2024 Super Analytics Challenge

Case Briefing on Workforce Development in Advanced Manufacturing Industry

Workforce development spans diverse sectors, such as community colleges, high schools, labor unions, nonprofits, local governments, and beyond. It involves not only internal programs within organizations but also initiatives nationwide aimed at fostering economic growth and facilitating career advancement across the United States. Fostering the growth and empowerment of employees is essential for a thriving and efficient workforce.

The core focus of this year's Super Analytics Challenge is how to address the barriers connecting people to companies and jobs in the advanced manufacturing sector.

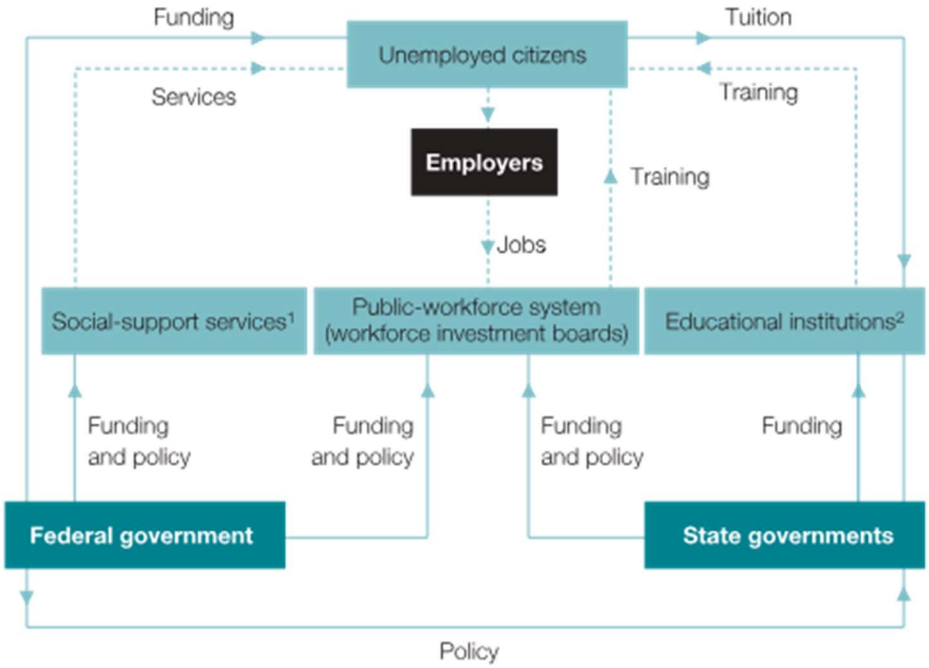
1. Background on Workforce Development in the United States

The world is changing at a rapid and unprecedented pace. Market forces, geopolitical situations, the pandemic, advances in technology, climate and sustainability implications, more demanding (and aware) customers and stakeholders are forcing organizations to radically transform their businesses. Organizations are under growing pressure to address these future challenges proactively, all while contemplating how to equip the upcoming workforce with the necessary skills for such tasks. McKinsey (2023) reports 40% of American employers are struggling to find people with the skills they need, even for entry-level jobs. While it is imperative to concentrate on enhancing workforce skills, it is insufficient to meet the demands of the current workforce and market conditions. The pace of change is so swift that even conventional reskilling endeavors quickly become outdated. What is essential is a workforce development strategy centered around personalized learning, leadership, experiences, and continuous growth seamlessly integrated into the flow of life. This approach acknowledges the dynamic nature of jobs and recognizes the equally dynamic potential of individuals to reinvent themselves.

Today, the essential attributes for both workers and organizations to not only endure but excel are distinct from those required in the past. This shift is attributed, in part, to economies transitioning from a production-oriented age to one driven by imagination and innovation. Historically, business prosperity was predominantly linked to the deployment of finely tuned skills to efficiently produce goods or provide services on a large scale. However, contemporary success

is increasingly contingent on innovation, entrepreneurship, and various forms of creativity that depend not only on skills but also on less easily quantifiable capacities like critical thinking, emotional intelligence, and collaboration.[1]

The US workforce-development system involves numerous stakeholders.



[1]Such as child care and transportation.
[2]Including universities.

McKinsey&Company

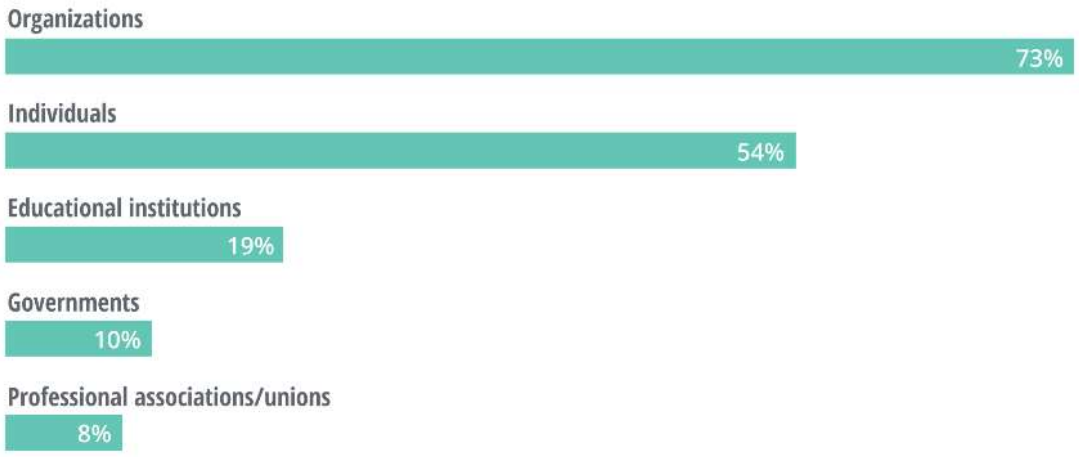
The skills race has jumped into the spotlight as both a business imperative and a social expectation. Organizations including Deloitte, Accenture, IBM, JPMorgan Chase, PricewaterhouseCoopers, and SAP have announced major worker skilling investments. Amazon, for instance, has garnered attention for its commitment to invest $700 million in upskilling 100,000 of its U.S. employees by 2025. This initiative reflects Amazon's dedication to enhancing workforce resilience through various programs catering to different workforce segments, technical groups, and communities. Additionally, Amazon supports employees in finding related roles in their communities through programs like Career Choice, a prepaid tuition initiative aiding fulfillment center associates in transitioning to sought-after occupations. Since 2012, 25,000 workers have used Career Choice to pursue careers in various fields, receiving immediate pay increases and experiencing long-term benefits in earnings and career advancement. The program also contributes to local ecosystem health by creating new career pathways and talent pipelines, leading to increased local business growth, higher household incomes, and elevated average wages in communities.[2]

[1] John Hagel, John Seely Brown, and Maggie Wooll, *"Skills change, but capabilities endure,"* Deloitte Insights, August 30, 2019.
[2] Amazon, "Amazon pledges to upskill 100,000 U.S. employees for in-demand jobs by 2025," press release, July 11, 2019; Ardine Williams (vice president, workforce development, Amazon), interview with Deloitte, February 5, 2020.

FIGURE 1

More respondents identified organizations as the entity responsible for workforce development than identified any other stakeholder

Which entities in society do you think are primarily responsible for workforce development? Select up to two.



Source: Deloitte Global Human Capital Trends survey, 2020.

Deloitte Insights | deloitte.com/insights

As some organizations are shifting their focus from building skills to captivating capabilities, the United States requires a more robust and inclusive workforce development system to connect with and adequately address the diverse needs of students and workers seeking skill enhancement. This includes youth and adults who are employed, underemployed, or unemployed. This system should also prioritize reaching individuals facing displacement or at risk of displacement, as well as those who are disadvantaged and aspire for upward mobility but are consistently being marginalized. This is particularly pertinent for individuals residing in segregated, low-income communities.

2. Advancing Equity in American Educational and Economic Opportunities Through Workforce Development

Over the past four decades, there has been a significant increase in labor market inequality in the United States, particularly evident in the widening earnings gap between individuals with bachelor's degrees or higher and those with lower levels of education. Numerous marginalized groups in the United States, such as people of color, new immigrants, individuals with disabilities, residents of rural and socio-economically segregated communities, and those entangled with the criminal justice system, face increasing challenges. These individuals, often with the least opportunity to achieve the 'American Dream,' are experiencing declining earnings and status over time. Moreover, there is a growing trend of these groups, initially observed mainly among African-American youth and men involved with the criminal justice system, now becoming widespread among non-college-educated workers in segregated communities, as they increasingly withdraw from the labor force.[3] As reported by the American Institutes for Research (2021), while many factors have contributed to stagnating earnings and rising inequality, there is no question that a

[3] Case, A., & Deaton, A. (2020). Deaths of despair and the future of capitalism. Princeton University Press.

skills gap, aggravated by various barriers to participation, has contributed significantly to this problem.

Securing well-paying jobs in high-demand sectors such as healthcare, advanced manufacturing, information technology, transportation/logistics, and various service industries requires workers to possess postsecondary education, training, and a diverse set of skills demanded by employers (including communication, collaboration, digital literacy, and problem-solving). This is particularly challenging for communities of color and the most disadvantaged populations, leading to employers facing difficulties in filling these positions and, consequently, generating fewer job opportunities or outsourcing existing ones.

These challenges have been intensified by the COVID-19 pandemic, which has disproportionately impacted low-income individuals, older workers, and communities of color. The recovery from the economic shutdown in spring 2020 has been notably unequal, with professional and managerial workers quickly recovering or not experiencing job losses, while less educated and minority workers have faced prolonged unemployment, lasting for months or even permanently.[4] The ongoing integration of technology into the workforce, along with globalization and automation, will result in persistent job displacement and the need for adaptation among all workers.

Although artificial intelligence (AI) poses a potential threat to the employment and income of college-educated individuals, their capacity to adapt by acquiring new skills and securing new employment opportunities is expected to surpass that of workers with lower levels of education. Since August 2014, nearly 10 million Americans have remained unemployed, even though employers have nearly 5 million open job postings, particularly for middle-skill, well-paying positions. This failure in the job market is attributed to a disconnection between U.S. employers and talent suppliers, coupled with insufficient investment and limited outreach of skill-building initiatives, as noted by experts.

Additionally, young individuals not in school or employment, known as opportunity youth or promise youth, constitute a rising segment with untapped potential, which makes it critical to enable pathways to attract and retain this talent pipeline. In 2019, there were 4.5 million individuals aged 16 to 24 in the United States falling into this category, representing a significant pool of talent essential to meet the nation's demand for skilled workers.[5] 'The Economics of Investing in Opportunity Youth' highlights a lifetime cost burden of over $900,000 per disconnected young person to society. Those who stay disconnected encounter systemic challenges such as poverty, involvement with the criminal justice system, unaddressed trauma, and inequitable education experiences that do not align with the demands of the current labor market.[6]

[4] Hershbein, B., & Holzer, H. (2021). The COVID-19 pandemic's evolving impacts on the labor market: Who's been hurt and what we should do. W. E. Upjohn Institute for Employment Research. https://research.upjohn.org/cgi/viewcontent.cgi?article=1360&context=up_workingpapers

[5] The Importance of Workforce Development for a Future- Ready, Resilient, and Equitable American Economy. (2021). https://www.air.org/sites/default/files/WDEMP-Importance-of-Workforce-Development-Brief-April-2021.pdf

[6] White House Office of Community Solutions (2012)

3. Understanding the Ongoing Labor Shortage and Barriers to Participation

Connecting job seekers to employment opportunities and workforce development initiatives is one of the major issues in our current economy. Companies across various industries and states are facing unprecedented challenges in finding an adequate workforce to fill available job positions. Current data reveals a substantial gap, with 9.5 million job openings in the U.S. and only 6.5 million unemployed individuals. In 2022, employers added a record 4.5 million jobs, contributing to a robust job market.[7] However, a significant number of job vacancies remain unfilled due to an insufficient workforce. Despite an increased number of Americans participating in the workforce compared to pre-pandemic levels, the overall percentage of the population engaged in the labor force has declined. The current labor force participation rate is 62.5%, down from 63.3% in February 2020 and 67.2% in January 2001.

Various factors have contributed to the ongoing labor shortage such as lack of reliable access to public transportation within rural areas as well as limited resources and opportunities for under-represented and disadvantaged communities. While over 95% of employees live in households with at least one car and driving alone is the primary mode of commuting for over two-thirds of U.S. workers, there are significant variations in car ownership rates across the income spectrum. Additionally, not having access to a car in an area with abundant transportation alternatives differs significantly from not having a car in a region with limited options. Census Bureau data, derived from the American Community Survey, indicates low car access rates are observed not only in urban areas but also in certain rural counties in the Fifth District. These rural areas, characterized by both low car access and high poverty levels, tend to offer fewer transportation alternatives compared to their urban counterparts.[8]

Moreover, the relocation of jobs to car-dependent suburbs creates a barrier for individuals without access to cars and this lack of transportation also limits employment opportunities and participation in apprenticeship programs, forcing some to endure lengthy commutes via multiple buses or preventing access to certain jobs altogether.[9] In the present economic conditions, commuting without a car has become increasingly challenging for a significant population reliant on public transit. Many individuals who depend on transportation services continue to find it harder to reach their workplaces due to service reductions or eliminations.

Another prominent factor is a lack of access to childcare. Even before the pandemic, insufficient access to affordable and high-quality childcare was an issue. The pandemic exacerbated the situation, leading to the closure or downsizing of childcare providers and a loss of 370,600 jobs in the industry, disproportionately affecting women.[10] The recovery in the childcare industry has been slow, with employment levels remaining 10% lower than pre-pandemic levels as of September 2021. Women, in particular, have been impacted, with their labor force participation rates dropping to the lowest levels since the 1970s. The pandemic prompted 3.5 million mothers to leave their jobs, reducing the labor force participation rate for working moms from around 70% to 55%. Unfortunately, the challenges faced by childcare providers have created a vicious cycle;

[7] Ferguson, S. (2022, February 7). Understanding America's Labor Shortage. U.S. Chamber of Commerce. https://www.uschamber.com/workforce/understanding-americas-labor-shortage

[8] Transportation Access as a Barrier to Work | District Digest | Richmond Fed. (n.d.). Www.richmondfed.org. Retrieved January 17, 2024, from https://www.richmondfed.org/publications/research/econ_focus/2023/q4_district_digest

[9] *Addressing Youth Apprenticeship Transportation Barriers: How Employers Can Lead*. (n.d.). New America. Retrieved January 17, 2024, from https://www.newamerica.org/education-policy/edcentral/addressing-youth-apprenticeship-transportation-challenges-how-employers-can-lead/

[10] Equity in Child Care is Everyone's Business. (2021). https://chamber-foundation.files.svdcdn.com/production/documents/Equity_ChildCare_Final_web.pdf?dm=1694110498

even when childcare is available, it is often so expensive that it does not financially benefit a parent to work and pay for childcare simultaneously.

4. Workforce Development and the Future of Advanced Manufacturing

'Advanced Manufacturing' is defined as the "use of innovative technologies to create existing products and the creation of new products. It can include production activities that depend on information, automation, computation, software, sensing, and networking."[11] Advanced manufacturing boosts productivity, strengthens the economy, fosters innovation, and offers fulfilling career prospects. However, the National Association of Manufacturers anticipates a need to fill 4.6 million jobs by 2028. Successfully staffing these positions hinges on overcoming a critical obstacle: attracting and retaining workers.[12] Like many industries, manufacturing is undergoing continual transformation with the introduction of innovative technologies. Automation, including robotics and automated systems, is increasingly prevalent, aimed at enhancing efficiency, productivity, and addressing labor challenges. The reports and surveys indicate a clear trajectory towards Industry 4.0, signifying the Fourth Industrial Revolution, characterized by connectivity, automation, human and machine integration, and other technologies to propel the industry forward. Embracing Industry 4.0 presents opportunities for enhanced productivity and efficiency to meet the growing demand for quickly delivered products.[13]

As per the findings from the research project on the "Future of Manufacturing" published by the American Society of Mechanical Engineers (ASME) in collaboration with Autodesk, Inc. in 2022, several emerging technologies are entering the market and aiding the transition to Industry 4.0. These include:

- Design for manufacturing (DfM)
- Operations technology (OT) infrastructure
- Artificial Intelligence (AI)/Machine Learning (ML)-driven technologies like generative design
- Cloud-based software platforms like integrated computer-aided design and manufacturing (CAD/CAM)
- Project lifecycle management (PLM)
- Manufacturing execution systems (MES)
- Business intelligence (BI) solutions
- Centralized data management for collaboration and data analysis

But with this transition also comes the need to connect people to these job opportunities and train workers to manage the expanding skills gap. Workforce development in the advanced manufacturing sector aims to create a skilled workforce that can meet the demands of the rapidly evolving industry.[14] Some key initiatives and programs include:

[11] Advanced Manufacturing National Program Office (AMNPO) https://www.manufacturing.gov/glossary/advanced-manufacturing
[12] Manufacturing Workforce Development. (n.d.). Manufacturing USA. https://www.manufacturingusa.com/key-initiatives/manufacturing-workforce-development
[13] Jensen, S. (2022, October 19). The Future of Manufacturing and its Impacts on Workforce Development. Power & Motion. https://www.powermotiontech.com/community/article/21252951/the-future-of-manufacturing-and-its-impacts-on-workforce-development
[14] https://www.apprenticeship.gov/advanced-manufacturing-apprenticeship-sprint
https://www.cmtc.com/workforce-development
https://www.whitehouse.gov
https://www.manufacturingusa.com/key-initiatives/manufacturing-workforce-development
https://cwdb.ca.gov/special_committees/advanced_manufacturing_workforce_development_counc/

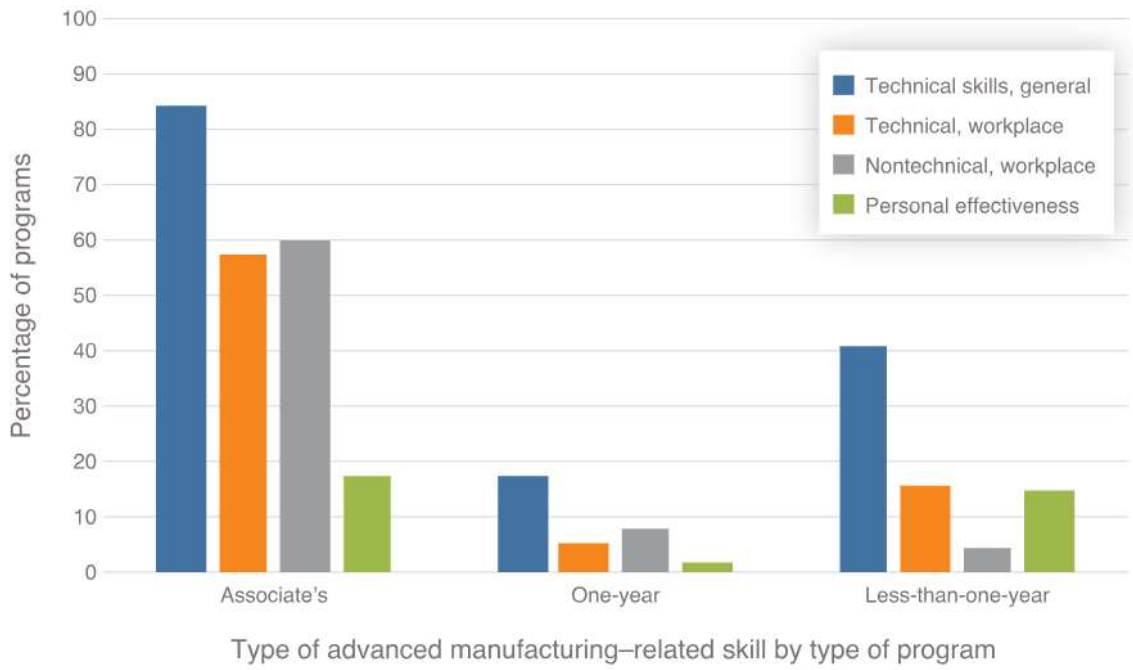
- *Advanced Manufacturing Workforce Development Council*: This council was established to help California's Workforce Investment Board's Strategic Plan, focusing on advanced manufacturing, and highlighting the future of highly technological solutions and highly skilled workers.
- *Manufacturing USA:* This organization has developed a national education and workforce development roadmap to help ensure that advanced manufacturing supports U.S. technological competitiveness and drives product and process improvements that advance the U.S. economy.
- *Investing in America Tour:* The Biden-Harris Administration has launched a sprint to catalyze workforce development efforts for advanced manufacturing jobs and careers, focusing on areas such as cybersecurity, bio fabrication, and semiconductors.
- *Advanced Manufacturing Apprenticeship Sprint:* This national sprint brings together employers, labor unions, workforce development organizations, and others to develop high-quality education and training programs for advanced manufacturing occupations.
- *California Manufacturing Training Center (CMTC):* CMTC offers workforce development programs that provide customized training for small and medium-sized manufacturers in California, focusing on areas such as lean manufacturing methodologies, six sigma, statistical process control, and supply chain management.

5. Data and Analytics as Opportunities to Bridge Connections Between the Jobs, the People and the Programs

The availability of a properly skilled workforce is the differentiator that gives the regional advanced manufacturing companies the competitive advantage to conduct business in today's global economy– an economy that continues to evolve as a result of the COVID-19 pandemic and certain geopolitical factors. Advanced Manufacturing (AM) career pathways can include going right from school to work, attending an apprenticeship program, participating in an accelerated trade school program, or completing a college degree. Data and analytics can be used to better serve the demand and supply side of the workforce by providing insights into current and future workforce needs. Workforce analysis provides information about the present workforce in critical occupations, encompassing demographic and background characteristics, retirement eligibility, turnover, and workforce management aspects like recruitment and retention within the region. This information is essential for recognizing trends that affect the entire workforce or even specific segments. It serves as a foundation for workforce and succession planning, offering insights and actionable data to address demographic and employment trends that could impact future capabilities.

Figure 1 shows skills emphasized in program materials in the Midwest region and Pennsylvania. Skill categories were taken from the U.S. Department of Labor's AM competency and are mutually exclusive. The skill categories shown in the figure are "Technical skills, general"; "Technical, workplace"; "Nontechnical, workplace"; and "Personal effectiveness." The figure shows that most programs emphasize technical skills (such as working with tools and technologies) over nontechnical workplace skills (such as teamwork) and personal effectiveness skills (such as dependability and reliability).

Figure 1. Percentage of Programs Emphasizing Various Advanced Manufacturing–Related Skills, Midwest and Pennsylvania, 2019



SOURCE: CareerOneStop data.

From a data perspective, the Department of Commerce and the Census Bureau and its American Community Survey, Current Population Survey, Annual Business Survey, and Center for Economic Studies, among other surveys and programs, provide key understanding and decision-making capabilities about the work, the people, and the workforce development programs. For instance, states are increasingly utilizing administrative data to construct comprehensive data systems that capture and monitor information related to student outcomes, human services, workforce development, and employment. In 2014, the federal government introduced a standardized set of national performance standards under the Workforce Innovation and Opportunity Act (WIOA). These standards have influenced initiatives for supporting and funding career and technical education, adult education, and temporary cash assistance for families in need. Some states and counties have integrated WIOA performance standards into their economic development strategies, employing online tools like dashboards to oversee and evaluate the effectiveness of their workforce programs and systems.

There are several other ways data and analytics can help serve the demand and supply side of the workforce[15]:

- *Workforce Planning:* Data analytics can help organizations evaluate current data about employees and employee demographics to anticipate future needs. By understanding the

[15] https://www.adp.com/resources/articles-and-insights/articles/w/workforce-analytics.aspx
https://www.peoplescout.com/insights/workforce-planning-analytics-insights/
https://study.com/academy/lesson/workforce-analysis-considerations-staffing-planning.html
https://www.infotech.com/research/ss/build-a-data-driven-workforce-plan-a-critical-cio-exercise
https://www.icf.com/insights/workforce/strategic-workforce-planning

demand and supply of skills and talent, organizations can make informed decisions about hiring, training, and retention.

- *Predictive Analysis:* Predictive analytics leverages historical data to create predictive models that anticipate skills shortages and shifts in the labor market. Techniques such as regression analysis, forecasting, multivariate statistics, and pattern matching enable organizations to understand future trends and make proactive decisions.
- *Workforce Demand Analysis:* Workforce analytics can help organizations understand their current and future workforce requirements. By leveraging workforce data, organizations can identify areas where they need to focus their efforts to meet their workforce goals.
- *Workforce Supply Analysis:* Supply analysis involves evaluating current data about employees and employee demographics to determine the availability of talent within the organization. This information can help organizations identify gaps in their workforce and develop strategies to address them.
- *Talent Forecasting:* Workforce analytics can be combined with workforce planning to predict future leaders within the organization, craft succession plans for critical positions, and recruit the right talent.
- *Data-Driven Decision Making:* Data-driven workforce planning focuses on the future by assessing current hiring needs and modeling future requirements. This approach helps organizations remain agile and competitive in the ever-changing business landscape.
- *Benchmarking and Comparison:* Workforce analytics can be used to compare an organization's workforce data with industry benchmarks and best practices. This comparison can help organizations identify areas where they excel and areas where they need improvement.

6. Information on Community Partners

A. Allegheny Conference on Community Development:

The Allegheny Conference on Community Development is an organization that brings together communities and businesses to build mutually beneficial partnerships, resulting in tangible economic gains for the region. The Strengthening Communities Partnership (SCP) program, initiated by the Allegheny Conference, focuses on promoting regional vitality and creating strategic partnerships essential for the region's communities to thrive.

In 2019, Allegheny Conference on Community Development actively involved over 1,000 stakeholders from across the Pittsburgh region in a year-long initiative called ‘Our Next 75’. This extensive effort aimed to build consensus on the future of our region, collecting and analyzing data points, plans, and aspirations from various stakeholders. The outcome, outlined in the report titled 'Next Is Now: A 10-Year Vision of Vitality for the Pittsburgh Region,'[16] defines a plan for the community's growth, emphasizing thriving individuals, quality of place, and a robust, inclusive economy.

[16] https://www.alleghenyconference.org/wp-content/uploads/2019/12/2030LongRangeReport_Digital.pdf

The goal for 2023 is "to lay the foundation for achieving our shared vision for a vital, globally competitive region where all people thrive", which is why the Allegheny Conference will advance a focused agenda across three strategic priorities and mobilize members and partners across the region to grow our economy, galvanize inclusive regional engagement, and unlock the region's potential. For the Advanced Manufacturing sector, in particular, the goal is to "build out key clusters to grow the economy, create jobs and drive regional competitiveness" by defining and pursuing "transformational investments and attraction of high-value R&D and production opportunities."[17]

https://www.alleghenyconference.org/scp/

B. Catalyst Connection

Catalyst Connection, headquartered in Pittsburgh, PA, is a private not-for-profit, economic development organization that provides business consulting, organizational development, and training services to small manufacturers in southwestern Pennsylvania. They work to accelerate revenue growth and improve productivity for small manufacturers in the 12-county southwestern Pennsylvania region through active collaboration with clients and the manufacturing community.[18]

In October 2023, Catalyst Connection received a $10 Million grant from Appalachian Regional Commission (ARC) to boost green energy manufacturing & workforce development among SWPA manufacturers.[19] The grant allows Catalyst Connection to spearhead a multi-state initiative, aiding over 1,000 small- to medium-sized manufacturers (SMMs) in over 150 counties across Appalachian Pennsylvania, Maryland, New York, Ohio, and West Virginia to expand or enter the green technology and clean energy sectors. The funds will be utilized for training, technical assistance, supply chain mapping, and guidance on factory upgrades, specifically supporting manufacturers in renewable energy, hydrogen power, low-carbon and decarbonized power, smart grid improvements, electric vehicles, and green buildings.

As part of a grant initiative supported by the Appalachian Regional Commission (ARC), Catalyst Connection collected data from manufacturing companies to discern immediate workforce and training requirements for entry-level positions. A significant discovery from this investigation was that most manufacturers are facing difficulties filling their existing entry-level positions. The primary challenges in recruitment include a shortage of qualified applicants (76%), inadequate applicant numbers (58%), and competition with other regional manufacturers for top candidates (50%). Additionally, when turning down a job offer, the most common reasons identified were shift work requirements (44%), location too far from home (31%), and a better salary and benefits offer from another employer (31%).[20]

https://www.catalystconnection.org/

[17] https://www.alleghenyconference.org/wp-content/uploads/2023/02/ACCD_2021-23-Goals.pdf
[18] https://www.catalystconnection.org/about-us/
[19] https://www.catalystconnection.org/news-blog/catalyst-connection-receives-10-million-grant-from-appalachian-regional-commission-to-boost-green-energy-manufacturing-workforce-development-among-southwestern-pa-manufacturers/
[20] https://www.catalystconnection.org/wp-content/uploads/2023/08/2023-Workforce-Training-Demand-Study.pdf

C. Partner4Work

Partner4Work serves as the workforce development organization in the Pittsburgh region, linking funding, expertise, and opportunities to cultivate a thriving workforce. The organization collaborates with businesses to identify and train the necessary talent for economic growth, partners with job seekers to overcome barriers and unlock opportunities in expanding industries and collaborates with agencies to make a positive impact in communities.

To achieve a robust workforce, Partner4Work strategically invests, offers expertise, and generates opportunities for businesses, job seekers, agencies, and policymakers in Allegheny County and the City of Pittsburgh. The organization proactively supports community organizations through funding, information, and professional connections; interprets and disseminates labor market information, trends, and best practices to inform data-driven strategies and policy development; and brings together diverse partners to learn, collaborate, and devise solutions for enhancing the local workforce.

According to the Labor Market Report for Allegheny County (October 2023), the labor force consisted of over 630,000 workers, but participation rate was at only 61%. Moreover, 26% of Allegheny County residents have a high-school diploma as their highest level of education; however, 60% of jobs in the county require more education or training than a high-school diploma.[21] Access to resources and opportunities are one set of barriers to entry for workers, but it is critical to also understand the supply side of the labor market in order to better serve communities and connect people to career pathways.

https://www.partner4work.org/programs

[21] https://www.partner4work.org/uploads/october-2023-lmi-report-(final).pdf

7. Challenge Objective with Suggested High Impact Questions

The core focus of this year's Super Analytics Challenge is how to address the variety of barriers connecting the people (demand side) to the companies/jobs (supply side) in the advanced manufacturing sector. The goal is to enable career pathways for people and develop an innovative solution to effectively address some of these workforce development challenges.

The Super Analytics Challenge Advisory Committee wants student teams to acquire data and utilize it in a more predictive form of analytics, to help better serve the regional communities. For instance, there are numerous ways that data and analytics-related solutions can be used to assess service demand and community need, improve system constraints, and increase the impact of the community partner organizations highlighted above in various avenues.

We want the students to 'embrace' the topic, not just analyze the data. Below are some examples of the types of 'High Impact Questions (HIQ)' student teams may want to consider; however, teams are encouraged to identify and pursue any HIQ related to the case.

The ultimate goal is to devise a HIQ, or hypothesis for how your team can make an impact in the region around the case topic, backed by data and analytical insights, and enable an implementable solution that can make a difference in the region.

Below are some areas you may want to consider focusing on as you develop your HIQ; however, again teams are encouraged to generate your own.

Assessing Service Demand/Community Need:

- In the advanced manufacturing sector, what specific job categories are anticipated to drive sustained growth in Pennsylvania and West Virginia, and how can workforce development initiatives align with these projections?
- What industries within advanced manufacturing will be pivotal for job growth in the targeted regions, and how can collaborative efforts be directed toward sustaining and expanding these industries?
- To enhance accessibility and outreach, how can existing skills development programs for advanced manufacturing jobs in the region be expanded and promoted to ensure broader participation and cultivate a skilled and adaptive workforce?
- Given present-day demographic projections, how can the regional workforce be strategically shaped to align with the future needs of the advanced manufacturing sector in Pennsylvania and West Virginia?

Improving System Constraints:

- How can workforce development programs navigate potential limitations in access to advanced technologies within under-represented communities to ensure effective skill development for the evolving needs of the advanced manufacturing sector?
- Given potential constraints (and changes) in educational infrastructure, what alternative approaches can be explored to ensure the regional workforce possesses the skills required for competitiveness in the advanced manufacturing sector?

- What strategies can be devised to address potential constraints and barriers to entry in program outreach and accessibility, ensuring that skill-development programs effectively reach diverse groups within the targeted communities?
- In the presence of potential bureaucratic constraints, what collaborative efforts and innovative strategies can be employed to translate ideas into tangible impact, creating pathways for diverse groups in Pennsylvania and West Virginia to fill crucial roles in advanced manufacturing?

Increasing the Impact of Community Partners:

- Considering potential barriers to inclusivity, how can skill-development programs be designed to address the unique needs of underrepresented groups and communities, ensuring accessibility, and fostering diversity in the advanced manufacturing workforce?
- How can community organizations systematically assess the tangible impact of their workforce development programs on participants, considering factors like employment rates, wage growth, and long-term career success?
- What collaborative strategies can be employed to leverage data analytics, industry feedback, and collaboration with advanced manufacturing employers to identify opportunities for program enhancement, ensuring that workforce development initiatives align closely with evolving industry needs?
- How can we establish a strategic and systematic framework within community organizations to integrate and unify diverse workforce development programs, ensuring these initiatives reach and benefit targeted communities in advanced manufacturing sectors?

8. Your Team's Answer to the Challenge

Your team has been hired to provide the community partners with the objective of providing the following three-phase deliverable:

- **Phase 1: Problem Framing**

  The initial phase focuses on framing a critical question (the "High Impact Question") specifically tailored to have an immediate and lasting impact on workforce development within the advanced manufacturing sector. The chosen HIQ will address the unique challenges and opportunities present in this sector, offering a clear rationale for its selection in both the short and long term. The deliverable for this phase will emphasize the benefits associated with solving the identified HIQ, with a keen focus on connecting people to job opportunities, and advancing the skills, innovation, and economic vitality within the advanced manufacturing workforce. The HIQ may be derived from the Advisory Committee's existing considerations (noted above) or formulated as a new idea by the Team. Regardless, the proposed solution must be cost-effective, ensuring affordability and practical implementation for sustainable advancement in the advanced manufacturing workforce.

- **Phase 2: Solution Design and Modeling**

  In this phase, the focus shifts to developing a robust data and analytics model (or set of models) specifically tailored to offer the insights needed to support the benefits identified

in the initial workforce development phase. The Team is empowered to refine their High Impact Question (HIQ) based on feedback from judges, or new opportunities unearthed during data analysis. Teams are encouraged to augment data sources already provided with their own research findings or alternate public sources, enhancing the depth and breadth of their analytics. Utilizing publicly available databases and modeling tools, the Team is tasked with generating the most insightful model outputs and analytics. The emphasis lies in highlighting the value of answering the HIQ and how the proposed data and analytics model(s) align with and contribute to the goals of advancing the advanced manufacturing workforce.

- **Phase 3: Final Solution Presentation**

  Storytelling is a critical aspect of gaining organizational buy-in and resources. The delivery of a high-impact presentation (leveraging whatever format you deem most appropriate which could include multi-media, PowerPoint, etc.) to a senior management/advisory team will determine which recommendation will be implemented first. The presentation should be focused on a combination of impact, feasibility, and affordability.

9. Rubrics

Specifically, evaluators will be assessing each phase of the deliverable based on common rubrics as follows:

Rubric for Phase 1. Problem Framing (20% weight for the final score)

- How well did the team define the problem through HIQ and are the elements of the HIQ defined in detail?
- Additional evaluation points will be credited to those teams that create an original HIQ or modify an existing HIQ which indicates the team's creativity and depth of knowledge.
- Is the quality of the research (i.e., pre-work) that supports the HIQ "high"?
- How well did the team communicate the expected solution/impact and does it match the HIQ?
- Is the team addressing a critical need?
- Is the expected use of the solution/model output well defined – i.e., how will it be used?
- Was there significant thought given to the data that is available to model a solution and were creative new data sources identified?
- Is the proposed solution practical (think budget/cost, capability, resources) and can it be deployed?
- Does the solution have up/downstream implications – how pervasive and permanent can the solution be?

Rubric for Phase 2. Solution Design and Modeling (30% weight for the final score)

- How well did the team address the problem (as identified in Phase 1)? (Versus addressing a proxy for the problem – i.e., is the target the actual target)
- How performant is the model (e.g., accuracy)?
- Did the team select the right metric to optimize (e.g., specificity versus sensitivity)?

- Did the team drive the outcome to the cost (is the solution cost effective)?
- Is the solution/output:
    - Impactful/meaningful?
    - Usable/pragmatic?
    - Sustainable without significant maintenance?

Rubric for Phase 3. Final Solution Presentation (50% weight for the final score)

- Recommendation/Analysis
    - The solution is innovative, original, and creative.
    - Solution is impactful and solves the problem
    - Solution has a component that is specific, feasible and realistic and can be advanced in the next year.
    - Solution demonstrates an understanding of the context and will actually impact people's lives.
    - Solution had that special awesomeness or "it-factor" – meaning novel and innovative.
- Presentation
    - Presenters worked well together as a team.
    - The team's visuals support and enhance their presentation

10. Data Sources

The following is a list of potential data sources that you may want to incorporate in your solution. This list also includes additional research and resources related to workforce development.

The Team is allowed and even encouraged to use any additional data sources they may find, as well as their own research in addition to the ones provided.

- Bureau of Labor Statistics: Databases on Employment, Unemployment, Employment Projections: https://www.bls.gov/data/
- Bureau of Labor Statistics, Data Retrieval Tools: https://www.bls.gov/data/tools.htm
- Labor Force Statistics from the Current Population Survey: https://www.bls.gov/cps/tables.htm
    - The Current Population Survey (CPS) is a monthly survey of households conducted by the Bureau of Census for the Bureau of Labor Statistics. It provides a comprehensive body of data on the labor force, employment, unemployment, persons not in the labor force, hours of work, earnings, and other demographic and labor force characteristics.
- Job Openings and Labor Turnover Survey Database: https://www.bls.gov/jlt/data.htm
- Occupational Employment Projections Data: https://www.bls.gov/emp/data/occupational-data.htm
- U.S. Census Bureau: https://data.census.gov/
- Labor force Statistics from U.S. Census: https://www.census.gov/topics/employment/labor-force.html
    - The Census Bureau's labor force statistics provide information about employment status, employment dynamics, and work experience (usual hours worked, and the number of weeks worked in the last year).
- U.S. Department of Labor, Public Use Datasets: https://www.dol.gov/agencies/eta/research/public-use-datasets
- Public Workforce System Dataset (PWSD): https://www.dol.gov/agencies/eta/reports/public-workforce-system-dataset
    - The Public Workforce System Dataset (PWSD) is a dataset that can be used to answer questions about various public workforce system programs and how these programs fit in with the overall public workforce system and the economy.
- U.S. Department of Labor, Employment and Training Administration, Information and Statistics on Workforce Related Programs: https://www.dol.gov/agencies/eta/program-areas
    - The Employment and Training Administration and federal, state and local partners have developed a large repository of information, tools, and for the public workforce system.

- American Community Survey Data: https://data.census.gov/table?q=DP02
    - The American Community Survey (ACS) releases new data every year through a variety of data tables that you can access with different data tools. Data Profiles contain the most popular social, economic, housing, and demographic data for a single geographic area. The Data Profiles summarize the data, providing both estimates and percentages, to cover the most basic data on all ACS topics.
- Appalachian Regional Commission: Socioeconomic Data Profile by County: https://data.arc.gov/data
    - This report will return the following data on the selected county and will include national, state, and Appalachian averages: Population, Income, Unemployment, Poverty, Education, and Geography.
    - Additional resource: "Appalachia Then and Now: Examining [Socioeconomic] Changes to the Appalachian Region since 1965": https://www.arc.gov/wp-content/uploads/2020/06/AppalachiaThenAndNowCompiledReports.pdf
- Center for Workforce Information & Analysis, Department of Labor and Industry (PA): https://www.workstats.dli.pa.gov/dashboards/Pages/default.aspx
- Migration/Geographic Mobility Data: https://www.census.gov/topics/population/migration/data.html
- Data.gov provides a wealth of information – the link below has over 185 data sets on various aspects of workforce development: https://catalog.data.gov/dataset?q=workforce+development
- Southwestern Pennsylvania Manufacturing Workforce & Training Demand Study (**Catalyst Connection**): https://www.catalystconnection.org/wp-content/uploads/2023/08/2023-Workforce-Training-Demand-Study.pdf
- Additional resource: Making Your Future – Manufacturing Career Information: https://makingyourfuture.org/industry-4-0/
    - Making Your Future is an initiative, led by **Catalyst Connection**, to help thousands of people find a career in manufacturing with a desired outcome of connecting qualified employees to manufacturing job vacancies over the next 10 years.
- Additional resource: Explore the New Manufacturing Purpose **(Catalyst Connection)**: https://explorenewmfg.org/data/
    - Catalyst Connection has been engaged in STEM programming to build a pipeline of talent for manufacturing companies in our region.
- Additional research via **Partner4Work** (The Workforce Development Board for the Pittsburgh Area): https://www.partner4work.org/research
- Additional resource on Workforce Development Investments: https://www.commerce.gov/issues/workforce-development/workforce-development-investments

    - The Department of Commerce invests in employer-driven regional workforce education and training systems that lead to quality jobs.

- Additional resource: “Understanding America’s Labor Shortage”: https://www.uschamber.com/workforce/understanding-americas-labor-shortage
- Additional resource: “Workforce Development Woven Throughout EDA Investments”: https://www.eda.gov/news/blog/2023/07/06/workforce-development-woven-throughout-eda-investments
- Additional resource: “How to Create Solutions that Connect People to Work”: https://www.aspeninstitute.org/blog-posts/how-create-solutions-connect-people-work/