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India’s Biomanufacturing Revolution and the MSME Challenge

07 April 2025 | Views | By Kiran Pillai, Author at Vastuta Think Tank

India’s global competitiveness in biomanufacturing will be determined by how well its smaller enterprises are equipped to participate in this transformation

India is evolving in its biotechnology and pharmaceutical journey. As the world looks toward building more resilient, intelligent, and decentralised supply chains, India’s aspiration to lead in biomanufacturing is stronger than ever.

Central to this transformation is the rise of predictive technologies where artificial intelligence, sensor networks, and digital twins allow for real-time monitoring, simulation, and optimization of pharmaceutical manufacturing processes. These tools promise cleaner batches, faster responses to deviations, and smarter decision-making across production lines. For large pharmaceutical corporations, adopting these technologies is already underway.

But for India to truly become a global leader in biotech and pharma manufacturing, the inclusion of its vast network of Micro, Small, and Medium Enterprises (MSMEs) is essential.

MSMEs form the backbone of India's pharmaceutical industry. They produce a significant share of generics, cater to rural and regional markets, and employ tens of thousands across industrial corridors. Yet, most operate under resource constraints, with limited access to modern digital infrastructure or AI expertise. Without timely intervention, these enterprises risk being sidelined by a future they helped build. The challenge is about creating an enabling ecosystem that brings advanced tools within the reach of every manufacturer, big or small.

Strategies to Democratise Predictive Tools

To bring MSMEs into the AI-driven manufacturing fold, India can build upon the success of its digital public goods like the India Stack. A similar initiative, an Open Biotech Stack, can be developed as a modular, open-access infrastructure of AI tools, APIs, and datasets tailored for pharmaceutical needs. This stack could include algorithms for batch prediction, environmental monitoring, contamination detection, and real-time quality assessment. Making such tools available to small manufacturers through public platforms would significantly lower the cost and complexity of AI integration.

In parallel, India's pharmaceutical clusters, such as those in Baddi, Hyderabad, and Ahmedabad, can be transformed into national-level bio-manufacturing hubs. These hubs could house shared AI labs, digital twin testing environments, smart cleanroom simulators, and real-time analytics dashboards. MSMEs within these clusters could access these capabilities on a subscription or pay-per-use basis, eliminating the need for massive capital investment. This shared model can level the playing field while fostering cross-firm collaboration and innovation. Emerging startups in SaaS can also offer AI-as-a-Service (AIaaS), allowing MSMEs to run predictive analytics or receive contamination alerts using simple interfaces without hiring full-scale data teams.

Policy support will be critical. A national grant scheme, modeled after the Production Linked Incentive (PLI) approach, should be launched specifically to digitize MSME pharma units. Such a scheme could offer matching grants, tax breaks on AI adoption, subsidized access to predictive software, and government-certified datasets for model training. These interventions would make predictive manufacturing tools affordable and trusted, encouraging wider adoption across the country.

Talent and the Future of Inclusive Innovation

Even with access to tools and infrastructure, predictive biomanufacturing cannot scale without the right talent. India must develop a new generation of technicians and mid-level professionals who understand both biomanufacturing and the logic of artificial intelligence. This means investing in hybrid skilling programs that merge AI with process engineering, biosciences, and quality control. Vocational institutions like ITIs and polytechnics can lead this movement by updating curricula, offering short-term certifications, and collaborating with pharma firms for hands-on training modules.

Training centres located within bio-clusters can serve a dual purpose of delivering skilling and providing innovation access to real-time tools. MSME employees can be trained not just to operate AI systems, but to interpret insights, make process decisions, and even contribute to improving models with domain-specific knowledge. Over time, this workforce will not only power their own units but may also seed India's broader bioeconomy with grassroots digital expertise.

New Vision for National Competitiveness

India's global competitiveness in biomanufacturing will not be determined by how many large corporations embrace Industry 4.0, but by how well its smaller enterprises are equipped to participate in this transformation. If predictive manufacturing becomes a privilege of scale, the sector will remain fragile and uneven. But if the country invests in inclusive infrastructure, affordable services, smart subsidies, and relevant talent, then a new kind of biomanufacturing ecosystem can emerge - one that is distributed, resilient, and future-proof.

By placing MSMEs at the center of this vision, India has the opportunity to lead not just in biotech volume, but in biotech intelligence. The tools exist. The models exist. What remains is a national commitment to ensure that no pharma enterprise, regardless of size is left behind in the AI revolution.

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