Biologic manufacturing capacity expansion with single-use technologies

Key variables to consider
The following presentation is based on a simulation of a 2 × 2000 L mAb process. The simulation compares a single-use process train (SU) with a comparable stainless steel-based process train (SS), both modeled in a traditional, stick-built facility. Are you interested in a simulation of your biomanufacturing process? With our range of simulation tools, we can assist in this, whether it is for scale up/down, "de-bottlenecking", process intensification, transition from stainless to single use, or general optimization.
### Manufacturing setup simulation for 2 × 2000 L mAb process

<table>
<thead>
<tr>
<th>Titer</th>
<th>3.0 g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall process yield</td>
<td>70%</td>
</tr>
<tr>
<td>Number of products per year</td>
<td>4</td>
</tr>
<tr>
<td>Facility utilization</td>
<td>80%</td>
</tr>
<tr>
<td>mAb output per year</td>
<td>168 kg</td>
</tr>
</tbody>
</table>

#### TITER

<table>
<thead>
<tr>
<th>TITER</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 × 500 L</td>
<td>28</td>
<td>42</td>
<td>56</td>
</tr>
<tr>
<td>2 × 1000 L</td>
<td>56</td>
<td>84</td>
<td>112</td>
</tr>
<tr>
<td>2 × 2000 L</td>
<td>112</td>
<td>168</td>
<td>224</td>
</tr>
<tr>
<td>4 × 2000 L</td>
<td>224</td>
<td>336</td>
<td>448</td>
</tr>
</tbody>
</table>

Assumptions: 70% recovery through purification of 20 batches per year, per reactor.
Time to market and capital expenditure

**Single-use vs stainless steel technologies**

<table>
<thead>
<tr>
<th></th>
<th><strong>SU</strong></th>
<th><strong>SS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time to market</strong></td>
<td>9–12 months</td>
<td>24 months</td>
</tr>
<tr>
<td><strong>CAPEX</strong></td>
<td>52%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Stainless steel technologies**

- Take longer to procure, source, qualify, and validate.
- The initial cost is also higher.

**Single-use technologies**

- Provide faster time to market at lower capital expenditure.
### Operating expense

#### Single-use vs stainless steel technologies

<table>
<thead>
<tr>
<th>OPEX</th>
<th>SU</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEX – labor</td>
<td>68%</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Industry reports vary from 70% to 120%

OPEX = operational expenditure

Single-use technologies allowed 32% reduction in labor, based on elimination of cleaning and sanitization in place (CIP, SIP), and related testing.
Changeover and output

*Single-use vs stainless steel technologies*

Changeover
- **SU**: 1–2 days
- **SS**: 5–10 days

Output
- **SU**: 44 batches per year
- **SS**: 40 batches per year

Examples:
- **mAb_01**: batch 1, 2 days changeover, batch 2
- **mAb_02**: batch 1, 2 days changeover
Footprint

Single-use vs stainless steel technologies

Single-use technologies enable smaller facility, less cleanroom space — resulting in lower utilities and HVAC costs.

HVAC = central heating ventilation and air-conditioning  
DSP = downstream processing  
Equip. prep. = equipment preparation  
Inoc./prep. = inoculation/preparation
Cytiva’s single-use technologies

Across the entire bioprocess workflow
Medium preparation:
Xcellerex™ XDUO 100 to 2500 L mixers, HyClone™ cell culture media

Cell culture production
Xcellerex XDR 2000 L bioreactor
ReadyToProcess™ filter for CFF

Film management
ReadyToProcess portfolio
ReadyCircuit™ bag and filter assemblies
ReadyToProcess bins and ReadyCircuit bags
ReadyMate™ aseptic connectors

Fast Trak Services
Process development
Bridge Manufacturing Services
Training and education

Buffer preparation:
Xcellerex XDUO 100 to 2500 L mixers, HyClone buffers and process liquids

Harvest operations
FlexFactory™ harvest
BioProcess™ NFF Pump System

Virus reduction
Xcellerex XDUO mixers

Purification operations
ÄKTA™ ready system
ReadyToProcess chromatography column
ReadyToProcess filter for CFF

Virus filtration
FlexFactory viral clearance
BioProcess NFF Pump System

Bulk formulation and sterile filtration
Bulk fill equipment

Treatment and education
Fast Trak Services
Process development
Bridge Manufacturing Services
Training and education

NFF = normal flow filtration
UF/DF = ultrafiltration/diafiltration
CFF = crossflow filtration