

Perfusion, PAT, And Smart Manufacturing Are Redefining Bioprocessing Economics Across APAC

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Chua Keng Hock discusses the growing adoption of perfusion manufacturing, process analytical technologies, and connected bioprocessing workflows that are helping biologics manufacturers achieve greater efficiency, scalability, and operational agility across the region.



As biologics manufacturing continues to evolve, Asia Pacific is emerging as a key region for innovation in process intensification, continuous bioprocessing, and smart manufacturing. Manufacturers are increasingly seeking ways to maximise productivity, optimise facility utilisation, and accelerate development timelines without significant capital expansion. Technologies such as perfusion based manufacturing, real time process analytics, and integrated automation are becoming central to this transformation.

In this exclusive conversation with **BioSpectrum Asia**, **Chua Keng Hock, Senior Vice President APAC at Repligen**, shares his perspectives on the growing adoption of perfusion technologies, the role of process analytical technologies in enabling real time decision making, and the future of connected, data driven biomanufacturing. He also highlights how emerging APAC biopharma hubs are embracing scalable manufacturing strategies to support the next generation of biologics and advanced therapies while improving operational efficiency and cost competitiveness

Repligen has been among the early pioneers of ATF-based perfusion technologies. How do you see process intensification reshaping the future economics of biomanufacturing across Asia Pacific?

Process intensification is changing the economics of biologics manufacturing in a very practical way. For many manufacturers, the traditional answer to growing demand was to add more capacity: larger bioreactors, more cleanroom space, and greater infrastructure investment. That model is becoming harder to sustain, especially in markets where speed, flexibility, and cost efficiency are critical.

Across Asia Pacific, we see manufacturers looking for ways to get more productivity from the assets they already have. Perfusion-based manufacturing, supported by technologies such as Repligen's XCell® ATF platform, plays an important role in that shift. By enabling higher cell densities and greater volumetric productivity, perfusion can help manufacturers increase output without always expanding their facility footprint.

That matters for both emerging biopharma companies and established manufacturers in the region. It gives teams more flexibility as programs move from development toward commercial production and can help improve facility utilization, reduce cycle times, and support faster progress to clinic and market.

From our perspective, process intensification is not just about producing more. It is about building more agile, efficient, and scalable manufacturing strategies that help bring important therapies to patients faster.

Many biopharma companies continue to operate within traditional fed-batch frameworks. What are the biggest misconceptions surrounding perfusion adoption today, and how is the industry mindset evolving?

One misconception we still hear is that perfusion is too complex or only appropriate for companies that are ready to move directly into full continuous manufacturing. That is not how many organizations are adopting it today.

In practice, perfusion can be introduced in a stepwise and very practical way. For example, N-1 perfusion allows manufacturers to intensify the seed train and increase the starting cell density of the production bioreactor while keeping much of the existing fed-batch framework in place. That approach can help improve productivity and shorten timelines without requiring a complete process redesign.

Another misconception is that perfusion only makes sense at very large commercial scale. We are seeing more companies evaluate perfusion earlier in development because it can help generate material faster, improve process understanding, and give teams more options as programs advance.

The mindset is evolving from "Is perfusion too difficult?" to "Where can perfusion create the most impact?" That is an important shift. Manufacturers are looking more holistically at upstream productivity, downstream readiness, analytics, automation, and facility utilization together — not as separate decisions.

The XCell® ATF platform highlights linear scalability from bench to commercial manufacturing. How important is scalability consistency for companies transitioning toward commercial biologics production?

Scalability consistency is extremely important because it gives manufacturers confidence as they move from development into GMP and commercial production.

When a process performs well at bench scale, teams need to know that the same process principles can translate reliably as they scale. If that consistency is not there, companies can lose time repeating development work, troubleshooting process changes, or managing additional technical transfer risk.

The XCell® ATF platform is designed to support a scalable path from bench through commercial manufacturing. That consistency helps reduce risk, supports faster process transfer, and gives teams a clearer path as they move toward larger-scale production.

For companies in fast-growing APAC markets, that can be especially valuable. Many are working under aggressive timelines while also managing cost, capacity, and regulatory expectations. A scalable platform helps protect timelines and gives manufacturers more confidence as they move important biologics programs closer to patients.

Process analytical technologies (PAT) are increasingly becoming central to modern bioprocessing. How is the PATsmart™ portfolio enabling real-time decision making and operational efficiency across upstream and downstream workflows?

PAT is becoming more central because manufacturers need better process visibility and faster decisions. Offline testing still has a place, but when teams are waiting on delayed results, they can lose valuable time and may miss opportunities to adjust the process while it is still running.

Repligen's PATsmart™ portfolio is focused on helping customers bring insight closer to the process. In upstream workflows, PATsmart™ MAVEN® and PATsmart™ MAVERICK® support real-time monitoring and control of key process parameters to help teams better understand cell culture performance, feeding strategies, and process consistency. In

downstream workflows, PATsmart™ FlowVPX® enables continuous in-line concentration measurement, while PATsmart™ SoloVPE® PLUS provides fast, dilution-free at-line concentration measurement.

The value is not simply having more data. The value is using that data to make better decisions, reduce manual sampling, improve consistency, and support greater process control.

That is where we see PAT making a meaningful difference. When analytics are connected more directly to the workflow, manufacturers can respond faster, reduce variability, and move toward more efficient and intelligent bioprocessing.

Cost optimization remains a major focus area for biosimilar and biologics manufacturers. From Repligen's perspective, how does perfusion manufacturing contribute toward lowering cost per gram and improving facility utilization?

Perfusion can support cost optimization by helping manufacturers increase productivity from the same or smaller bioreactor capacity. By maintaining high cell density and strong process performance over time, perfusion can increase output without always requiring larger vessels or additional facility expansion.

That is especially important for biosimilar and biologics manufacturers, where cost per gram and facility efficiency are major competitive factors. With XCell® ATF technology, manufacturers can intensify upstream processing, improve throughput, and reduce suite time. Those improvements can help facilities support more programs and make better use of existing capacity.

In many cases, the economics are not only about reducing direct manufacturing cost. They are also about flexibility. If a manufacturer can produce more within the same footprint, respond faster to demand, and avoid or delay major capital expansion, that can create a significant operational advantage.

From Repligen's perspective, perfusion is one of the practical tools manufacturers can use to improve productivity, strengthen facility utilization, and support more efficient biologics manufacturing.

Looking ahead, what major shifts do you anticipate in continuous bioprocessing, automation, and smart manufacturing over the next five years, particularly within emerging APAC biopharma hubs?

Over the next five years, we expect biomanufacturing to become more connected, more automated, and more data-driven. But we do not see that shift happening all at once. Many manufacturers will move in practical steps, starting with areas that can create immediate impact, such as N-1 perfusion, intensified fed-batch processes, automated feeding, in-line monitoring, and real-time concentration measurement.

At the same time, automation is evolving from a supporting function into a core operating model for modern biomanufacturing. It is no longer just about automating individual tasks. The bigger opportunity is to connect equipment, analytics, data, and process decisions so manufacturers can run more consistent, efficient, and responsive operations.

That shift is especially relevant for emerging APAC biopharma hubs. As companies scale quickly, they need manufacturing strategies that can support productivity, quality, and speed without adding unnecessary complexity. Smart manufacturing will increasingly depend on technologies that reduce manual intervention, improve process understanding, and enable faster decisions during the run.

We also expect PAT to play a larger role in this evolution. As real-time analytics become more integrated into upstream and downstream workflows, manufacturers will be better positioned to move from monitoring the process to actively controlling it.

Repligen's focus is to help enable that transition with technologies that support intensified production, scalable workflows, and real-time decision making. From XCell® ATF perfusion to the PATsmart™ portfolio, our goal is to help manufacturers build more efficient, flexible, and intelligent processes — ultimately helping accelerate the delivery of therapies to patients.