

# SINGLE USE SUPPORT.

PIONEERING BIOPHARMA



## CASE STUDY

**Safe and efficient: The benefits  
of automated ADC filling**



# The situation

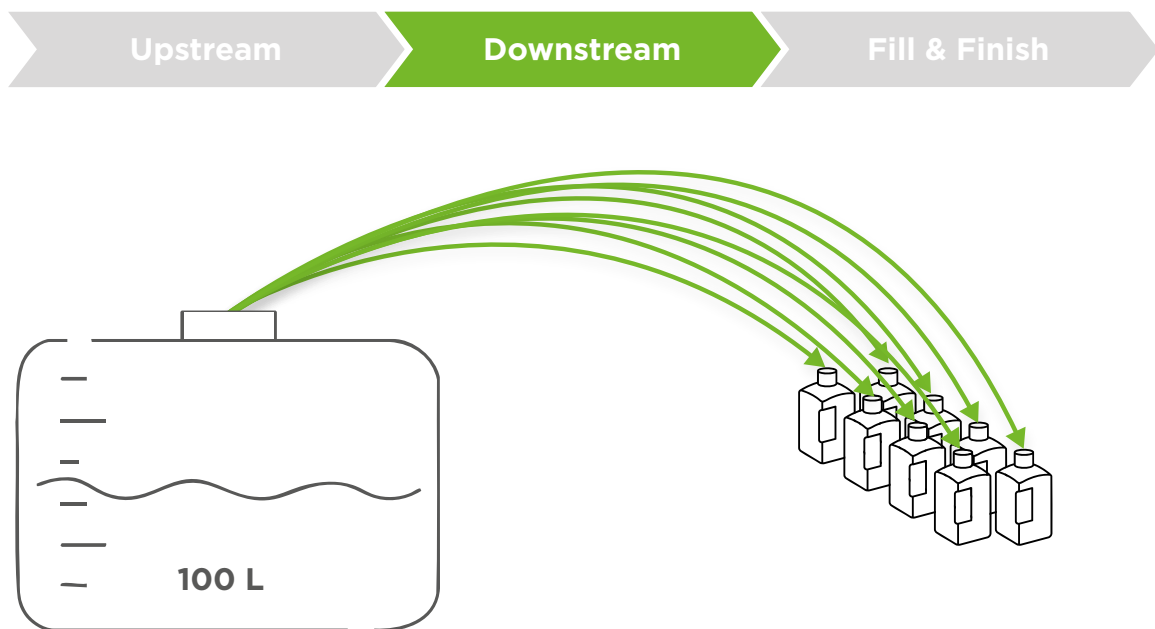
Manual handling continues to dominate many steps in ADC production - from transferring toxic intermediates to filling small volumes inside biosafety cabinets. Despite the growing availability of advanced automated systems designed to improve safety and precision, many manufacturers remain entrenched in legacy process workflows.

Take the example of one Irish biopharmaceutical site, the manual filling step of placing ADCs into intermediate bags in preparation for fill-finish had become increasingly inefficient. The considerable operator hours, process variability, and the exposure risks associated with the cytotoxicity of ADCs prompted process engineers to explore alternative solutions. Determined to modernize and align with regulatory recommendations for aseptically closed systems (Annex 1), the company set out to replace manual biosafety cabinet operations with a fully automated fluid management process, and began an in-depth evaluation of both approaches as outlined below.

## ADC intermediate volume

- Batch volume: 100 L
- 10 batches/year
- Total: 1,000 L filled/year
- Value of drug substance per batch: approx. EUR 500,000

**Closed systems for handling bulk drug substances are recommended by the US FDA and the EU Annex 1. They can also lead to cost savings due to the reduced risk of product loss caused by contamination and the potential for residual drug substance to remain in the tubing.**





# The solution

## Comparison of automated vs. manual filling

The Irish biopharmaceutical company shared data detailing their current manual filling practices. This information was benchmarked against performance metrics from Single Use Support’s automated filling platform for single-use bags and bottles, RoSS.FILL.



Figure 1: Bottle filling with RoSS.FILL

Automated bulk drug substance filling is the most reliable method to ensure sterility, eliminate human error, and achieve high throughput.

**Scalability:** As batch volumes increase, automation becomes even more critical. The RoSS.FILL Bottle system only requires one operator to fill multiple bottles, each with a capacity of up to 10 L, per run. Additional filling modules can be attached, enabling RoSS.FILL to fill even larger batches per run.

**Accuracy:** The integrated scales ensure the greatest filling accuracy to prevent overfilling. For smaller volumes of less than 40 mL that require greater filling accuracy, the gravimetric system can be replaced with flow sensor technology.

**Modularity:** It is possible to add further process steps, such as bulk filtration and pre-use post-sterilization integrity testing (PUPSIT) systems. The modular design of single-use assemblies enables the flexibility to simultaneously dispense product into multiple single-use bag and bottle types and sizes (Figure 1).

**Documentation:** For each bag filled, a label with relevant information, such as the weight, batch identification number, and barcode, is printed to ensure traceability. The system meets cGMP- and 21 CFR part 11-relevant quality standards.

	Automated filling	Manual filling
<b>Risk of contamination</b>	Very low (<0.1%)	Low to medium (up to 1%)
<b>Scalability</b>	High (up to 1000L+)	Low
<b>Loss caused due to residual holdup volume</b>	Very low	Up to 3%
<b>In-plant labor hours required</b>	2 hours (1 person for max. 2 hours per batch)	30 hours (3 people for 10 hours per batch)
<b>Documentation/validation in compliance with GMP</b>	GMP-compatible software control unit integrated in RoSS.FILL	Manual documentation, validation, standard operating procedure (SOP) required

Table 1: Comparison of automated vs. manual filling



# The result

## Total cost of ownership of manual vs. automated ADC intermediates filling

Despite a higher initial capital expenditure, automated filling rapidly becomes cost-effective. Real-world data from the Irish biopharmaceutical company show that the investment in RoSS.FILL reached the break-even point after just 5 batches. The main cost drivers associated with manual filling (highly labor-intensive; product losses due to contamination risk and residual hold-up volume) resulted in considerably higher operational expenses.



**ROI of RoSS.FILL achieved in less than 1 year, after 5 batches.**

The lower operational expenditure associated with automated filling will result in **significant annual savings.**

Manual filling is labor-intensive and exposes high-value drug substances to avoidable risk, including losses from handling errors, inaccuracies and holdup volumes. As outlined in Figure 2, automated filling has **reduced labor hours by more than 90 %**, requiring just one operator per batch for two hours. In addition, the automated workflow minimizes human error and delivers precise, sterile filling with full documentation.

For companies handling large volumes or running frequent batches, the savings increase proportionally. This makes automation not only a technical upgrade but also a strategic financial decision.

Total labor hours required for sterile filling

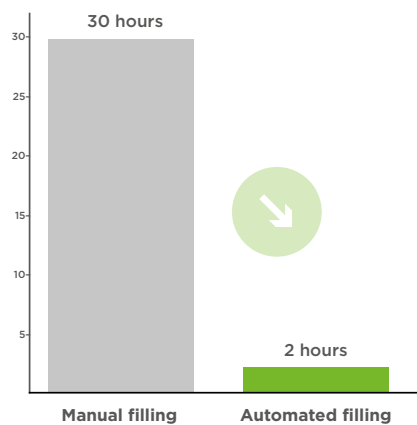


Figure 2: Operator hours required for manual vs. automated filling

### TCO - Total cost of ownership

The total cost of ownership (TCO) refers to the overall expenditure in implementing new technology and comprises capital expenditure and operational expenditure.

#### CAPEX (capital expenditure):

Manual filling only requires filling equipment, including a Class II biosafety cabinet, single-use containers, and sterile assemblies, and in most cases a peristaltic pump, while automated filling comes with additional upfront expenditures for equipment such as the RoSS.FILL system, including the control unit, and filling racks.

#### OPEX (operational expenditure):

Manual filling incurs ongoing costs for labor, documentation, validation, and SOP development, while also having a higher risk of product loss due to contamination, low recovery rates, and manual dispensing. Automated filling requires compatible sterile assemblies, but far fewer labor hours and has a lower risk of product contamination and residual volume loss.



## Benefits beyond costs

Ultimately, the advantages of automated filling outweighed the costs, convincing the biopharmaceutical company to take its drug substance handling processes to the next level with RoSS.FILL.

- Broad filling range
  - Bags: up to 1000 L+
  - Bottles: up to 160 L+
- Highly accurate filling
- Better contamination control (sterility assurance)
- Reduced labor requirements
- Guaranteed GMP-compatible validation
- High-speed filling
- Minimal footprint
- Modular filling racks can be added
- Can be connected to any manufacturing execution system (MES)
- Optional filtration and PUPSIT
- Modular manifold design



Figure 3: Scalable dispensing into single-use bags and bottles, from small to large volumes



Figure 4: The RoSS.FILL for dispensing drug substances into 2D single-use bags