

WHITE PAPER

Future Challenges in Biopharmaceutical Workforce Development

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01 INTRODUCTION

The Evolving Biopharmaceutical Landscape and the Impact on Workforce Development

The biopharmaceutical industry is currently one of the main cornerstones of the modern healthcare system. The industry's innovative nature is evident in the constant emergence of novel therapeutics and technology platforms. This wave of innovation contributes significantly to both economic output and job creation. In the United States, the biopharmaceutical sector (both R&D and Manufacturing) directly employed approximately 1,000,000 directly and close to 5,000,000 indirectly in 2022 with a projected growth rate of 30% between 2024 – 2032. The ability of the biopharmaceutical industry to maintain its growth is highly dependent on the availability of a skilled and adaptable workforce. now requires a workforce equipped with the knowledge and capabilities to navigate these changes effectively. As the biopharmaceutical market continues to expand, a key challenge lies in attracting and retaining highly skilled individuals who can comprehend and integrate the rapid pace of technological advancements and evolving regulatory guidelines. The development of a strong talent pipeline is essential to maintain technology growth and implement the newly implemented technological advances.

Several key trends and challenges are shaping the future of biopharmaceutical workforce development. Artificial Intelligence (AI) and Machine Learning (ML) are transforming drug discovery, clinical trials, and manufacturing processes. Personalized medicine and sustainable manufacturing practices are redefining the skills required in the industry. To these points, the biopharmaceutical industry is experiencing significant skill gaps especially in areas like data science and advanced manufacturing resulting in shortages of qualified talent. The interplay between these trends and challenges will dramatically influence the future of workforce development in the biopharmaceutical sector.



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directly employed over**

1,000,000

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The Impact of Technological Advances on Workforce Biopharmaceutical Skills

Artificial Intelligence (AI) and Machine Learning (ML) are at the forefront of a technological revolution within the biopharmaceutical industry changing how drugs are discovered, developed, and manufactured. These technologies are leveraged to analyze immense datasets, predict patient responses to therapies, identify potential drug candidates, and streamline the lengthy and costly process of clinical trials. AI and ML are accelerating the pace of drug discovery and clinical trials, demanding new skill sets in data interpretation and cybersecurity to protect sensitive information. In addition, AI capabilities extend to manufacturing to optimize production workflows, predict and control process parameters, and enhance overall processing efficiency. AI algorithms also improve the probability of clinical success by analyzing large datasets and refining trial designs, leading to faster and more effective drug development.¹⁷ The increasing reliance on AI in the biopharmaceutical industry is necessitating a workforce proficient in advanced data analysis and machine learning methodologies.³

Automation and advanced manufacturing technologies are also playing an increasingly vital role in biopharmaceutical production. The adoption of bioprocessing innovations such as single-use technologies, modular manufacturing, and continuous bioprocessing is reducing production costs and enhancing operational flexibility. AI and advanced analytics are being used to address challenges in biomanufacturing, such as poor equipment visibility and variable yields, by harnessing vast amounts of process data to optimize production dynamically. The integration of AI, automation, and robotics is leading to improved efficiency in pharmaceutical production resulting in a reduction in human error. Generative AI is also being explored for its potential to streamline production maintenance, accelerate root cause analysis, and optimize supply chain performance in biopharma operations. These technological advances necessitate a workforce capable of operating, maintaining, and optimizing these advanced systems.

However, it is projected that by 2030, AI, ML, and automation could potentially displace a significant portion of the biopharma manufacturing workforce, particularly those in low-skilled and repetitive roles. This shift towards advanced manufacturing is creating a demand for specialized roles, including data analysts, robotics engineers, and AI specialists, who possess both industrial expertise and a strong foundation in technology. The increasing complexity and data-driven nature of the industry requires a highly educated and adaptive workforce capable of leveraging these advanced technologies. Companies are prioritizing a “skills-first” approach to future-proof their teams, emphasizing the importance of digital transformation skills. There is a growing demand for professionals like computational biologists who can combine biology, data science, and engineering expertise to translate scientific discoveries into patient-ready solutions.

The ability to analyze vast amounts of data, manage smart quality management systems using data analytics and real-time monitoring, and navigate digital compliance processes is becoming increasingly critical.

Pharmaceutical manufacturers are increasingly seeking professionals with skills in data analytics and real-time monitoring to manage next-generation quality systems. While core scientific skills remain important, there is a growing need for computational and digital literacy within the life sciences sector. The demand for data talent, including data scientists, engineers, and analysts, is rapidly increasing across the pharmaceutical and biotechnology industries, driven by the pervasive adoption of AI and machine learning.

03

Identifying the Growing Skills Gap in the Biopharmaceutical Sector

A significant challenge facing the biopharmaceutical industry is the growing skills gap across various functional areas, including research and development (R&D), manufacturing, and regulatory affairs. A substantial majority of life sciences and pharmaceutical talent leaders are struggling to find individuals with the necessary skills, and this shortage is expected to worsen in the near future. This issue is extensive, with around 80% of hiring/placement firms indicating difficulties in filling critical roles across multiple departments. The traditional reliance on experience-based decision-making in areas like operations and project management suggests a lack of professionals equipped with advanced skills to optimize these processes. The integration of digital technologies is further exacerbating this gap, with a large proportion of biopharma supply chain leaders recognizing the urgent need to upskill or reskill their workforce to support digital transformation. The pharmaceutical industry as a whole is grappling with a considerable talent shortage, particularly in the critical STEM (Science, Technology, Engineering, and Mathematics) and digital domains, as the demand for specialized expertise continues to outpace the available supply. The extent of this shortage is highlighted by estimates suggesting over 60,000 job vacancies within the biopharmaceutical industry, representing a significant shortfall in the required workforce. The United States is reportedly struggling to meet the sustained demand for professionals proficient in emerging areas such as new vaccine platforms, AI-driven biotechnology, cell and gene therapies, and precision medicine. A large number of pharmaceutical manufacturers acknowledge a mismatch between the existing skills of their employees and the evolving demands of their jobs. Finding qualified talent in manufacturing is proving particularly challenging, negatively impacting both productivity and overall growth within the sector. Reports from previous years also indicate significant skills shortages in crucial areas like computational and digital skills, as well as in the integration of diverse research disciplines like clinical, industrial, and economic research.

This issue persists presently, with a large percentage of hiring/placement firms still reporting difficulties in filling critical roles across R&D, manufacturing, and regulatory affairs. While fundamental scientific knowledge, communication abilities, and problem-solving skills within the workforce may have seen improvements, there remains a significant need for development in more specialized and technologically focused areas. Specifically, there is a recognized need for a workforce that possesses the skills necessary to effectively navigate the digital revolution underway in the industry. This includes the ability to analyze and interpret complex data sets and to collaborate effectively with experts in automation and digitalization. The potential consequences of this widening skills gap are significant, impacting on the industry's capacity for innovation, overall productivity, and the ability to maintain compliance within stringent regulatory standards. If these workforce shortages are not effectively addressed, they could impede the development of new therapies and slow down the progress of scientific discovery.

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04

Navigating the Challenges of Talent Acquisition and Retention

Securing and retaining qualified talent in the biopharmaceutical sector is becoming increasingly challenging due to heightened competition from various sources. The industry is not only competing with other biopharmaceutical companies but also with the rapidly expanding technology sector, which often offers more attractive compensation packages and innovative work environments, making it difficult to attract professionals with advanced digital and analytical skills. The talent acquisition landscape in biotech and pharma is characterized by rapid innovation and intense global competition, meaning companies must look beyond their immediate geographic locations to find the right expertise. While the United States has historically been a leader in attracting global talent in technology-related fields, its dominance is showing signs of weakening, indicating that other countries are becoming more competitive in securing these highly skilled individuals. The demand for specific roles, such as data scientists, engineers, and analysts, has surged within the pharmaceutical industry, leading to direct competition with major technology companies that have traditionally targeted these professionals. Demographic shifts have become increasingly problematic particularly the aging of the workforce as experienced professionals retire and leave critical positions unfilled, reducing the overall pool of available expertise.

The trend of older individuals remaining in the workforce for longer periods suggests that biopharmaceutical companies need to consider how to effectively engage and retain these experienced professionals.

To effectively attract and retain top talent in this competitive environment, biopharmaceutical companies must prioritize building a strong employer brand, focusing on the overall talent experience, and offering flexible work models. Providing flexibility in work arrangements can significantly broaden the talent pool and improve job satisfaction, making companies that offer such options more appealing to prospective employees.

Changing workforce expectations, including a growing desire for flexible working arrangements, add complexity to the challenge of attracting and retaining skilled professionals. The shift towards hybrid and remote working, which was accelerated by the recent pandemic, is likely to remain a key feature of the pharmaceutical and biotech industries, offering a balance that appeals to a wider range of talent. Enhancing the overall talent experience by offering competitive compensation and benefits, prioritizing employee well-being, and providing opportunities for growth and development are crucial for keeping employees engaged, motivated, and ultimately, for improving retention rates. A strong employer brand is essential for attracting top-tier talent, with a significant majority of biotech candidates indicating that they prioritize companies whose values align with their own. Expanding recruitment efforts geographically and actively participating in industry events to network with both established and emerging talent are important strategies for sourcing skilled professionals.



05

Current and Future Initiatives in Biopharmaceutical Workforce Development

Recognizing the critical need to address the evolving skill requirements of the biopharmaceutical industry, a multitude of initiatives are underway, directed by corporations, academic institutions, and government bodies. Pharmaceutical companies are increasingly focusing on internal workforce training programs to ensure their employees remain competitive and adaptable in a rapidly changing sector. Structured onboarding programs are being implemented to improve employee retention, and internal academies are being established to equip employees with advanced skills in areas such as digital therapeutics and AI-driven drug discovery. A significant emphasis is being placed on upskilling and reskilling the existing workforce to support the ongoing digital transformation within the industry. Companies are actively seeking professionals with skills in data analytics, regulatory information systems, AI, and automation, indicating a targeted approach to internal training programs. Organizations are also creating partnerships with universities to develop specialized training programs and are prioritizing the upskilling of their current employees to address talent shortages. Innovative approaches to training are developing, such as the use of mock manufacturing facilities to accelerate the learning process for new hires and to accommodate individuals with limited prior experience. Blended learning models, combining classroom instruction with hands-on experience and virtual components, are also being adopted to provide comprehensive training. Human resources departments within biopharmaceutical companies are expanding their professional development programs to include more robust upskilling and reskilling opportunities, acknowledging the rapid pace of technological change and the need for continuous learning. A growing number of companies are focusing on internal talent mobility by investing in upskilling and reskilling their current workforce to fill newly emerging roles, thereby reducing their reliance on external recruitment in a competitive market.

Companies are now employing a three-phase approach to talent acquisition involving scouting, shaping, and shifting talent address critical skill gaps. This approach focuses on roles in manufacturing and quality, and

the development of skills in advanced data analysis, adaptability, and critical thinking. Emphasizing lifelong learning through internal academies is becoming a key strategy for companies to ensure their workforce remains well prepared against evolving industry demands. Furthermore, companies are implementing comprehensive digital transformation plans, change management strategies, and cybersecurity measures, alongside investments in data analytics and AI technologies, all of which require a skilled and adaptable workforce. Academic institutions are playing a vital role in developing relevant curricula and establishing partnerships with the biopharmaceutical industry to address workforce development needs. Collaborations between universities⁶ and companies are leading to the creation of specialized training programs designed to meet the specific demands of the industry.

EXAMPLES INCLUDE

University programs offering GMP/GLP courses and dedicated workforce development centers focused on life sciences programming. Academic institutions are also working closely with industry partners to address specific skill shortages, such as in biopharmaceutical science and engineering, through hands-on training and online learning platforms.

Innovative partnerships, such as the collaboration between Bioversity, the Massachusetts College of Pharmacy and Health Sciences (MCPHS), and Moderna, are leading to the development of targeted biomanufacturing training programs that incorporate industry expertise and provide hands-on experience at company facilities. Biotechnology companies are also investing resources in providing students with real-world research experiences through internships, grants, and scholarships. Initiatives like Boston's Life Sciences Workforce Development Initiative are forging partnerships between government, academic institutions, and industry organizations to connect residents with education, job training, and career readiness opportunities in the life sciences.

Government initiatives and public-private partnerships are also playing a crucial role in fostering biopharmaceutical workforce development. 6 The National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) serves as a prime example of a public-private partnership focused on accelerating innovation in biopharmaceutical manufacturing, developing advanced manufacturing technologies, and supporting workforce development through targeted training programs and curriculum development.

Regional initiatives, such as the one in North Carolina (NC Biotech), demonstrate the impact of government support at the state level. City-level programs, like Boston's Life Sciences Workforce Development Initiative, highlight the role of local governments in connecting residents to life sciences careers. Successful examples of these various initiatives highlight the potential for effective workforce development Biogen's Digital Academy provides a model for internal upskilling within a major biopharmaceutical company.



06

Addressing Future Challenges and Recommendations

The biopharmaceutical industry stands at a crossroads, facing a convergence of rapidly evolving technological landscapes, significant skills deficits, and increasing competition for talent. The relentless pace of technological change, particularly the integration of AI/ML, automation, and digital technologies, demands a workforce committed to continuous learning and adaptation. Substantial skills gaps persist in critical domains such as data science, computational biology, AI/ML, and advanced manufacturing, which are essential for driving future innovation and maintaining productivity. The competition for specialized talent is fierce, extending beyond the biopharmaceutical sector to include technology giants and a global marketplace. Demographic shifts, notably an aging workforce and potential declines in birth rates, present challenges to talent availability and necessitate strategies for retaining experienced professionals and attracting younger generations. The industry must also navigate potential disruptions arising from regulatory changes affecting drug pricing and approval pathways, as well as economic pressures such as inflation and funding constraints, which can impact workforce planning and talent acquisition strategies. Finally, there is a pressing need for more effective and innovative approaches to talent acquisition and retention that go beyond traditional recruitment methods and embrace employer branding, a positive talent experience, flexible work arrangements, and global sourcing.

To address these multifaceted challenges, biopharmaceutical companies should prioritize investing in robust and continuous internal training and development programs focused on cultivating future skills,⁷ including digital literacy, data analytics, AI/ML expertise, and advanced manufacturing techniques. Building stronger, more strategic partnerships with academic institutions is crucial for co-developing relevant curricula, offering valuable internship opportunities, and providing experiential learning that directly aligns with the industry's evolving needs.

Companies must also develop proactive and diversified talent acquisition strategies that effectively leverage

global talent pools, explore the possibilities of remote work, and establish strong relationships with universities and research institutions worldwide. Implementing flexible work models, enhancing employee benefits and compensation packages. Actively engaging in upskilling and reskilling initiatives aimed at retaining experienced workers, offering them clear pathways for career advancement, and enabling them to transition into new roles within the evolving industry is also paramount. Finally, the strategic utilization of data analytics and workforce planning tools will enable companies to better understand current workforce trends, anticipate future skill requirements, and proactively address potential talent gaps before they impact operations.

A concerted effort focused on continuous learning is essential within biopharmaceutical organizations, encouraging employees to actively engage in ongoing professional development and upskilling activities to remain current with the rapid technological advancements in the field. Mechanisms for the rapid adaptation of training programs and academic curricula are needed to keep pace with the fast-evolving technological landscape of the biopharmaceutical industry. Facilitating and incentivizing collaboration between biopharmaceutical companies, academic institutions, and government agencies will promote the sharing of best practices, resources, and expertise in workforce development. Implementing long-term strategies to ensure a sustainable talent pipeline by attracting young people to STEM fields, providing clear and attractive career pathways within the biopharmaceutical industry, and proactively addressing issues of diversity and inclusion to fully leverage the potential of the entire workforce are critical for the sector's future success.

07 CONCLUSION

Future-Proofing the Biopharmaceutical Workforce for Sustained Innovation

The future success of the biopharmaceutical industry is inextricably linked to its ability to cultivate and maintain a highly skilled and adaptable workforce. This workforce is the driving force behind medical breakthroughs, the guarantor of the quality and safety of life-saving medicines, and a significant contributor to overall economic growth. To ensure continued progress and global leadership, proactive and collaborative efforts are essential to overcome the identified challenges. Strategic investments in comprehensive training programs, the cultivation of strong partnerships between industry and academia, and the implementation of supportive government policies are all critical components of this endeavor. By prioritizing continuous learning, embracing adaptability, fostering robust collaboration, and strategically building a sustainable talent pipeline, the biopharmaceutical sector can future-proof its workforce, ensuring its long-term vitality and its ability to deliver innovative solutions that benefit patients and society worldwide.

Building the Workforce of the Future at SynerG

Working for a company like Syner-G offers a unique advantage in this dynamic environment. Syner-G's commitment to innovation is matched by a culture that prioritizes continuous learning, professional development, and crossdisciplinary collaboration. Employees benefit from access to cutting-edge technologies, robust internal training programs, and strong partnerships with leading⁷ academic institutions, all designed to cultivate future-ready skills. By fostering an environment that values adaptability, creativity, and teamwork, Syner-G empowers its workforce to not only keep pace with the evolving industry landscape but to actively shape it. This forward-thinking approach makes Syner-G an ideal place for professionals looking to advance their careers while contributing to meaningful breakthroughs in healthcare.



REFERENCES

1. Economy & Workforce - PhRMA, <https://www.phrma.org/policy-issues/research-development/economy-workforce>
2. The Economic Impact of the U.S. Biopharmaceutical Industry: 2022 National and State Estimates, <https://www.teconomypartners.com/wp-content/uploads/2024/05/The-Econ-Impact-of-U.S.-Biopharma-Industry-2024-Report.pdf>
3. Pharmaceutical Trends 2025: Key Innovations and Essential Workforce Training - Amity Institute Of Training & Development, <https://aitd.amity.edu/blog/pharmaceutical-trends-2024/>
4. 2025 talent trends: life sciences & pharma - Randstad Sourceright, <https://www.randstadenterprise.com/insights/white-paper-and-report/life-sciences-talent-trends-ebook/>
5. Futureproofing US Pharma Manufacturing Jobs | Pharmaceutical ..., <https://ispe.org/pharmaceutical-engineering/ispeak/futureproofing-us-pharma-manufacturing-jobs>
6. Chapter 5: Build the Biotechnology Workforce of the Future - Biotech, <https://www.biotech.senate.gov/final-report/chapters/chapter-5>
7. Challenges of Pharmaceutical Industry: Key Issues in 2025 - Viseven, <https://viseven.com/pharmaceutical-industry-challenges/>
8. Navigating Talent Acquisition in 2025: Biotech and Pharma in · GQR, <https://www.gqr.com/blog/2025/01/navigating-talent-acquisition-in-2025-biotech-and-pharma-in-focus>
9. 6 Trends for the Biopharma Industry in 2024 - Cora Systems, <https://corasystems.com/blog/sixtrends-in-biopharma-industry-2024/>
10. Trends and Challenges in Hiring for the Pharmaceutical and Biotechnology Sectors, <https://www.panda-int.com/insights/trends-and-challenges-in-hiring-for-the-pharmaceutical-and-biotechnology-sectors/>
11. How AI and Automation Are Transforming Biopharmaceutical Manufacturing, <https://www.technologynetworks.com/biopharma/lists/how-ai-and-automation-are-transforming-biopharmaceutical-manufacturing-397962>
12. ML and AI Implementation Insights for Bio/Pharma Manufacturing - BioPharm International, <https://www.biopharminternational.com/view/ml-and-ai-implementation-insights-for-biopharmamanufacturing>
13. [www.mckinsey.com, https://www.mckinsey.com/industries/life-sciences/our-insights/automation-and-the-future-of-work-in-the-us-biopharma-industry#:~:text=Production%20workers%20such%20as%20manufacturing,displaced%20by%20automation%20by%202030.](https://www.mckinsey.com/industries/life-sciences/our-insights/automation-and-the-future-of-work-in-the-us-biopharma-industry#:~:text=Production%20workers%20such%20as%20manufacturing,displaced%20by%20automation%20by%202030.)
14. The Impact of Advanced Manufacturing on Process Management - MAU Workforce Solutions, <https://mau.com/the-impact-of-advanced-manufacturing-on-process-management/>
15. Automation and the future of work in the US biopharma industry ..., <https://www.mckinsey.com/industries/life-sciences/our-insights/automation-and-the-future-of-work-in-the-us-biopharma-industry>
16. Advanced Biopharmaceutical Manufacturing: An Evolution Underway - Deloitte, <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/life-sciences-health-care/us-lshc-advanced-biopharmaceutical-manufacturing-white-paper-051515.pdf>
17. Transforming the Industry: The Advantages of Automation in Pharmaceutical Manufacturing, <https://praxie.com/automation-in-pharmaceutical-manufacturing/>
18. Gen AI: A game changer for biopharma operations - McKinsey & Company, 18 <https://www.mckinsey.com/industries/life-sciences/our-insights/gen-ai-a-game-changer-for-biopharma-operations>
19. Bridging the skills gap in the biopharmaceutical industry, <https://www.abpi.org.uk/media/ya2fjboi/bridging-the-skills-gap-jan-2022.pdf>
20. AI and The Surging Demand for Data Talent in Pharma and Biotech: A Prescription for Success- Ursus, Inc., <https://ursusinc.com/ai-and-the-surging-demand-for-data-talent-in-pharma-and-biotech-a-prescription-for-success/>
21. New Training Models Address Workforce Gap in Biopharma Manufacturing - BioSpace, <https://www.biospace.com/training-addresses-workforce-gap-in-biopharma-manufacturing>
22. The Evolution of HR in Pharmaceutical and Biotech Sectors for 2025 - Hppy, <https://gethppy.com/hrtrends/the-evolution-of-hr-in-pharmaceutical-and-biotech-sectors-for-2025> 22. Building the Pharma Talent of Tomorrow from Today's Workforce, <https://www.pharmexec.com/view/building-pharma-talent-tomorrow-workforce>
23. How upskilling is molding pharma workforce of the future?, <https://www.biospectrumindia.com/views/17/16715/how-upskilling-is-moulding-pharma-workforce-of-the-future.html>
24. Bioversity and the Massachusetts College of Pharmacy and Health ..., <https://bioversityma.org/bioversity-and-the-massachusetts-college-of-pharmacy-and-health-sciences-mcphs-launch-new-biomanufacturing-training-program-in-collaboration-with-moderna/>
25. Community college, biotech companies partner to prepare students for careers, <https://www.strada.org/news-insights/community-college-biotech-companies-partner-to-prepare-students-for-careers>
26. Biopharmaceutical Fellowships | MCPHS - Massachusetts College of Pharmacy and Health Sciences, <https://www.mcphs.edu/faculty-and-research/fellowships-and-residencies/biopharmaceutical-fellowships>
27. Life Science Workforce Development Initiatives, <https://raleighwake.org/blog/life-scienceworkforce-development-initiatives>
28. Education & Workforce Development - BioMADE, <https://www.biomade.org/education-workforce-development>
29. Workforce + Education - California Biotech Foundation, <https://cabitech.org/biotech-impact/workforce-education/> 30. Life Sciences Workforce Development Initiative | Boston.gov, <https://www.boston.gov/government/cabinets/worker-empowerment/life-sciences-workforce-development-initiative>