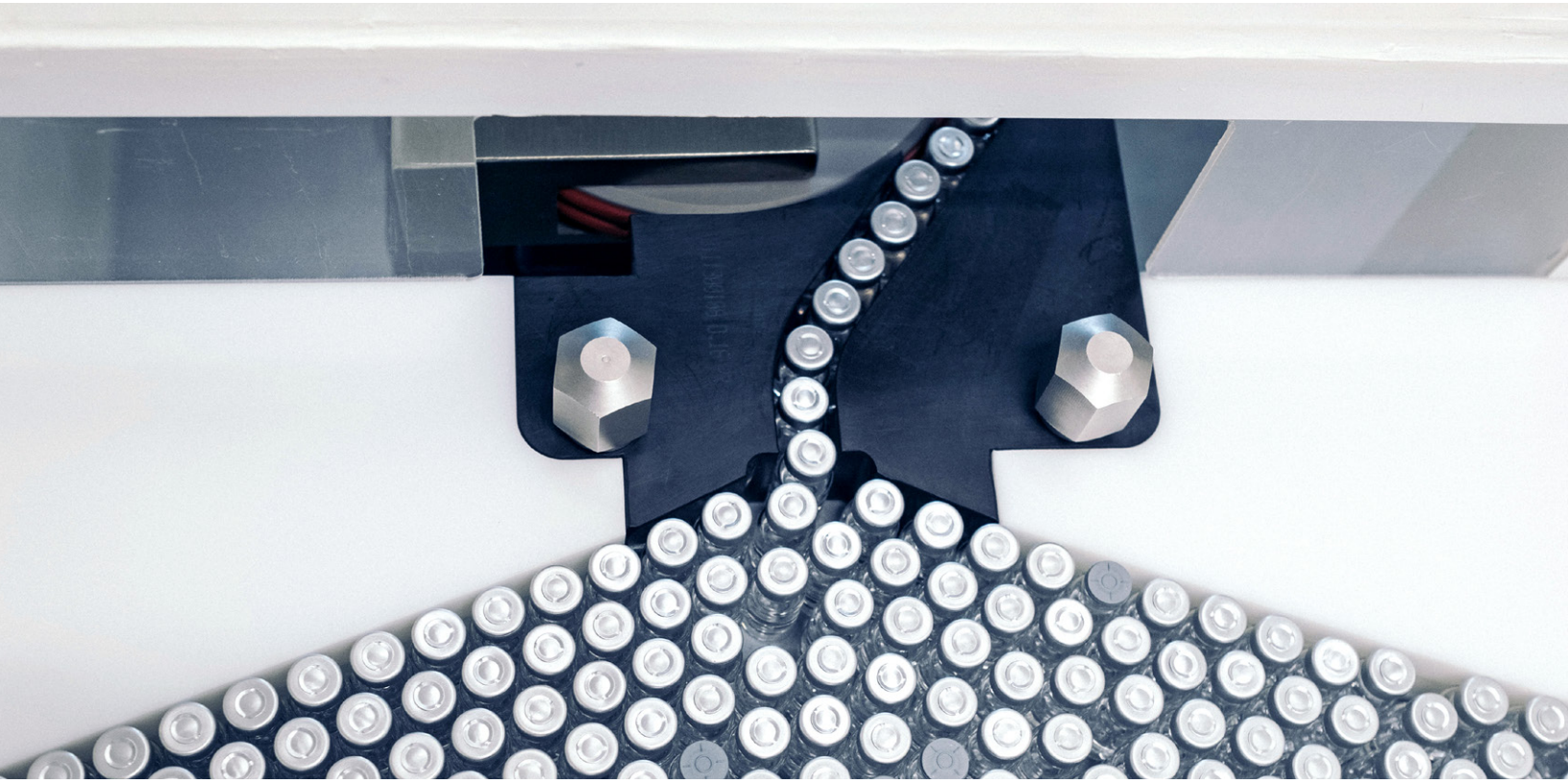
McKinsey & Company

Life Sciences Practice

How sterile pharma manufacturers can grow capacity without capital investment

The world will need more sterile products than manufacturers have or can build capacity for. But they can create capacity and take market share by running higher volumes through their existing lines.

This article is a collaborative effort by Giulio Barth, Pierre-Olivier Esteve, Giulia Ghiadistri, Philipp Korrell, Lucas Picci, Paul Rutten, and Matthias Spiegl, representing views from McKinsey's Life Sciences Practice.



January 2023

The sterile pharmaceuticals market is expected to expand by more than 50 percent over the next seven years (Exhibit 1). A significant driver has been the COVID-19 pandemic, which boosted demand for recombinant antibodies and small molecules. Sterile manufacturers need to create more capacity quickly to capture additional market share.

However, sterile capacity has always been difficult to ramp up due to the significant investments needed for new lines; long delivery, qualification, and validation times; and the effort required to train and qualify new employees. These conditions make it difficult for manufacturers to respond to the projected surge in demand. Data from McKinsey's pharmaceutical operations benchmarking of solids (POBOS) from the past five years shows that capacity per sterile manufacturing site has had a median increase of only 2.6 percent, while the median overall equipment efficiency (OEE) has decreased by 2.7 percent.

The challenges of building capacity

The time it takes to install a new sterile line has typically ranged from two to three years, although the current global supply crisis likely extends these installation times significantly. The shortage of sterile-manufacturing talent is likely to prolong the ramp up of new lines even further. Therefore, it is not viable to increase sterile capacity in the short term by installing additional production lines.

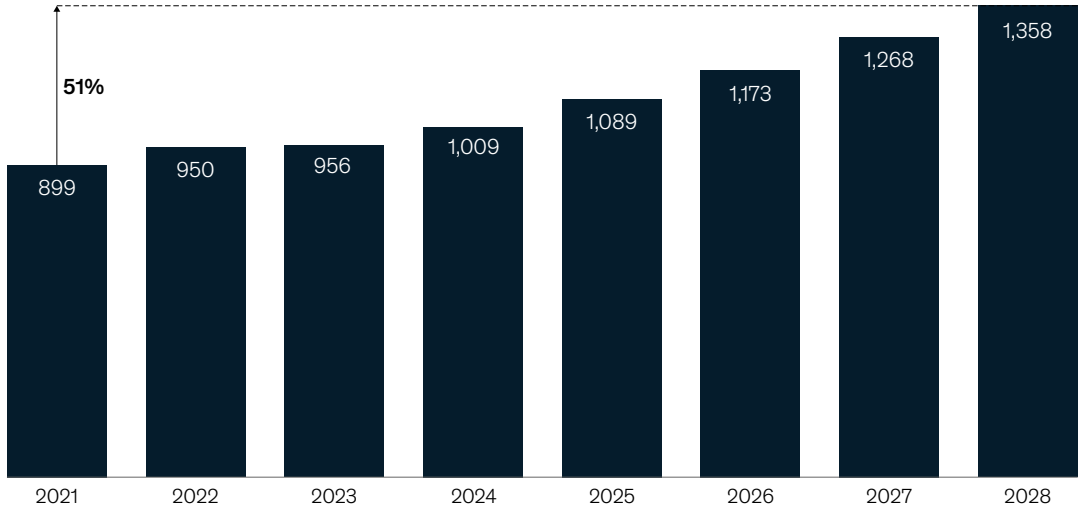
Boosting capacity in the short term by partnering with contract manufacturing organizations or contract development and manufacturing organizations (CDMOs) requires significant time and energy because of the complexities involved in transferring technology, particularly in filling operations where extensive process validations are required.

A tremendous untapped potential, however, remains in operational excellence. Looking at the efficiency of existing sterile lines, there is clearly room for

Exhibit 1

The global sterile-manufacturing market is expected to grow by more than 50 percent by 2028.

Projected global sterile-manufacturing market revenue,[1] $ billion



[1]Biotechnology and conventional.
Source: EvaluatePharma, Sept 2022

McKinsey & Company

improvement: utilization in POBOS shows a median value of 51 percent. Moreover, OEE in POBOS shows a range of 11 to 49 percent between the bottom quartile and the top decile in sterile filling operations based on validated speed (Exhibit 2). Many sterile manufacturers do not leverage the maximum possible capacity from their assets. Additionally, there is a 14-percentage-point performance gap in OEE between the top quartile (35 percent OEE) and top decile (49 percent OEE), showing significant improvement potential between high performers and those that are best in class.

When we remove from the sample the product lines with tailwinds—that is, lines dedicated to only one product or staffed with more operators than the median—we see a further increase in OEE range given the intrinsic performance of the lines and differences in operational efficiency.

Operational excellence can yield higher throughput

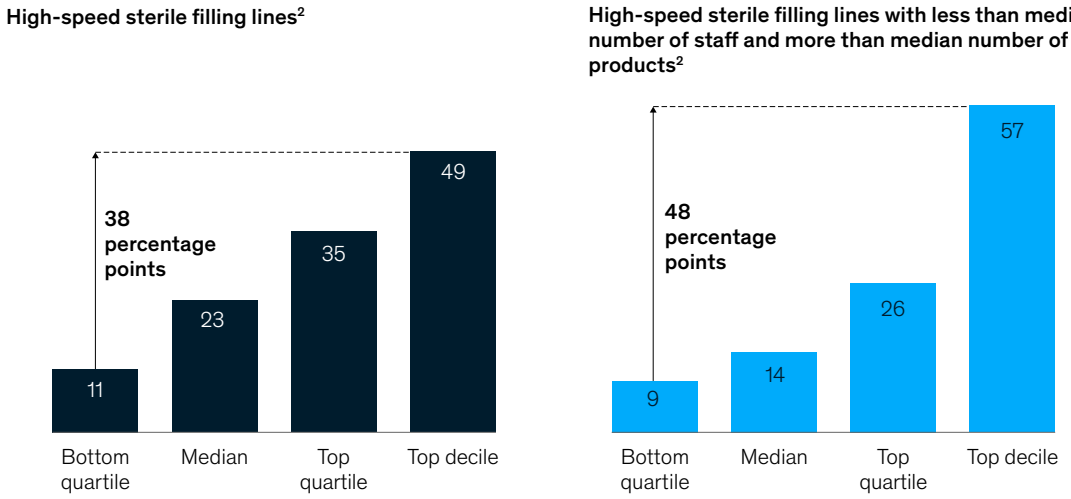
We have accompanied several clients on their journey from low to best-in-class performance as they worked through the challenges of constrained capacity. Two success stories highlight the potential impact of a capacity-focused transformation at the site and network levels and demonstrate the tangible benefits of focusing on operational excellence.

A large CDMO urgently needed to create new capacity for vaccine production and faced challenges including a lack of experience in growing capacity quickly. The challenges were reflected in the baseline OEE, which was in the third quartile according to POBOS. The company launched a network-wide transformation program from a strategic site to double worldwide revenues within five years.

Exhibit 2

The performance gap in sterile filling cannot be explained by product portfolios or staffing levels.

Comparison of high-speed[1] sterile filling-line performance based on staffing levels and number of products, % of overall equipment efficiency (OEE)



Note: OEE based on validated speed.
[1]180–400 vials per minute.
[2]59 high-speed lines overall; 15 lines with less than median number of staff and more than median number of products.
Source: McKinsey pharmaceutical operations benchmarking of solids

McKinsey & Company

We adopted a three-phase approach. First, we supported the client in basic process improvement, helping to stabilize and standardize systems and processes, which delivered results quickly. Raising process awareness helped lay the groundwork for the second phase, in which we assessed Industrial Internet of Things (IIoT) readiness and built capability around specific learning journeys. This allowed the company to unlock its digital working potential with tools such as advanced digital performance management and digital changeover guides. In the third phase, the company unlocked its full potential by introducing advanced analytics to enhance forecasting and support timely, data-driven decision making.

Advanced digital-performance-management practices, such as standardizing and bringing transparency on key processes, enabled a 50 to 60 percent improvement in OEE. Digital guides helped reduce changeover time on the sterile filling lines by 40 percent. Analytics-based root-cause problem solving reduced breakdowns, speed losses, and micro-stops by 30 to 40 percent. Overall lead time decreased by 20 percent, and within 12 months, the site's capacity doubled, as shown in Exhibit 3.

The second example involved a CDMO plant producing sterile injectable products on traditional aseptic lines. The company needed the line to run at three times its historical capacity to meet client demand. Challenges included a fast ramp-up of a new, more complex product, an unstable site organization with multiple recent leadership changes, and little experience in operational excellence.

We used traditional lean levers to identify and remove waste, boost flexibility, and dramatically improve the output of people and machines without substantial investments. These included the use of single-minute exchange of die (SMED) approach, which helped shorten and standardize changeovers. We increased process status awareness with hourly performance tracking on the shop floor. We also helped tracking operations by implementing value-stream performance management on the line,

Exhibit 3

Success stories in sterile manufacturing derive from a variety of contexts and approaches.

Comparison of scenarios by financial and operational achievements, %

Context	Approach	Changeover times	Performance losses through advanced analytics after 2.5 months	Overall equipment efficiency increase vs baseline
Digital lighthouse of a large contract development and manufacturing organization (CDMO) with goal of doubling global revenues in 5 years	Integrated lean and digital approach to permanently establish and scale up operational excellence across the network	–40	–30 to 40	50 to 60
CDMO plant producing sterile injectables in need of unlocking additional capacity	Traditional lean to capture quick wins	–60		100

McKinsey & Company

tracking every production step (such as compounding, filling, and packaging) and connecting with support function (such as quality assurance, quality control, and maintenance)—twice a day.

The plant experienced immediate results. Line OEE increased in the third month of the transformation, from 23 percent to almost 60 percent, that is, from the bottom to top quartile. Changeover times were reduced from 15.0 hours to a stable duration around 6.5 hours.

Based on our extensive experience working hand in hand with clients, researching and designing best-in-class sterile operations, we shortlisted, refined, and probed six critical principles that manufacturers can use to increase sterile capacity through operational excellence.

1. Leadership at every level sets stretch goals and leads change

Leaders at every level can support and inspire efforts to free up capacity. Once goals have been established, global operations leadership can design structured transformation governance to align them with the leaders of the various sites and co-develop a change story. This story can then be communicated at every level down to frontline workers at each location to maximize buy-in. This conveys the urgency of the initiative and confidence that the target is reachable. Within a network, one strategic site is usually chosen to pilot the transformation and inform the subsequent rollout.

2. Targeted interventions create capacity quickly

A core principle of operational excellence is that it generates superior outcomes by relentlessly focusing on process improvement that leverages simple production system concepts. Short-term, capacity-focused transformation uses operational excellence to free up critical bottlenecks along the value chain and rapidly unlock value. The bottlenecks can be clearly identified during the site diagnostic phase. For the first CDMO, we supported the client in stabilizing systems and processes first and then delivered rapid results through standardization and other lean practices.

3. Key processes are optimized first, then boosted with digital and analytics

While digital tools and analytic methods can generally unlock capacity beyond classic lean levers, key processes should be standardized and made lean before applying them. Doing so can dramatically improve performance management, accelerate breakdown resolution, and shorten reactions to deviations from standards.

The first step in improving performance management can be to design a meeting cascade that ensures clear information flows and escalation paths. People playing key production roles, such as line managers or shift supervisors, can be trained to lead key meetings such as daily huddles, shift handovers, and performance reviews. Then digital performance management can strengthen processes with near real-time and comprehensive information sharing.

A three-step process also applies equally to breakdowns. First, they are tracked at least daily, along with other performance losses such as line slowdowns. Second, process experts, maintenance technicians, and operational-excellence experts can participate in corrective actions and root-cause problem-solving (RCPS) during daily huddles. Third, everyone can measure and review the effectiveness of corrective actions in weekly performance review meetings. Once this basic routine is in place, advanced analytics can be applied to systematically identify loss drivers through data analysis and prevent issues by calculating the ideal parameter settings for optimal performance.

The process of deviation management—closing identified performance gaps—also benefits from taking selected key steps before applying analytics-driven prediction and reporting. These initial steps boost awareness and purpose and include redesigning the incident triage process, revamping the investigator training curriculum and certification requirements, improving the investigation process to prioritize rework, linking deviation and performance management to boost cross-functional collaboration, and standardizing RCPS meetings and review boards.

Finally, to avoid delays in the transition to digital and analytics, an IIoT readiness assessment should be carried out by each site before laying out an implementation road map. This allows an understanding of the different levels of data maturity across the network, allowing for adjustment of the rollout schedule accordingly. A highly standardized and proven approach to IIoT assessments only requires three weeks and a trained assessor who collaborates with key partners, including site information technology/operational technology (IT/OT) providers and central IT/OT.

4. Rapid adoption and effectiveness at scale are initiated with a pilot

A well-designed pilot program can boost agility and accelerate the learning and cultural acceptance of operational excellence. As improvement levers are designed and implemented at the pilot site, the knowledge and capabilities developed in the process can be codified and managed centrally. The more replicable and scalable the levers, the faster the rollout and the larger the benefit of both digital and analytics and traditional lean levers. KPI dashboards, advanced-analytics code blocks, work instructions templates, and other key tools can be reused in different sites.

5. Strong micro-biology validation capabilities enable process efficiency

A considerable part of downtime on a sterile production line comes from precautions taken to ensure sterility. Any effort to limit these downtimes in favor of increased efficiency needs to ensure patient safety by focusing on the optimization of selected operational parameters. For example, the automated clean-in-place/sterilize-in-place cycle designed to clean and sterilize filling assets between two consecutive batches makes up 30 to 60 percent of changeover time. It can only be modified by reprogramming the filling machine, which the manufacturer usually does. Having strong micro-biology validation, change control, quality assurance, and engineering capabilities on-site ensures that the machine's built-in cleaning and sterilizing cycles are calibrated to meet sterility requirements efficiently.

6. Focus on quickly developing specialized yet flexible talent

Talent for sterile operations is currently scarce, and many players have hired relatively low-skilled workers to face the surge in demand, as highlighted in the first example above. This resulted in inefficient, capacity-constrained operations. While it is indeed very difficult to directly hire a highly specialized sterile operator, value can still be maximized by creating fast and targeted upskilling programs. The first step to doing this is to map all required skills—for example, sampling, filter setup in changeover, using the autoclave—against the current workforce to highlight where the talent gaps are. This can be done through a simple skill matrix that is regularly updated by line managers. Once talent needs are clear, shift manning can be designed to pair experienced workers with potential targets for upskilling in selected activities. Ideally, running such a skill-matrix-based exercise in parallel in all production lines adds flexibility to the system by potentially allowing for the exchange of workers between lines.

Operational transformation is also a long-term solution

For many companies the best response to growing demand for sterile capacity will be to improve their manufacturing processes, leveraging their existing assets and workforce. Operational transformation does not just address immediate capacity and efficiency issues; it can also deliver deep and enduring benefits. We believe that assessing the key dimensions highlighted in this article is the first step sterile manufacturers can take to shape a more efficient future and meet the ever-increasing demand for sterile capacity.

Giulio Barth is an associate partner in McKinsey's Cologne office; **Pierre-Olivier Esteve** is a partner in the Frankfurt office; **Giulia Ghiadistri** is a specialist in the Rome office; **Philipp Korrell** is an expert in the Hamburg office, where **Matthias Spiegl** is a partner; **Lucas Picci** is an expert in the Lyon office; and **Paul Rutten** is a partner in the Amsterdam office.

Designed by McKinsey Global Publishing