Growing success in biotechnology

How a smart, connected facility cultivates innovation that improves output.

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Introduction

The global biotechnology sector is growing well. Lean, agile and progressive, it benefits from a changing health care climate and the need to deliver more targeted drugs more cost-effectively.

The global pharmaceutical market has been forecast to reach $1.6 trillion by 2020. For its own part, the biotechnology sector had a revenue of $289 billion in 2013, with annual growth over the previous five years of 10.8%2, and is set to exceed $407.3 billion by 2018.

An ageing, increasing world population heightens the demand for health care products, as does wider access to services and the investment needed to provide them, particularly in emerging markets. In China the government has pledged to provide health coverage to at least 90 per cent of its 1.3 billion citizens within the next 10 years. India, one of the world's leading producers of generic drugs, is putting legislation in place to take advantage of the market for biosimilars. And Russia's simplified regulatory processes make it an attractive place to conduct clinical trials, with the government putting together a 10-year plan to drive innovation through collaborative clusters of knowledge and activity.

In developed markets, the US and Europe continue to lead the way, moving from high volume, low variety production to delivery of a wider variety of products in smaller batches at lower costs to meet existing and future demand.

Maintaining momentum.

The biotechnology sector has faced many challenges since its first successes in the late 1970s, initially in discovering new solutions to disease, and then developing the processes to make them more widely available.

Transforming natural, biological processes into commercial production was – and is – a challenge in itself. Build in the unpredictability of clinical trials, regulation and validation, along with the need to invest in expensive manufacturing facilities before product approval, and the challenges multiply.

Early production required the development of equipment and control systems that the broader pharmaceutical industry, based on chemistry, hadn't had the need for. Consequently, the initial focus was on making new products, not production efficiency, and demand quickly outstripped the capacity to supply. Over time, facilities became larger but without the flexibility to meet changing demand, and costs of development and production remained high.

Central to the biotech drug production is finding the balance between accommodating the natural cell growth cycle and maximising manufacturing productivity. Outdated equipment operating in isolation limits the value that manufacturers are able to extract from their automated technology. The ability to extract and share actionable information is limited, and it takes longer to validate each independent system.

Today, advances in the sector itself and in other industries mean that biotech companies will soon have the ability to achieve high-yield production, respond rapidly to shifts in demand and development cycles, and lower investment in production infrastructure. These changes are being driven technically, by advances in biological and process engineering, as well as economically, through facility-sharing and utilisation.

Taking advantage of integrated, single platform process technologies available will result in:

- Increased yields through process development and biological science instead of hardware solutions
- Safe, secure production that meets or exceeds legislative requirements
- Standardisation of facilities and processes, leading to higher product quality and consistency, and lower costs

Reform and regulation

Health care reform is centred around ensuring drug safety, reducing costs, enhancing innovation and improving market access, driving the evolution from a volume- to value-based marketplace.

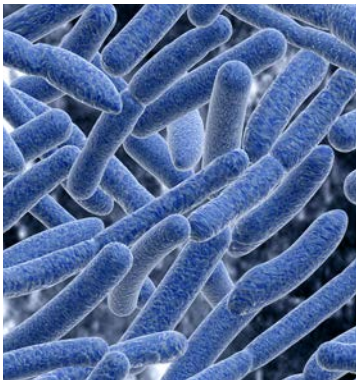
Increasingly stringent drug safety standards surround quality systems implementation, data integrity, and validation of processes in manufacturing or testing. Maintaining control over environmental conditions including temperature, pressure and relative humidity is central to product quality and regulatory compliance, particularly in biotechnology, where living cells are involved.

Traditionally, facilities that operate within regulated environments have used a combination of various disparate automation systems, stand-alone chart recorders, or manual data recording to manage critical environmental data. Compared to modern-day best practice, these systems are inefficient and costly, and make compliance more complex than it needs to be. Improvements in technology mean that there are now smarter, more efficient and cost-effective means available to mitigate the risks and optimise the returns.

Pricing issues

Governments and private insurers are asking for clinical demonstrations of drug outcomes, increasing the risk factors of early product development and intensifying cost pressures.

However, the demand for drugs is projected to increase as the population ages and a more personalised approach to treatment evolves. At the same time, the shift from large-scale production to a more demand-centric approach ultimately suits biotech. Smaller batches mean increased numbers of higher ticket items moving out of the production environment, and new technologies such as genomics and nanotechnology enable companies to discover new drugs and get them to market faster.



Solvent recovery

Pharmaceutical manufacturing is the most solvent-intensive of all chemical processes. Instead of recycling spent solvents, manufacturers incinerate a vast majority of the solvents on-site as a means to generate energy. The decision to burn rather than recycle has been driven by simple financial analysis and return on investment.

New business drivers are changing this mindset. The rising cost of raw materials, legislative pressures, and sustainability credentials, particularly relevant to biotech, mean that companies now are motivated to implement solvent recovery rather than incinerating their waste.

The benefits of on-site solvent recovery are clear: it reduces production costs in terms of raw materials, hauling and treatment, reduces waste volumes, mitigates supply risk, meets regulatory requirements and satisfies green initiatives, all while maintaining the quality required for manufacturing.

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The need for security – IP and counterfeit products

Intellectual property protection

In biotech, where innovation is the difference between success and failure, it is vital to be able to protect patents. Effective measures are fundamental to stimulating R&D activity, enabling innovators to recoup their investments on product approval and ensure wider advancement of the field. Investors are aware of the key role patents and data security play, and demand rigorous IP protection strategies to minimise risks.

Counterfeiting

According to international newspaper reports, 200,000 people died in China in 2008 from using fake drugs. It has also been reported that 260,000 bottles of cold medicine with added diethyleneglycol were sold in Panama in 2006, resulting in 365 deaths. Weak or incomplete supply chain security - particularly when many supply chains are expanding across the globe - is exacerbating the spread of counterfeit drugs, particularly in emerging markets.

The need for precision

Biosciences involves large molecules derived from live cell biologic agents or compounds. As complex organic compounds with limited dosage delivery methods, they are more sensitive to process conditions, and have to be intensely and precisely managed. Biotech, consequently, is one of the most complex types of manufacturing that exists. The challenge of scaling up living organisms combined with purifying their products to ensure safe administration to human beings creates a high-risk process technically, financially, as well as from a public health perspective.

The solution: using technology to connect and innovate.

Technology advancements are connecting developed and emerging biotech markets and participants along the value chain. Advances in industrial Ethernet, virtualised application servers and scalable architectures have made it easier to migrate to a single platform for building management, process automation and environmental monitoring. Actionable machine and process information can be provided to the right people at the right time, with changes made in real-time in the drive towards optimal production.

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In the same way, new digital health information technologies including electronic medical records, telemedicine, and mobile health applications revolutionise the way physicians, patients and other stakeholders interact.

Merging these functions into a unified solution makes validation easier, improves product quality, reduces total cost of ownership and improves time to market. These technologies also help users reduce both the risk of failure and the impact of failures on facility operations and data.

Best practice biotech manufacturers are looking to these technologies to move forward, focusing on optimising their IT investments, concentrating their efforts on improved asset utilisation and developing a standardised approach.

Integrated architecture

An integrated, plant-wide architecture, including control, integrated motion, visualisation and networking technology, brings together upstream and downstream processes and creates the opportunity to optimise output overall. Additionally, it represents a scalable solution that can easily be incorporated enterprise-wide.

At the heart of the architecture is a flexible, modular and open control platform with inherent built-in security features to make validation adherence a simpler process. To efficiently change over from one product line to the next, well-developed validation methods and agile, robust machines can support multiple product recipes.

Increased productivity

Higher productivity and niche products driven by personalised medicine mean fewer large-scale bioreactors and plants built. The desire for a smaller footprint also reduces the difference in size between pilot and commercial facilities, so opening up the possibilities for continuous production in one location.

Lower costs, shorter timelines, smaller scale multi-product facilities make the manufacturing process more accessible to smaller, emerging companies, and create greater opportunities for niche production. These technological innovations, in addition to innovations in new drug products and new, emerging technology platforms such as hybrid products and cell therapies, all create opportunities in more innovative, complex types of production at early stages, including first commercial launches, and for smaller, niche volumes, potentially with continuous production from clinical through commercial.

Standardisation and consistency

Manufacturing facilities take up to five years to build and validate, and up to $800 million in capital investment, limiting the flexibility to respond quickly to market changes. What's more, with fewer than one in five drug candidates moving from clinical trials to the market, investing in manufacturing facilities before regulatory approval is a significant risk. Even drugs predicted to be blockbusters could end up serving niche markets if clinical trials results lead to indication restrictions.

Historically, the industry has adapted to these conditions with contract manufacturing or partnerships with competing companies to share capacity when the need has arisen. Whether production remains in-house or is outsourced, raw materials, production equipment, quality procedures, fermentation technology and methods as well as batch monitoring and documentation have to remain consistent in order to maintain quality and meet regulations.

As the sector moves forward, a standardised approach using automation best practices achieves a number of objectives including:

- Improving traceability of goods, products, manufacturing activities and production line changes
- The ability to record and archive data centrally
- Using visualisation and simulation software to improve planning and to minimise the impact of production line changes
- Establishing self-learning and decision-making workflows to feedback, analyse and improve processes
- Centralising control over multiple manufacturing sites

Product serialisation - track and trace

To counter the 10% of all medicinal products in the world that are counterfeit, many pharmaceutical companies and their machine builders are turning to serialisation.

With a drug's pedigree representing the complete history of a given product's chain of custody, from the manufacturer to the point of dispensing, technologies are becoming available that make it easier to create and track serialisation for each product, providing an auditable electronic record of every step taken by a retail package of prescription drugs, as it moves from the factory to the final point of sale.

These solutions enable manufacturers to incorporate mass serialisation capabilities into their existing lines without a significant impact on line speed or the valuable equipment within their cleanrooms. Serialisation data printed on packaging can be transferred to globally-hosted central serialisation databases and national government databases, which will be accessible by pharmacists and those dispensing medication.

A quick scan of the data matrix will confirm the type of drug and the quantity; data that should concur with the information on the drug's packaging. It will still be possible for counterfeiters to copy the appearance of data matrices, but the chances of these concurring with the data held on the central database will be slim.

Summary

Smart, connected, informed, productive: the way forward for biotech

For every challenge in biotech, there's a technology solution. To produce multiple products in multiple variations, all on a single line, an enterprise-wide infrastructure is essential, along with the business systems that provide a real-time window into your operations and supply chain, and keep all relevant stakeholders informed.

To combat counterfeiting, best practice manufacturers are putting serialisation processes in place, whereby each item is marked with a unique serial number.

A smart, connected facility supports the flow of this critical information securely to and from machines and people – at every level, in any location and in the right context.

An information-enabled control and information system that utilises EtherNet/IP can help you more easily move toward the use of a single network, streamline multiple disciplines and applications into a single package, and help enable secure and easy flow of production data.

Manufacturing execution systems can play a critical role in reducing defects and process variability, eliminating waste and improving cycle times. By collecting manufacturing data, they provide an important prerequisite for measuring key aspects of the process. Integrated Manufacturing Intelligence tools assist analyse data, investigate and verify cause-and-effect relationships, and seek out the root cause. And finally, MES plays an important role supporting the implementation of intended process improvements in the production environment.

Dynamic, adaptable and highly progressive, MES supports biotech customers in their efforts to help:

- Reduce cost of compliance
- Improve time to market
- Optimise total cost of ownership with the goal helping them be competitive in the global market place.

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Publication LS-WP003A-EN-P