments on the production line. Because the production system will require high usage of real-time data, the firm envisions a growth in already-existing jobs, including engineers, digital twin technicians, predictive supply network analysts and robot testing coordinators.¹¹

2.2.2 Semiconductors

Total employees in the wider industry for semiconductors plus electronic components have grown from 374,000 in February 2020 to 389,400 in August 2022.¹² These traditional roles will still need to be filled, and the semiconductor industry—like the manufacturing sector as a whole—is experiencing issues filling current openings. Moreover, as semiconductors become more advanced, new roles will open in the industry, including positions focused on data analytics and digitalization; nearly three out of five chip companies have already begun their digital transformation journey, and this transformation will continue if companies want to remain competitive.¹³ Software skills are also a growing area within semiconductor companies, as programming is needed to integrate chips into other rapidly growing industries (e.g., electric vehicles).

¹⁰ “The shift to all-electric vehicles could create over 150,000 jobs by 2030—if policymakers make smart investments to secure U.S. leadership in the auto sector.” Economic Policy Institute. 22 September 2021.

¹¹ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms,” MIT Task Force on the Future of Work. January 2021.

¹² Also based on data from the Bureau of Labor Statistics; see <https://www.bls.gov/news.release/pdf/empst.pdf>.

¹³ “2022 semiconductor industry outlook,” Deloitte. 2022.

The recent signing of the 2022 CHIPS and Science Act further highlights the urgent need for semiconductors and people who are adequately trained to make semiconductors and parts.¹⁴ Increased government investment in research and workforce development, in addition to company investment in building or expanding semiconductor facilities, will create greater awareness of the semiconductor industry and boost American production. Taken together, the semiconductor industry will not only need to sustain its current workforce, but it also will need to expand roles in new areas to accommodate American production growth, such as data analytics and software skills.

2.2.3 Pharmaceuticals

While the pharmaceutical industry has always been important, it cannot be denied that the COVID-19 pandemic has thrust the industry into a new light. According to NAM President and CEO Jay Timmons, “Pharmaceutical manufacturers are essential to America’s health and well-being and to the success of our economy.” In fact, pharmaceutical and medicine manufacturing generates nearly \$339 billion in output, and industry employees produce \$1.3 million in output per employee, which is nearly seven times greater than the U.S. economy’s average output per employee.¹⁵ In December 2021, the pharmaceutical manufacturing industry employed just over 340,000 people in the U.S.¹⁶ Between the years 2000 and 2019, annual R&D budgets grew by around \$45 billion.¹⁷ As greater investment is thus made in R&D, the industry will need to hire more people to fulfill demand. The skills needed to fill these roles are not solely within the science realm. Though the word “pharmaceutical” often connotes purely science-based roles, the industry itself is quite broad in the types of people it employs. The perception that the pharmaceutical industry only hires people with advanced or terminal degrees simply is not true. In 2017, the U.S. biopharmaceutical industry directly and indirectly supported more than four million jobs.¹⁸ The industry needs people to fill a wide range of jobs, including R&D roles requiring advanced degrees and manufacturing technician roles requiring a high school diploma.¹⁹

Beyond roles traditionally associated with the pharmaceutical industry, such as chemists and engineers, there is a growing need for individuals who can work with new technologies and robotics. Many companies are already starting to recognize this need; pharmaceutical companies in North America saw the largest growth in machine learning roles in the last quarter compared to the previous year.²⁰ Moreover, an increasing number of companies are utilizing predictive analytics and smart manufacturing solutions, such as batch processing software and process optimization software, to improve reliability and validity of products.²¹ With the rise of such technologies comes the need to have individuals skilled and trained in software and data analytics.

“Though facilities are more automated, we still need people to think about data, advance processes to the next step, troubleshoot and drive continuous improvement.”

—John Neal, Vice President of Manufacturing Strategy, Eli Lilly

2.2.4 Logistics

The COVID-19 pandemic also highlighted how critical supply chains are for ensuring that goods and products can reach consumers. Though digitization of systems was already occurring, the pandemic accelerated this transition to increase operational efficiency and effectiveness. This trend is unlikely to slow down; as the logistics industry becomes more technologically advanced, more roles will need to be filled. By 2030, the number

¹⁴ [“FACT SHEET: CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains and Counter China,”](#) White House. 9 August 2022.

¹⁵ [“New NAM Report Highlights the Impact and Importance of Pharmaceutical Manufacturing,”](#) NAM. 9 September 2021.

¹⁶ [“Quarterly Census of Employment and Wages,”](#) U.S. Bureau of Labor Statistics (NAICS 3254).

¹⁷ [“5 things to understand about pharmaceutical R&D,”](#) Brookings Institute. 2 June 2022.

¹⁸ [“Economic Impact of the U.S. Biopharmaceutical Industry,”](#) PhRMA. December 2019.

¹⁹ Ibid.

²⁰ [“North America is seeing a hiring boom in pharmaceutical industry machine learning roles,”](#) Pharmaceutical Technology. 4 August 2022.

²¹ [“Pharma Analytics,”](#) AspenTech.

of logistics roles²² is expected to grow nearly 30%.²³ However, it should be noted that as automation and autonomous vehicle usage are scaled up, the mix of logistics roles will shift more heavily towards technicians, analysts, supply chain planners and inventory managers.²⁴ In its signature program for military members, veterans and their spouses—Heroes MAKE America²⁵—the National Association of Manufacturers and its partners are already offering training, certifications and other resources for precisely these roles. Though fully autonomous vehicles are still at least a decade away, logistics companies should still be planning for the future with the knowledge that one day, these vehicles will be in use; in the meantime, any automation solutions in the logistics industry are likely to be ones that assist, rather than replace, human workers.²⁶

Because talent gaps persist across supply chains and operations, logistics companies must consider how to upskill their workforce to be able to master newer technologies and make data-informed decisions. Additionally, the industry has had to become more collaborative and communicative to meet customer expectations, whether that involves formal partnerships or collaboration with truck drivers providing last-mile delivery, highlighting the importance of communication.²⁷ Streamlining and standardizing operations across logistics partners and within companies can also help minimize interruptions to consumers. According to PwC, digital fitness, or the maximum and intelligent use of technology, will be the skill that allows companies to examine a range of new technologies, from data analytics to automation and platform solutions; without digital fitness, companies risk obsolescence.²⁸ Ultimately, moving towards digital capabilities and upgrading logistics operating models will help boost companies' resiliency in the face of future disruptions.²⁹

The importance of a strong logistics industry for manufacturers cannot be overstated. To future-proof business and meet customer demands, manufacturers will need to make greater investments in understanding the manufacturing ecosystem, which includes material suppliers, contractor companies and logistics providers. Manufacturers will also need to be more agile in adjusting asset distribution and leveraging digital capabilities to better respond to disruptions.

2.2.5 Sustainability

Employment in environmentally focused occupations is expected to grow up to 68% in some areas by 2030.³⁰ Consumers are paying greater attention to how products are manufactured and how companies impact the health of the planet. Within the manufacturing space, an increasing number of companies are devoting time and resources to identifying ways to manufacture more sustainably. With examples such as more creative product design, reduced usage of water and electricity and increased recycling, manufacturers are demonstrating their commitment to making the necessary investments to become more sustainable.

“Sustainability and digital transformation go hand in hand. The skill sets for digital disruption include design thinking, agile business transformation and marketing for the digital age.”

—Tom O'Reilly, Vice President of Sustainability, Rockwell Automation

The skills needed to make manufacturing more sustainable are far-reaching because the methods used by manufacturers to become more sustainable can be far-reaching. Identifying ways to reduce water or natural resource consumption may require environmental engineers; increasing the longevity of a machine may require maintenance technicians; creating longer-lasting, more innovative products may require product designers. In the auto industry, more carmakers are considering how to change the design process of vehicles to make

²² Roles include logisticians, analysts, coordinators, planners and specialists.

²³ “[Employment Projections](#),” U.S. Bureau of Labor Statistics.

²⁴ “[Warehousing, Trucking and Technology: The Future of Work in Logistics](#),” MIT Work of the Future. September 2020.

²⁵ For more information, see <https://www.themanufacturinginstitute.org/veterans/heroes-make-america/>.

²⁶ “[Manufacturing in America: A View from the Field](#),” MIT Work of the Future. November 2020.

²⁷ “[Shifting patterns: The future of the logistics industry](#),” PwC.

²⁸ Ibid.

²⁹ “[Supply chain disruption](#),” Accenture.

³⁰ “[Green growth: Employment projections in environmentally focused occupations](#),” U.S. Bureau of Labor Statistics. April 2022.

dismantling easier for recycling purposes, sparking the need for sustainability-focused designers.³¹ In the same vein, future employees in multiple roles will need greater engineering, environmental science and digital skills, among others. As greater investments are made in sustainable manufacturing, companies will need to consider reskilling employees to ensure they can fill current needs while continuing to build out recruiting pipelines.³²

“Being a software company that serves manufacturers, we look at sustainability through the lens of how we empower our customers to build better things, better. Some of the barriers to sustainable designs are factors like customer buying habits, or product usage. The other challenge is how to design things in whole new sustainable ways, which is where we can help. For example, by utilizing new technologies to empower generative design, companies are able to reduce material usage, driving smaller impacts on the world. Also with design simulation technologies, companies are able to find ways to utilize materials which are recyclable, reduce the carbon footprint of the product, or increase the overall usage life of the product.”

—Michael DiTullio, President, Digital Thread, PTC

2.3 SKILLS TO FILL CURRENT GAPS AND FUTURE TRENDS

Data analytics and digital skills are needed to fill current job openings. Many large manufacturing firms either have begun to make or have already made great strides towards a more digitized strategy, where data from machines and products are continuously collected and used to streamline the production process.³³ Upskilling of current workers will also be needed to ensure that employees can level up and be proficient in advanced technologies. Indeed, the need for continuous learning has become the norm in manufacturing, with manufacturers stressing training programs for their employees. According to the MI’s 2020 Training Survey, nearly 70% of manufacturers are addressing the workforce crisis by creating and expanding internal training programs.³⁴ For example, workers on the shop floor will need to have an increased ability to analyze digital information; therefore, manufacturers should incorporate data skills into their training programs.³⁵ In a study of large manufacturing firms, researchers found a preference for tailored, individualized approach to training; this approach equips employees with the skills most relevant to the new tasks they may need to perform.³⁶ As companies work to develop pipelines to hire for the skills they need, they can also reskill their current employees to ensure that there is a consistent influx of employees with the skills needed for companies to succeed.

The manufacturing sector should continue to work to change perceptions about automation, especially among workers who might be concerned about job security. By using automation to replace particular tasks, companies can minimize risk to human life, as well as free up human resources to enhance worker efficiency and effectiveness. In a study from MIT’s Task Force on the Future of Work, interviewees noted that improving quality was a major reason for purchasing new technology, often leading to upskilling of current workers and hiring new workers with the requisite skill to use the new technology.³⁷ Automation therefore can eliminate some of the least desirable parts of manufacturing jobs, as well as increase safety and precision. Increasing automation creates different skill needs to engage with and operate this new technology. With manufacturers kicking off 2022 with the highest number of robot purchases ever in a single quarter (valued at \$646 million), companies must ensure that current employees receive training on how to utilize, maintain and troubleshoot, while continuing to hire and train for the skills needed to work alongside robotics.³⁸

³¹ “Some Carmakers Say Recycling Car Parts Is the Future. But Is It Realistic?” New York Times. 31 August 2022.

³² “US manufacturing: The next frontier for sustainable, inclusive growth,” McKinsey & Company. 21 April 2022.

³³ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms.”

³⁴ “The Manufacturing Institute Training Survey.” 17 January 2020.

³⁵ A recent study on the transformative nature of 5G technologies discussed this trend (and how 5G would improve the analysis of data). It also focused on how 5G might improve, but also necessitate, more training. See <https://www.themanufacturinginstitute.org/wp-content/uploads/2021/03/Manufacturing-Institute-5G-study.pdf>.

³⁶ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms.”

³⁷ “Manufacturing in America: A View from the Field.”

³⁸ “Robot Sales in North America Continue Record Surge into 2022.” Business Wire. 31 May 2022.

“To maximize sustainability and productivity, you need skills that marry the physical and digital worlds: namely, you need the ability to deal with cloud-based software and the ability to understand applications and interactions between mechanical and automation systems.”

—Tom O'Reilly, Vice President of Sustainability, Rockwell Automation

While gaps in the areas of data analytics and digital skills already exist in the manufacturing industry, in the future, the need for these skills will only increase. In addition to data analytics and digital skills, the four sectors and one initiative highlighted in this report will also need to fill roles that require an agile mindset and critical thinking, as well as interpersonal skills. With the influx of data, both in terms of sheer amount and level of detail, employees will need to develop a mindset where they are able to make data-informed decisions, respond to customer demands and incorporate customer feedback. Lastly, as automation becomes more common in the manufacturing industry, communication, teamwork and collaboration are skills that will be more important than ever.



3. FUTURE SKILLS

Based on interviews with company leaders from the sectors of electric vehicles and battery production, semiconductors, pharmaceuticals, logistics and sustainability, three major skill needs for the future emerged: (1) data analytics, (2) agile mindset, problem-solving and critical thinking and (3) interpersonal skills. Although these skill needs currently exist, company leaders project that these needs will continue to accelerate and grow as greater investments are made in digitization and newer technologies.

3.1 DATA ANALYTICS

“While we get a lot of data from tools and sensors, we need people with advanced troubleshooting skills to process the data and take the best action.”

—Tim Kinnard, Vice President of Wafer Fab Manufacturing, Texas Instruments

In recent years, interviewees have observed a proliferation of data that have the potential to improve operations and decision-making; however, the amount of data first requires thoughtful processing and direction to the right teams and individuals at the right times. Automation has enabled the round-the-clock monitoring and sophisticated data infrastructure necessary to leverage data to achieve company goals—whether related to safety, sustainability, productivity, quality or any combination of these dimensions. Still, interpretation of data, implementation of decisions and related internal and external communications are needed skills. Because of this increasing need for data-proficient and data-aware workers, many manufacturers now report having to compete for talent with large technology companies when hiring for the growing number of roles that involve data science and analytics. To gain a competitive advantage over other industries, manufacturing companies will need to make concerted efforts to evolve into an employer of choice.

“The digital acceleration is giving us access to more data, but we need more people to interpret data.”

—Sherry Cassano, Senior Vice President of People Experience, Pfizer

Multiple manufacturers also expressed the need for analytical abilities beyond any particular degree or credential; this trend was true for all sectors interviewed. One interviewee recommended that current and future students consider data one of their “core electives.” In other words, data should be a part of what all workers should be able to “live and breathe every day” moving into the future. For this reason, other interviewees recommended that employers and educational institutions offer training focused on “real” or applied data analytics, with opportunities to work with actual information—rather than estimates or made-up numbers—and to troubleshoot varied issues with data from start to finish. This type of training was said to have the additional benefits of garnering higher engagement from individuals and accelerating onboarding processes for recent graduates.

“We have established a digital academy, which will be an enterprise-wide upskilling and learning and development program. Everyone in the company needs at least a certain level of proficiency in the basics of digitalization – whether that’s about data technologies, systems, or smart manufacturing. Ultimately, our employees need to be data-savvy enough that, when we equip them with an app or a report, they can read it and make more informed and strategic decisions.”

—Athina Kanioura, Chief Strategy and Transformation Officer, PepsiCo



RECOMMENDATION: Offer training focused on “real” or applied data analytics, with opportunities to work with actual information—rather than estimates or made-up numbers—and to troubleshoot varied issues with data from start to finish.

3.2 AGILE MINDSET, PROBLEM-SOLVING AND CRITICAL THINKING

“Creativity and adaptability just can’t be automated, particularly when it comes to problem-solving.”

— Michael DiTullio, President, Digital Thread, PTC

Nearly all participating manufacturers identified critical thinking and problem-solving as key skills that are nonetheless difficult to find in sufficient number among current job applicants. As supply chains grow more complex, for example, manufacturers’ employees will need to be able to identify and evaluate viable solutions or improvements—often across different time horizons and in response to fluctuating circumstances—and optimize their use of finite resources. As such, employers would love to see curricula in high schools and colleges provide more opportunities for young people to build the “muscles” of critical thinking and problem-solving. In the absence of such curricula or educational training, many manufacturers are also being proactive by taking action to cultivate those skills within their workforces through extensive onboarding processes. Some companies are partnering with local educational institutions to educate students as early as kindergarten about the manufacturing sector and needed skills and abilities in the future.



RECOMMENDATION: Support curricula in high schools and colleges that provide more opportunities for young people to build the “muscles” of critical thinking and problem-solving.

For many interviewees, these critical thinking skills go hand in hand with the ability to take cross-departmental or interdisciplinary approaches. In the experience of some employers, new workers may be highly educated on how to operate different software or comply with different industry standards but still need practice recognizing the comprehensive ways their work touches other parts of the same company. That is, good engineers may design products that accomplish objectives, but great engineers, over time, are further able to grasp the energy-intensiveness of production of their designs, or customer behavior in response to different aesthetics, or options for streamlining supply chains and internal production processes. As a result, multiple manufacturers value applicants who have backgrounds working across functions or with multiple types of stakeholders, including dual degrees, cross-training or time spent learning from mentors with holistic views.

Similarly, numerous interviewees emphasized the need for workers who can not only adapt to, but also thrive on change. Manufacturers characterized agility (i.e., the capacity to predict, quickly address and remain successful in the face of situational shifts) as equally important as technical or interpersonal skills, with some companies reporting they prioritize flexibility and ability to learn when assessing potential hires over these other skills. Constantly improving technology appears to be one driver of this focus, as employers view skill-building “as a journey rather than a destination,” in the words of one interviewee. Hiring for individuals who already have this sort of growth mindset would likely result in a manufacturing workforce more interested in upskilling as technology changes.

A growth mindset is not just needed in the employees working on the shop floor. Though shop floor workers may need to adapt to new technology, workers with higher levels of education, such as data scientists and engineers, will also need to learn about the intricacies of production from the workers most familiar with the processes. Collaboration between data-specialized employees and production workers is similarly critical for success.

Data scientists may struggle to translate data collection and analysis into shop floor improvement, while production workers may be unaware of data efforts and their impact on the production process. Collaboration between data analysts and production workers can help ensure that the former is aware of shop floor decision-making dynamics and the latter is informed of the benefits of data.³⁹

For company leaders, change management and other related skills will continue to be key to effectively navigating the industry for the foreseeable future. Finally, while diversification of experience and skills can help workers adapt to the constantly changing nature of manufacturing, educational or on-the-job programs are also beneficial for instilling knowledge of agile manufacturing concepts like modular product design.

3.3 INTERPERSONAL SKILLS

“Soft skills are vitally important to our business. Manufacturing is a people business and we need leaders that can connect with people.”—Tamberlin Golden, Executive Director of Diversity, Equity and Inclusion, GM

All participating companies noted the critical nature of soft skills such as communication and collaboration. Even as automation makes some aspects of jobs easier and safer, in many cases, it has actually increased the number of workers or departments that collaborate or delegate, thus placing more importance on workers who can, for example, give and comprehend complex instructions. In the same vein, manufacturers across locations and sectors reported a need for employees with emotional intelligence and empathy, especially as these skills relate to teamwork. With the fast pace of manufacturing showing no signs of slowing, successful workers will need to be capable of presenting information clearly, actively listening to peers and persuading stakeholders within a fast-paced environment.



RECOMMENDATION: Hire and promote workers who are capable of presenting information clearly, actively listening to peers and persuading stakeholders within a fast-paced environment. Reward emotional intelligence and empathy.

Interviewees said they increasingly seek to hire workers who already possess positive interpersonal traits that are difficult to teach. Train-to-hire programs can be attractive for this reason. In these programs, individuals skilled in collaboration teamwork or other soft skills—or those whom hiring managers know would add value to team dynamics—but who may be less experienced with the technical aspects of certain roles can be paid to undergo training for the technical components of the role. These programs can be beneficial for all parties: employers can hire individuals with existing interpersonal skills, which can sometimes be difficult to train for, and employees can gain valuable technical experience.

In nearly all interviews, manufacturers interpreted “interpersonal skills” through a traditional lens (e.g., strong verbal communication skills, mastery of face-to-face interactions and comfort speaking in front of new people). A few manufacturers noted the specific challenge of finding younger workers with a strong grasp of these traditional interpersonal skills. However, a few manufacturers also asserted that technological changes have highlighted the need for new and more digital types of interpersonal skills, like participating in virtual meetings or juggling multiple messaging platforms. That is, as the pandemic has increased the prevalence of hybrid work, and as technology has advanced to allow for augmented and virtual reality, some manufacturers’ notions of interpersonal skills, including what those mean and how those manifest, have shifted. Employers should consider how to update position descriptions, while keeping these shifts in mind.

³⁹ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms.”

More and more manufacturers are also looking to ensure diversity, equity and inclusion within their workforces; therefore, companies are seeking individuals with the ability to communicate unique perspectives or to facilitate environments where those perspectives are incorporated into all levels of discussion. Many believe that such environments lead to more innovation and better company performance. According to a study from the MIT Task Force on the Future of Work, “ideas about how to improve production often [come] from workers on the factory floor. It’s the interaction between production workers and design engineers . . . that drives changes in the plant that improve quality and sometimes lead to new products.”⁴⁰ Diverse perspectives from people with diverse backgrounds are critical for innovation.

“Measures like EQ (emotional intelligence) contribute to how much teamwork you can accomplish, regardless of where people are physically working.”

—Jacqueline Floro-Forde, Vice President of Human Resources and General Affairs & Carl Walton, Vice President of Strategic Initiatives and Facilities, Panasonic

The value of diversity goes beyond creativity and innovation as they relate to product development. Multiple companies also explained that attention to DEI will be key to attracting and retaining incoming employees. To give just a few examples of multiple, varied efforts to think about skills through the lens of DEI, some companies commented that they have reevaluated the educational requirements within their job descriptions to potentially open roles to more candidates. Other companies have rolled out tools for job candidates or employees whose first language is not English to help fully integrate those individuals and ensure equitable training and career trajectories among all employees.



⁴⁰ “Manufacturing in America: A View from the Field.”

4. MAJOR THEMES

Beyond hiring and developing the aforementioned skills of the future, interviews revealed several common key themes: (1) the necessary shift in future planning, (2) the need to educate students about manufacturing, (3) the importance of company values and culture, (4) the value of diversity, equity and inclusion and (5) the role of upskilling and training. Manufacturers should be cognizant of these themes as they continue to plan, project and strategize for the future.

4.1 THE NECESSARY SHIFT IN FUTURE PLANNING

Events during the pandemic forced companies to rethink their efforts to build workforces, including their previous approaches to training, talent pipelines and job descriptions.

“As we’re deploying new technology and implementing our five- to ten-year strategy maps while also monitoring the outside world in terms of new technologies (whether equipment or software or other enabling tools), we make sure to think about and align all human factor elements as well.”

—Nicole Murphy, Executive Vice President of Pharmaceutical Operations and Technologies, Biogen

Nearly all interviewees in the logistics space and many companies across other sectors experienced significant impacts over the past few years as trends such as remote work; consumer attention to environmental, social and corporate governance and company values; improved artificial intelligence and other advanced technologies; and wider use of electric vehicles—just to name a few—either commenced or took on new importance. Unsurprising, then, is that numerous manufacturers reported a growing need to make their organizations more resilient in the face of future disruptions. For example, manufacturers are more interested in using virtual reality as part of upskilling programs; in reevaluating the skills and degrees “required” to perform certain jobs; and in assessing possible savings through hybrid work on facility space, energy use and relocation costs. Manufacturers reported that their past efforts to address skills shortages have often been reactive rather than proactive, and they are looking to plan more strategically moving forward, including making a concerted effort to think about the long-term when selecting workers and worker-related resources (e.g., training platforms).

“We see the future of developing skills and capabilities being shaped by virtual reality. The skills needed in a future state will largely be influenced through the changes and advancements in digital and sustainability.”

—Paul Mefford, Senior Director of Operations, Strategic Initiatives and Change Management, Dow

4.2 THE NEED TO EDUCATE STUDENTS ABOUT MANUFACTURING

Companies recognize the need to reach students earlier and educate them about manufacturing.

When asked about pipelines for talent, several interviewees expressed interest in preparing for upcoming skill needs by connecting now with children and teenagers—i.e., the workforce of the future—as well as parents who might otherwise underestimate the breadth and quality of manufacturing opportunities. The views of interviewees echo that of Creators Wanted⁴¹—one of the largest campaigns to build a future workforce for U.S. manufacturing—which aims to improve parents’ perceptions of the industry by 2025. Accordingly, the campaign has invested in digital and earned media to reach more than ten million potential employees. Multiple

⁴¹ For more information, see <https://www.creatorswanted.org/about-creators-wanted/>.

interviewees also said that the high demand within their organizations for skilled labor extends beyond roles such as engineers or technicians and that high schoolers should not overlook opportunities that they might qualify for as soon as senior year. Providing greater visibility about the prospects and paths available within the field of manufacturing may also help recruit workers with data analytics or writing skills who might not otherwise consider pharmaceutical or semiconductor manufacturing.

Similarly, some respondents have partnered with local high schools, colleges or technical schools to develop classes and curricula in anticipation of future talent needs. Other companies have made efforts to interact earlier with younger people and underrepresented groups in manufacturing, like women or people of color. Other interviewees are already thinking about how to connect better with upcoming generations that will have known only modern technology. The Manufacturing Institute has supported a variety of research⁴² related to these efforts. Events such as MFG Day,⁴³ which annually aims to inspire young people to start manufacturing careers and showcases modern manufacturing to parents and educators, provide other opportunities to supplement existing pipelines. For manufacturers located in areas where in-person education is less feasible—such as companies not located near large schools or rural areas—social media and digital marketing are part of multiple interviewees’ strategies for cultivating timely pipelines and attracting young people.

“We’re working to ensure that more semiconductor curriculum is in schools to make sure that those coming out of universities have key skills and are exposed to career opportunities in the industry.”

—Rebecca Peters, Director of Semiconductor Public Policy, Samsung

The value of educating younger generations about manufacturing goes beyond just developing talent pools. Increased education can also have the added benefit of boosting societal perceptions of manufacturing. In its 2022 study on Americans’ perceptions of U.S. manufacturing, the Manufacturing Institute found that far more individuals than in 2017 believe that U.S. manufacturing jobs require creativity, innovation or problem-solving skills. However, insufficient public awareness of the increasingly high-tech nature of manufacturing still reflects some disconnect from reality and contributes to worker shortages.⁴⁴ Moreover, because skill needs in the manufacturing industry, such as data analytics or engineering, are increasing, manufacturing companies will need to compete for labor with other, more well-known industries, like health care. If companies are able to teach younger generations about the advances in manufacturing, the industry as a whole may be able to become more top-of-mind when job candidates begin their job search.

4.3 THE IMPORTANCE OF COMPANY VALUES AND CULTURE

Companies’ values and cultures are becoming more important recruitment tools, particularly with younger workers.

Another theme that emerged in interviews was a growing focus on corporate culture as part of building and maintaining strong workforces, with one respondent saying “the environment that creates culture” is a priority of leadership. For example, some companies are evolving to meet the needs and wants of the newest wave of employees by incorporating mental health awareness and topics like psychological safety into their organizations’ discussions around culture. Another interviewee explained that a company with a reputation for valuing belonging and engagement among current employees can have an advantage when competing in the market for new employees. Beyond salary or company reputation, people want to work with other people who they feel comfortable around and in environments where they can picture a positive future. Study participants

⁴² See, for example, <https://www.themanufacturinginstitute.org/research/all-in-shaping-tomorrows-manufacturing-workforce-through-diversity-and-inclusion/> and <https://www.themanufacturinginstitute.org/research/multigenerational-teams-in-manufacturing/>.

⁴³ For more information, see <https://www.mfgday.com/#about>.

⁴⁴ For more information, see <https://www.themanufacturinginstitute.org/research/competing-for-talent-recasting-perceptions-of-manufacturing/>.

acknowledged that large or quickly growing teams can face particular challenges (i.e., “growing pains”) when it comes to these aspects of culture, but strong organizational structure, careful training and good company leadership can help mitigate those challenges. These elements can also be a draw for attracting talent.

“Thinking about attracting the next generation, I’ll say we must focus on culture first and foremost and specifically in terms of how we drive inclusivity. Our culture is constantly thinking about what we need to do differently to further innovate and to create a higher level of engagement.

—Nicole Murphy, Executive Vice President of Pharmaceutical Operations and Technologies, Biogen

Additionally, access to sufficient skilled labor may increasingly depend on companies’ willingness to be transparent and active in commitments to their values. That is, all else being equal, study participants believed that job candidates were more likely to say “yes” to offers from companies perceived as socially or environmentally conscious. Some felt that retention was tied to workers finding a “place where they can make a difference” and being able to tap into their skills and passions in ways that improve their own lives and the lives of others. Of final note is that manufacturers who can demonstrate the connections between company values and training programs may see better employee engagement when it comes to skills growth and related investments.

Beyond the way that company values and culture can draw in new talent, strong company culture and organizational structure are critical as firms work to adjust to change, particularly when that change involves technological advances. New technologies may necessitate additional training, and some workers may resist this training due to either lack of incentives or concern that technology will eventually eliminate their positions. A company culture that is prepared to address these challenges will better be able to facilitate technology acquisition than a weak company culture.⁴⁵

4.4 THE VALUE OF DIVERSITY, EQUITY AND INCLUSION

Through the lens of diversity, equity and inclusion, manufacturers are opening up their workforces to untapped sources of talent.

Study participants emphasized that demographics should not preclude valuable workers from being a part of any industry. More and more, companies are taking steps to intentionally recruit—and promote—segments of the population that have historically been excluded from manufacturing roles or manufacturing’s leadership, such as women, people of color and individuals with disabilities. Similarly, multiple interviewees reported an increased focus on hiring from areas in which their facilities are located, both to establish easier recruiting pipelines and to benefit the very communities who purchase their materials and products. Some manufacturers have added chief diversity officers to formalize a focus on DEI among their leadership, but interviewees across sectors and company types noted that efforts to build teams in the future will be incomplete without attention to representation, ideally balanced according to the communities that manufacturers serve.

In addition, a number of interviewees commented that creating more diverse workforces resulted in better business outcomes, in part by fostering consideration of multiple perspectives. When it comes to skills, more diverse workforces that simultaneously exhibit strong collaboration can reduce the pressure on manufacturers to employ perfect candidates—instead, groups of people who work well together can possess all necessary knowledge and abilities as a whole. In order for those diverse groups of people to truly function as a team, however, equity and inclusion become all the more important, particularly to ensure employees are comfortable contributing to decision-making by voicing their own opinions. That is, points made in interviews suggest that manufacturers recognize the need to consider equity and inclusion, in addition to diversity, when thinking about, for example, internal professional development.

⁴⁵ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms.”

“Having a diverse workforce helps . . . because everyone’s life and experiences are immensely valid and valuable. That drives better designs and better outcomes”

— Michael DiTullio, President, Digital Thread, PTC

4.5 THE ROLE OF UPSKILLING AND TRAINING

Training of current workers remains a priority for many manufacturers.

Nearly every company reported the importance of continuous training for their current workers (i.e., upskilling), and multiple interviewees had already made substantial investments in learning platforms, intracompany “academies” or tuition reimbursement programs. These efforts include (1) horizontal training, in which all or most employees are educated on fundamental concepts (e.g., a new technology or a particular approach to project management) and (2) vertical training, in which employees receive instruction on skills necessary to advance to the next level of their department or team or company leaders are trained on topics such as DEI. All in all, a majority of interviewees mentioned using upskilling to ensure workers have the chance to grow and improve alongside their employers even as manufacturing becomes more automated but more complicated.

“With automation, we need educated personnel who can create automation solutions and we need to upgrade our maintenance personnel who work on the upgraded automation and we need operators to learn how to operate better by using the new equipment.”

— Ramy Harik, Associate Professor at the University of South Carolina

Upskilling also appears to be one of the ways that manufacturers can mitigate labor shortages, technological disruptions and the impacts of business cycles or industry seasonality. If a company has been struggling, especially in the longer term, to hire workers with certain skills, choosing to instead place existing workers in relevant training programs can have the additional benefits of boosted employee engagement, retention and morale. To that end, when companies undergo this route to mitigate labor shortages, they should consider incentives to encourage their employees to further upskill. To give another example, manufacturers of cars and car parts may “always need engineers,” in the words of one interviewee, but the transformation of their industry from internal combustion engines to batteries and alternative forms of power will require the re-training of many of those engineers. Finally, in sectors that do experience short or occasional periods of slow demand, devoting excess staff hours to completing individual and team training can be a positive alternative to spending time and money firing and later hiring in large numbers —a concept also identified in the Manufacturing Institute’s November 2021 report on multigenerational teams in manufacturing.⁴⁶

⁴⁶ “[Multigenerational Teams in Manufacturing](#),” The Manufacturing Institute. November 2021.

5. KEY FINDINGS AND RECOMMENDATIONS

Based on a literature review and the conducted interviews, the following best practices and recommendations have been identified. Taken together, these suggestions can help manufacturing companies, regardless of sector, boost skills in the areas where they will be most needed in the future.

5.1 INVENTORY SKILLS OF CURRENT WORKERS

One important part of addressing skills shortages within the manufacturing industry is the set of actions that employers can take to identify untapped abilities within their existing workforce and strategically match those abilities to pressing and upcoming organizational needs. Identifying untapped talent can take the form of questionnaires or a series of semi-structured conversations or can occur more organically. Ways to activate newfound skills can range from more opportunities for employees to move between departments and receive cross-training to encouragement of alternative forms of mentoring (e.g., junior employees imparting niche knowledge or skills to their peers or even to more senior employees). Doing so can boost feelings of purpose and passion among employees, highlight different possible career progressions within companies and, in some cases, eliminate redundant training and thus accelerate onboarding. In addition, at least one interviewee explained that not properly inventorying the skills of employees, especially incoming employees, can lead companies to overlook less traditional but equally valuable skills, such as social media expertise or knowledge about topics like sustainability and DEI.

“In a future state, I think you’ll see more of a skills-based talent marketplace and people saying we have this problem, so what skills are there across the company to attack and solve it.”

—Denise DeLaune, Global Director of Operational Excellence and Leveraged Services, Dow

5.2 CONSIDER UPDATING POSITION DESCRIPTIONS

Companies should review position descriptions with a critical eye in terms of (1) skills required to fulfill the roles of a job and (2) the level of education necessary to meet the needs of the role. For the former, for example, if companies are interested in interpersonal skills, they should clearly delineate what type of communication this entails (e.g., face-to-face interactions versus digital communication). Interpersonal skills may manifest differently in people, so it is important to be as specific as possible in a position description to ensure the necessary skills are targeted. If a role requires a high level of proficiency in written communication, but it does not require much verbal communication, the position description should note that. Furthermore, as the pandemic has highlighted, digital or virtual communication has become much more common, potentially sparking the need to incorporate such skills in new position descriptions.

For the latter, companies should weigh whether specific educational degrees are required, or if equivalent experience through avenues such as the military or internships is sufficient. Companies should also examine their position descriptions to ensure they identify which skills are critical to bring to the role, versus skills that can be taught on the job. Several interviewees noted that machinery in facilities is highly specialized, meaning that entering employees must be technically trained to work with those machines. The training needed to work on specialized machines also suggests that candidates do not need to have those machinery skills when applying for related positions. Conversely, other interviewees noted that they look for critical thinking, problem-solving and agility in potential job candidates because these skills are harder to teach or train. Companies should plan to conduct a thorough review of position descriptions every few years to ensure that they are crafted in a way that targets the correct skills, highlights company values and culture and incorporates clear career growth trajectories, particularly as roles evolve with the advancement of technology.

5.3 OFFER APPRENTICESHIPS

“Ask more of what you as an organization can do to drive the outcomes you want. Consider train-to-hire programs, where someone might be highly collaborative and a good fit for the team, but may not have the necessary hard skills. Pay to have them trained up and upon training completion, hire them.”

— Michael DiTullio, President, Digital Thread, PTC

Multiple manufacturers suggested that widening needs for skilled workers might necessitate more apprenticeships, internships and train-to-hire programs. Substantive versions of these opportunities were praised as allowing hires to quickly be trained, for example, on interpreting data, making decisions with real financial impacts for their employers and contributing to the resolution of complex problems. Here, interviewees added that young workers in particular may benefit from the chance to connect classroom teachings with the ins and outs of “real” manufacturing—and that young workers are often particularly attracted to jobs where they will be able to “actually do something right out of the gate” and immediately apply learnings from school or other jobs. An additional benefit of offering apprenticeships is that existing employees can serve as mentors for soft skills and workplace norms, allowing for both fuller onboarding of young employees and smoother transitions between industries or roles for older individuals.

This recommendation is reflected in other sources, particularly MIT’s Task Force on the Future of Work; they suggest that manufacturing training systems should blend foundational knowledge from educational institutions with more specialized, on-the-job training from manufacturing firms.⁴⁷ Alternatively, if apprenticeships are not possible, companies can also consider train-to-hire programs. Rather than hiring for ability, companies can hire for aptitude in areas that can be harder to train (e.g., agile mindset and critical thinking) and train for the ability to use specific types of technology or other skills needed to fulfill a job’s responsibilities. As manufacturing companies acquire new technologies, specialized training is often needed to use new machines; thus, companies should hire individuals with an ability to acquire new skills quickly, instead of trying to hire individuals who already have this technical knowledge, which is unlikely to be found given the newness of technology.

“Taking a skills first approach opens the aperture beyond just the 4-year degree and provides exposure to a greater talent pool. . . . We welcome agile thinkers and agile learners because we will teach skills to ensure an individual’s success.”

— Tamberlin Golden, Executive Director of Diversity, Equity and Inclusion, GM

5.4 FOSTER INCLUSIVITY AND TRAIN COMPANY LEADERS

More and more, younger generations are concerned about feeling safe and comfortable bringing their whole selves to work. Inclusivity is of utmost importance; not only does it help ensure that employees are retained, but it can also be an asset when it comes to hiring. Employees may be more willing to stay at a company where they know their opinions, perspectives and backgrounds are valued. Highlighting inclusivity and strong company values can also assist with hiring, as more manufacturing companies now must compete for labor with other industries such as technology and health care. Because manufacturing companies are looking for skills that overlap with other lucrative, more recognizable industries, companies will need to do all that they can to make themselves competitive for labor. This can involve changing perceptions about manufacturing being outdated, but it can also involve actively revolutionizing the work environment to be one that is more diverse, equitable and inclusive, which are all attributes that younger generations seem to value more heavily when selecting an employer.

⁴⁷ “Factories of the Future: Technology, Skills and Digital Innovation at Large Manufacturing Firms.”

Companies must commit the necessary time, effort and resources to grow an inclusive work environment. This can be done in a myriad of ways, from honoring the diverse background of employees to investing in employee resource groups to creating accountability measures when microaggressions occur. Of particular importance, companies should consider training their company leaders to have the same skills that companies look for in new employees: teamwork, collaboration and respect. Without committed leadership, inclusivity efforts can be unsuccessful. Companies may need to seek outside help in such training; overreliance on internal resources may cause strain for those leading training, and an outside contractor may be less biased and more able to notice weaknesses.

5.5 WORK WITH CURRICULA DEVELOPERS

Several companies interviewed go beyond setting up talent pipelines through high schools, local community colleges and universities. In addition to such pipelines, through specialized programs, companies work with curricula developers to tailor skills taught in the classroom to the skills needed for a particular firm. In doing so, companies are able to ensure that not only do graduates have a clear career path, but they also receive training in the particular skill sets needed at a company. As one example, the Precision Metalforming Association has an online program in which companies are able to work with PMA to develop an internal curriculum.⁴⁸ For companies opting to become more involved in the curricula development process, input should be tailored, yet general enough that those going through the curricula are not pigeonholed into remaining at one company forever. Sufficient flexibility should be built into curricula so that employees have the freedom to move and grow at other companies.

If directly influencing curricula development is not possible, companies can still work with their partner schools to be clear about the skills needed, both currently and in the future, to inform educational institutions how curricula may need to change. Smaller companies or companies that do not have as much time or resources to devote to partnerships can consider working with other companies to pool resources in developing educational partnerships. One example of this approach is the Federation for Advanced Manufacturing,⁴⁹ which comprises nearly 400 companies across a dozen states and works with colleges and local organizations to provide students with integrated classroom instruction and hands-on experience relevant to manufacturing careers. That is, by presenting a united front, companies can collaborate with educational institutions to create new, relevant and highly specialized degree programs.

In this way, building strong relationships with educational partners and especially curricula developers is paramount for manufacturing companies to be able to influence skill development, but doing so can also strengthen recruiting pipelines and companies' own awareness of the changing labor market. Greater interaction between employers and students (i.e., potential employees) can facilitate trust and early culture-building, allow for assessments of and coaching for soft skills over time and provide additional opportunities to correct lingering misperceptions about the field of manufacturing. Of final note is that, given technological advances and changing operational environments, companies should continually assess and evaluate the skills that need to be taught in formal education programs. It may be that certain skills merely need to be activated among incoming employees, while other skills and knowledge particularly need to be added to curricula in certain regions or for certain sectors.

⁴⁸ "Manufacturing in America: A View from the Field."

⁴⁹ For more information, see <https://www.themanufacturinginstitute.org/workers/fame/>.

6. CONCLUSION

As the manufacturing industry continues to advance technologically, particularly in the sectors of electric vehicle and battery production, semiconductors, pharmaceuticals, logistics and sustainability, companies will need to become more agile. Not only will companies need to respond to customer demands more quickly, but they will also need to strategically plan for future potential business disruptions and for future skill needs.

To become more competitive and more resilient, companies will need to build up skills in data analytics, problem-solving and critical thinking and interpersonal skills. In addition to training current employees in these skills, companies should consider other efforts, including updating position descriptions, creating a more inclusive company environment and culture, offering apprenticeships and working with curricula developers to cultivate these skills in new talent pools so they become more attractive to potential job candidates. All in all, implementing the changes discussed in this paper can help companies future-proof against potential upcoming disruptions, as well as address current and future skills gaps.



ABOUT

THE MANUFACTURING INSTITUTE

The Manufacturing Institute, the 501(c)(3) workforce and education partner of the National Association of Manufacturers, is driving an agenda to research and support manufacturing excellence, innovation and talent, and deliver solutions to make manufacturers in America globally competitive. In partnership with some of the leading consulting and economic research firms in the country, the Institute studies the critical issues facing manufacturing and applies that research to develop and identify solutions that are implemented by companies, schools, governments, and organizations across the country.

KEYBRIDGE

The Institute's Center for Manufacturing Research collaborated with Keybridge Research for this study. Keybridge is a boutique economic and public policy consulting firm that serves as economists, policy experts and strategic advisers to a diverse clientele, including Fortune 500 companies, global financial firms, trade associations, non-profit organizations, federal agencies and other institutions that operate at the intersection of economics and public policy. Keybridge provides clients with a suite of analytical and advisory services, ranging from macroeconomic risk assessments, economic modeling studies, policy impact studies, qualitative policy evaluations, survey design and analysis and strategic consulting.

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