



# INNOVATION OF THE BIOPHARMACEUTICAL MANUFACTURING TALENT PIPELINE, PART II

**Community College Biotechnology Education:  
Innovation, Lessons in Success, and the Critical  
Need for Fostering Engagement with the  
Biopharmaceutical Manufacturing Industry**

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## AUTHOR'S NOTE:

*This whitepaper, next in a series that was launched in 2022, is focused primarily on community college degree programs as part of the United States biopharmaceutical manufacturing ecosystem. The intent of the series is to catalyze dialogue and action by:*

- 1. Shedding light on the current workforce situation in biopharmaceutical manufacturing*
- 2. Discussing some of the workforce development traditions that collectively hold back the U.S. biopharmaceutical manufacturing ecosystem*
- 3. Introducing examples of non-traditional approaches that are being explored across the U.S. to innovate the biopharmaceutical manufacturing talent development pipeline and workforce*

*In future whitepapers, the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) will build upon this foundational narrative by highlighting and featuring novel, innovative, non-traditional, and underutilized approaches to address and resolve the talent crisis in biopharmaceutical manufacturing. We intend to continue the discussion of the important role that community colleges play in the biopharmaceutical manufacturing ecosystem, including community college efforts in continuing education, customized training, and non-degree certificate programs.*

## INTRODUCTION

The community college system in the U.S. is integral to the development of tomorrow's technical workforce. Community college pathways into biopharmaceutical manufacturing careers have existed for decades, with the launch of the first two-year biotechnology degree program in the 1980s. In the years since, the U.S. has seen a proliferation of relevant education and training programs at the community college level. Through U.S. Department of Labor (DOL) and National Science Foundation (NSF) funding, community college educators have formed a close community and authored countless curriculum modules, textbooks, and lab protocols. These programs have educated and trained many thousands of technicians, providing them with a solid foundation of skills in areas such as aseptic processing and genetic engineering, as well as the upstream, downstream, and analytical technologies central to biopharmaceutical manufacturing.

Unfortunately, declining enrollment is evident in many state community college systems. The causes are multi-faceted, with cascading effects on biopharmaceutical manufacturing career awareness, program sustainability, and student placement. At the core, deeper industry engagement is critical to build and sustain institutional support for new and existing community college programs, catalyze the formation of new and innovative programs, and most critically, ensure that graduates from community college degree, diploma, and certificate programs are employed and adding value to the biopharmaceutical manufacturing industry. Lack of engagement by industry employers is not unique to biopharmaceutical manufacturing. A recent report authored by Harvard Business School in partnership with the American Association of Community Colleges noted that only 7% of community colleges were "very satisfied" with the level of collaboration with employers. Even more telling, they noted that "while 84% of business leaders claimed their organization hired community college graduates, the survey

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revealed that, in reality, employers do not perceive America's community colleges as the most efficient or effective way to acquire middle-skills talent."<sup>1</sup>

With this whitepaper, we seek to 1) ensure that the biopharmaceutical manufacturing industry understands the longstanding legacy of support that community college degree programs provide to the workforce development pipeline; 2) highlight the challenges that community colleges face in supporting the education and training of the biopharmaceutical manufacturing workforce; and 3) discuss how stronger industry-academic engagement can mitigate some of these challenges by building industry and career awareness, gaining institutional support for innovative programs and pathways, and ultimately, ensuring the talent needs of the biopharmaceutical manufacturing industry are met.

## A SUPPORTIVE NATIONAL NETWORK FOR COMMUNITY COLLEGE PROGRAMS

The 1980s saw the launch of the first community college biotechnology program in the U.S. Additional programs were started in Northern California<sup>2</sup> in response to the expanding workforce needs of Genentech, as well as in North Carolina<sup>3</sup> in response to the growing cluster of biotech companies in Research Triangle Park. Programs continued to pop up in areas where there was a need for biotechnology technicians, including in San Diego and Seattle, as well as in Maryland and Wisconsin. A hallmark of these community college workforce programs was that they were almost always led by industry advisory boards, championed by Ph.D. graduates or industry professionals, and informed by industry technician training needs.

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While early programs were very effective at growing to respond to small and large industry needs in their region, there was little consistency between the programs. In 1994, The NSF announced the Advanced Technological Education (ATE) program, focused on improving the education of skilled technicians. Recognizing that better harmonization was critical in the world of biotechnology education, the NSF-ATE program funded its first center in biotechnology, known as Bio-Link, in 1999. The

home institution for Bio-Link was City College of San Francisco, with several regional centers strategically located across the country. Funding for these centers was traditionally college-based with some industry support; with the launch of the NSF-ATE program, more federal funding was made available to further improve biotechnology education and training. For 20 years, Bio-Link was responsible and succeeded in building a cohesive national network of two-year biotechnology educators.

As a result, community college biotechnology programs began talking, collaborating, and learning from each other. They wrote cooperating and collaborative proposals for funding from the NSF, DOL, and other sources. These collaborations resulted in new curricula, laboratory protocols, equipment lists, and skill standards that distilled the knowledge, skills, and tasks of a bioscience technician into industry-validated modules that community college educators could use to develop training and curriculum programs.

In the years since, community colleges nationwide have made great strides in staying versed in industry needs, continuously improving their biotechnology programs and curricula, and leveraging federal funding and a strong professional network to help new programs get started. A separate NSF-ATE grant funded the Northeast Biomanufacturing Center and Collaborative (NBC<sup>2</sup>) in 2005. Based initially at Great Bay Community College in New Hampshire and later at Montgomery County Community College in Pennsylvania, NBC<sup>2</sup> made significant contributions to biomanufacturing curriculum development including the launch of textbooks, protocols, and standard operating procedures.

In 2019, as the era of Bio-Link and NBC<sup>2</sup> ended, the NSF-ATE program funded InnovATEBIO as a consortium of community colleges charged with enhancing programs through professional development for instructors, curriculum development, and maintenance of a unified system for sharing

information across the network. With the creation of InnovATEBIO, NSF-ATE also adopted a decentralized approach to supporting biotechnology education across the nation. Instead of geography-based regional centers, they divided up mentoring responsibilities based on specific technology trends (e.g., genomics) or unmet educational needs (e.g., embedding undergraduate research or industry projects within programs). Within the U.S., approximately 100 two-year colleges, distributed across 40 states, currently offer degrees (and/or certificates) in biotechnology and biomanufacturing. Of these programs, approximately 90 are active members of InnovATEBIO.<sup>4</sup> InnovATEBIO partners with the Biotechnology Innovation Organization (BIO), its state affiliates, K-12 teachers, and the Manufacturing USA institutes to meet regional industry needs, determine emerging workforce trends, promote efficient use of educational workforce resources, and serve as a bridge between education and industry.

Taken together, there are tremendous existing educational resources focused on biotechnology and biopharmaceutical manufacturing workforce development. More efficient and innovative utilization of these resources can ensure that workforce needs are met.

While the pathway from community college to the biopharmaceutical manufacturing industry can be improved by strengthening industry-academic engagement (e.g., through better integration of curriculum, job descriptions, and postings at large pharmaceutical companies), there is no doubt that community college programs have made a significant impact on the biopharmaceutical manufacturing workforce. InnovATEBIO tracks data on community college graduate placement from the more than 100 programs across 40 different states. To date, community college graduates have been hired by more than 1,376 employers in the U.S., including by familiar names in big pharma such as Merck, MilliporeSigma, Genentech, BMS, Pfizer, Astra Zeneca, and Sanofi.

## RESOURCES

Federal investment in biotechnology technician education has created a large bank of resources for educators, administrators, and workforce development professionals interested in starting and sustaining community college biotechnology degree programs.

[InnovATEBIO](#) is an NSF-ATE-funded initiative that provides free support to secondary and postsecondary institutions, nonprofit organizations, and industry to develop and sustain educational efforts to produce a bioscience workforce. After joining InnovATEBIO, partners can freely access extensive resources including:

- Information on existing programs (e.g., location, industry partners)
- Curriculum (e.g., “Courses in a Box,” modules, videos, animations)
- Skill standards
- Topic-specific hubs / networking
- Grant support

[Northeastern Biomanufacturing Center and Collaborative \(NBC<sup>2</sup>\)](#) is a previously funded NSF-ATE project with a very actively maintained web site that provides a large compendium of biomanufacturing-specific curriculum resources.

[National Center for the Biotechnology Workforce](#), catalyzed with funding from DOL, focused on partnership formation, leadership development, and sharing best practices related to biotechnology technician education.

[Mentor Connect](#) is an NSF-ATE-funded project that pairs inexperienced grant seekers with experienced grantees for the purpose of developing more successfully funded NSF-ATE grants.

[MentorLinks](#) is an American Association of Community Colleges program funded by NSF-ATE and designed to help colleges develop or strengthen technician training programs in STEM fields through mentoring.

## BARRIERS TO COMMUNITY COLLEGE PROGRAM GROWTH & ADOPTION

The development and evolution of a network of two-year biotechnology and biomanufacturing degree programs in the U.S. should be viewed as a tremendous success; however, it is far from a perfect system. Despite the need for more technicians, seemingly successful programs continue to close down and regions that could benefit from a program often struggle to get one started. Biotechnology is one of many industries that need more technicians. IT, semiconductors, health sciences, cybersecurity, and advanced manufacturing in other areas all need more people. Colleges must make choices regarding which programs to support, as they cannot support them all. Funding models are often based on projected/actual student demand or poorly sourced jobs data, rather than actual industry demand. As a result, programs that cannot recruit students to fill classes or develop waiting lists for students to enter are the last programs to be funded.

Challenges faced by two-year biotechnology and biomanufacturing degree programs include low public awareness of biopharmaceutical manufacturing technician careers as well as longstanding biases against community college education as “vocational education.” In addition to this foundational “brand awareness” problem, community colleges must contend with a number of specific challenges including high program costs; a lack of expertise or talent for staffing programs; and limited institutional support, program articulation with four-year institutions, and industry engagement.

### Brand Awareness

Branding problems exist for community colleges, and it’s imperative that these institutions consider how to attract prospective students interested in biotechnology and biomanufacturing careers. Unfortunately, parents and students often don’t view community colleges as a place to get an education leading to a well-paying career in a field such as biotechnology. Rather, community colleges are

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seen as places to prepare for attending a four-year school, finish high school (GED), or train for a trade such as in health sciences, IT, or construction.

Secondly, a skilled technical position in the biopharmaceutical industry is not perceived as career choice with options for advancement or horizontal positioning. They are often viewed as repetitive lab bench jobs with little innovation, no chance for learning, and no possibility for advancement. Much of this stems from suboptimal laboratory experiences in high school that don’t give students an accurate perspective on laboratory careers. Recipe-based experiments, the lack of troubleshooting, and lack of variety don’t match what technicians do in industry. While students gain a better awareness through college education, internships, and undergraduate research experiences, they must be exposed sooner to spark an interest.

### Staffing Challenges

Until recently, individuals from industry or from graduate or postdoctoral positions have not considered community college instructional positions as a career option. However, as the

availability of individuals with advanced degrees looking for career alternatives increased in the 2000s, many community colleges began leveraging these experts in their biotechnology programs. While this model worked initially and helped establish many strong STEM programs, growth in the biopharmaceutical manufacturing industry introduced a new challenge: the industry's need for talent made the high salaries, meaningful work, and cutting-edge science in new modalities hard to resist for potential educators. Unfortunately, most community colleges simply can't compete with the salaries and benefits offered by industry.

A related problem has emerged as many community colleges inevitably resort to staffing their biotechnology programs with individuals who lack industry experience. While many teaching faculty have strong knowledge of biology, microbiology, and biotechnology, they must be provided additional training in biopharmaceutical manufacturing, regulatory requirements such as cGMP, and real-world aseptic practice.

Even more challenging is the reality that many biotechnology programs are run by one full-time faculty member, with adjunct faculty who may come and go. Many institutions simply do not hire enough full-time individuals or qualified laboratory staff to support their programs. As a result, program leaders often must wear many "hats" and require a great deal of expertise in everything from curriculum development and pedagogy to the science of biomanufacturing, and even the complexities of community college administration in order to fight the bureaucratic battles necessary to keep programs going. As a result, many two-year biotechnology programs are fragile and run the risk of closing if they lose just one faculty member to industry or retirement.

### Startup Support

Biotechnology technician education programs, like many other workforce programs (e.g., health

science, welding, semiconductors, IT), are inherently expensive. Good biotechnology programs mimic industry and as such, require specialized laboratory spaces that accommodate cell culture, instrumentation, biomanufacturing, laboratory stations, chemical storage, and prep rooms. Specialized instrumentation and expensive reagents are needed to fill these spaces so that students can master the techniques used in industry, making follow-on funding for consumables essential.

As a result, biotechnology programs, which are usually relatively small, have a low return on investment – calculated as the amount of funding required to set up and maintain the program per number of students graduated – compared to other programs, such as health sciences. As a result, establishing new biotechnology programs is often a lower priority, and existing programs are more likely to be eliminated in the event of funding problems.

### Long-Term Institutional Support

Even once established through internal or outside funding sources, the justification for continued institutional support of biotechnology programs can be difficult. It may be relatively easier for other programs, such as nursing, welding, or IT, to demonstrate value and return on investment due to the constant need for talent in those industries and the established role of the community college in providing that workforce. Simply put, gaining

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longstanding institutional support is hard and requires buy-in from multiple angles. In the short term, the college must shoulder the significant expense to build program curriculum and acquire the equipment and materials needed for a suitable training center. But as Guy Hamilton, the Executive Dean of Workforce and STEM at Shoreline Community College in Seattle notes, “it doesn’t stop there. It is certainly not the case that if a college builds a program then students will come. Many of these students are not familiar with these careers, particularly students from underrepresented populations. Bringing students from underrepresented groups into these programs requires developing personal connections with students in high school or community-based organizations, as well as providing additional supports in the program as they transition to industry.” Colleges must commit to sustaining a long-term approach to promoting career and program awareness and be willing to work with industry partners to break down institutional biases that favor baccalaureate students with respect to hiring processes and workplace environment.

### Articulation with Four-Year Institutions

Another challenge that impacts community college biotechnology program sustainability and institutional support is related to program articulation and credit transfer for students interested in pursuing a four-year degree upon graduation. Most community college biotechnology, bioprocessing, and biomanufacturing programs award Associate in Applied Science (AAS) degrees. While the applied nature of these programs gives graduates a huge leg up getting into the industry, such programs are not universally recognized as a college transfer degree. As a result, gaining long-term institutional support can be challenging for community colleges that position themselves as college transfer institutions. Work-arounds can focus on establishing articulation agreements between community colleges and universities, but such partnerships take time to establish and institutional buy-in to navigate.

### Industry and Employer Engagement

Employer engagement and industry involvement in community college biotechnology programs is central to solving many of the above-noted challenges. Many community college degree and continuing education programs rely on advisory boards, local employer engagement, and internal industry champions to ensure the programs meet industry needs, demonstrate relevancy, secure institutional support, and get their graduates hired.

Yet, as previously noted, a 2022 report by the Harvard Business School cast a critical eye on the nature of industry-academic engagement and the value employers place on community colleges. The report notes that “underpinning that low engagement is [industry’s] belief that talent can be readily found in the open or ‘spot’ market” as industry falls back on well-worn recruitment and hiring strategies. The report goes on to note that “only one in four employers could claim that they were transparent in communicating their hiring needs to educators.”

For those of us frequently engaged in workforce development conversations nationally, these anecdotes sound familiar. Advisory boards are often poorly attended. Biotechnology and biomanufacturing workforce conferences and conference session chairs struggle to get industry representatives in the room. Meanwhile, community college relationships with employers are often championed by single individuals rather than through company-wide support and buy-in for partnerships.

Students are landing jobs, and many programs boast 95%+ placement rates. Yet community colleges often must work hard to demonstrate value and build pathways to employers, despite the need for talent our industry faces. If we are going to truly innovate hiring strategies and non-traditional pathways into the biopharmaceutical manufacturing industry, we need to usher in a new level of industry and employer engagement.



## CASE STUDY: Solano College and Mira Costa College

Industry engagement and active partnership have been critical to the evolution of community college biomanufacturing programs. The Industrial Biotechnology program at [Solano Community College](#) started 25 years ago. The launch of the program followed the announcement by the pioneering biotech company Genentech that they would build the largest multi-use cell culture biomanufacturing plant in the world across the street from the College's satellite campus in Vacaville, CA. Genentech helped design the curriculum to emphasize teaching the skills and knowledge required for graduates to enter the manufacturing sector of the biotech industry (rather than research or development). Subsequently, [MiraCosta College](#) (Oceanside, CA) launched their biomanufacturing program in response to IDEC building a manufacturing plant near their college, and Solano College faculty helped with the program design. The building was eventually purchased by Genentech and is now the Genentech Oceanside manufacturing site.



*Upstream biomanufacturing training laboratory at Solano Community College.*

Since then, the two community college programs have grown to offer several stacked and latticed certificates, associates degrees, and a Bachelor of Science in biomanufacturing degree (since 2017). These programs constitute a complete educational pathway from high school, with students advancing through several certificates, the associates degree, and the bachelor's degree program. Solano College has forged articulation agreements with six graduate schools, completing the pathway from high school through PhD with many onramps and offramps to ensure a near 100% placement rate for graduates. In addition, students are prepared to test for industry-recognized third-party credentials such as from Six Sigma and the American Society for Quality (ASQ).

Even more important are the cost savings to students. At \$10,000 for a four-year degree, the bachelor's degree program is in many ways an equity-based solution to educational attainment. California is now one of 23 states to offer community college baccalaureate degrees.

## A CALL TO ACTION TO DRIVE INDUSTRY-ACADEMIC ENGAGEMENT

This whitepaper describes the deep infrastructure and rich history of biotechnology and biomanufacturing education and training available within the network of community colleges in the U.S. As the biopharmaceutical manufacturing industry continues to explore innovative and more inclusive hiring strategies, such as dropping degree requirements for technician and manufacturing roles, strengthening partnerships between industry and community colleges will be critical. Collectively, as we look ahead at an increasingly integrated ecosystem, it will be critical to consider a few proactive strategies that industry and educators can undertake to deepen these industry-academic partnerships.

**Understand and promote regional education resources.** In the world of biopharmaceutical manufacturing workforce development, we frequently speak of the need to increase awareness. While we are trying to encourage more young people to pursue education and careers in biotechnology and biopharmaceutical manufacturing, there's another awareness problem that is less frequently communicated. Kathie Young, NIIMBL's Workforce Activity Committee Coordinator, notes that "NIIMBL frequently receives requests from companies looking for help with technical training. Surprisingly, most of the time, the solutions they need already exist. It's just a matter of making the right introductions." Simply stated, the biopharmaceutical manufacturing industry is often unaware of education and training resources in their own backyard.

**Communicate hiring preferences and needs.** Better definition of career pathways, needs, and opportunities for community college graduates can ensure that community college educators and programs are producing graduates who are employable. Community college instructors often have a hard time deciphering hiring preferences and the differences between technicians, assistants, and associates, for example. While much of this

terminology is company-specific, it is critical employers and educators are on the same page.

**Be intentional when it comes to industry engagement.** NIIMBL's October 2022 whitepaper noted that industry champions play a critical role in moving novel workforce development initiatives forward.<sup>5</sup> However, as that whitepaper discussed, "it's also imperative to recognize how fragile some of these innovative initiatives are when limited to single points of contact, such as a recruiter or a hiring manager." As we look ahead, we must recognize that individuals in different roles bring unique perspectives. Though all perspectives are valuable, we must be intentional about bringing the right voices to the proverbial partnership table. For example,

- **Senior leadership** provides a uniquely holistic view of an organization's workforce challenges. However, with busy schedules and competing priorities, they are often overlooked as the cornerstone that holds up and encourages partnership. As noted in the 2022 Harvard Business School report, "to revitalize the employer-educator relationship, senior leaders within the organization must be involved. Regrettably, that is only occasionally the case today." Without senior-level buy-in, it will be difficult to engage others and drive systems change within an organization.
- **Technical managers** bring technical and hiring expertise to the table. As mid-senior level scientific and engineering experts in their organizations, they bring a wealth of technical expertise that's critical to the development and evolution of curricula. Equally important, they are making most of the hiring decisions. For this reason, as we look to transform the nature of hiring in biopharmaceutical manufacturing, technical managers must be at the table to manage partnerships, guide program evolution, and advocate for internal change when necessary to ensure graduates meet industry needs and are hireable.

- **Human resources** professionals guide organizational strategy around job descriptions, compensation models, and pathways for advancement. As they are often at the front line regarding career pathway innovation within an organization, it is important that educators understand their role and their operational constraints. Conversely, it is equally important that human resources professionals understand the diversity of backgrounds, technical skills, and educational attainment levels that community college graduates possess.
- **Talent acquisition and recruiting** professionals own the process of identifying, interviewing, and hiring talent. Strengthening partnerships between community college programs and recruiting professionals will ensure that recruiters have community college programs on their short list. In return, community college faculty and administrators will have stronger inroads into particular employers and have the opportunity to ensure their graduates represent their college well and are considered for mission-critical interviews with hiring managers.

Ultimately, it's not just about having anyone from a given company at the table. Innovative

education, training, and workforce development partnerships require input, participation, and collaboration from a variety of the right stakeholders to drive innovation and systems change.

## A LOOK AHEAD

In the coming months, we will continue to highlight some of the successful initiatives underway within NIIMBL's growing ecosystem of large companies, small companies, community colleges, and non-profit groups. It's our hope that increased organizational awareness can help establish a business case for systems change, plant seeds for consideration, establish best practices for communicating effective strategies across organizations, and ultimately forge new industry-academic partnerships to make disparate efforts better understood and aligned as we strive to innovate the biopharmaceutical manufacturing talent pipeline.

As noted at the beginning of this whitepaper, we also plan to expand the discussion of the community college role in the biopharmaceutical manufacturing ecosystem to include non-degree certificate programs, credentialing and micro-credentialing initiatives, continuing education, and customized training. Stay tuned!

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