

LIMS & Lab Automation

Optimising efficiency, traceability, and integration with liquid handling for GlaxoSmithKline

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To enhance process compliance, traceability, and efficiency in drug development and clinical trials, the early drug discovery group at GlaxoSmithKline (Harlow, UK) partnered with Azenta Life Sciences to modernise their small molecule sample management. The implementation of two Azenta SampleArc™ Flex Automated Storage Systems was made to streamline storage, automation, and workflow integration for improved visibility and high-throughput processing with liquid handling integration.

Introduction

GlaxoSmithKline (GSK) is a global pharmaceutical company that uses science, data, and technology to develop life-saving therapeutics. The GSK site in Harlow, UK needed to improve process compliance, gain visibility, and enhance efficiency in the management of their small molecule samples. Their state-of-the-art compound management facility required rapid access to their proprietary small molecule sample collection, critical for lead identification and lead optimisation efforts through target identification and focused screening strategies. They also required better visibility into the location of their samples at any given time (such as internal storage, academic institutes, or third-party sites) and integration with a liquid handling system.

The challenge

GSK needed to replace their obsolete and aging automated storage platform with a modernised system capable of storage, high-throughput cherry picking for tubes, and integrated liquid handling capabilities for sample plate production. Most of their samples are used in early drug discovery for the identification of new candidates that progress into the drug development phase.

Preliminary discussions with Azenta included a tour through their current facilities, a workflow review, and an update about migrating to a future building and new workflow. To date, GSK's samples have been stored in 1.2 ml split septum tubes, with a future view of switching to Azenta FluidX™ Acoustic Sample Tubes.

As part of the whiteboarding exercise, Azenta also assessed what a busy day would look like at their site (i.e., how samples coming in and out of the facility).

Technical and project topics that were also discussed included capacity, throughput, store size, robotics, available room space, sample migration, controlling and orchestrating multiple pieces of tabletop equipment under the control of Azenta software, and software integration with their existing LIMS.

During planning, GSK outlined a number of additional requirements:

- **Liquid handling:** Addressed parameters such as volume, dilution, and third-party equipment orchestration.
- **Storage capacity:** Defined storage capacity and input/output capacity needs.
- **Software function:** Capabilities for order placement, workflow priorities, and LIMS compatibility.
- **Order grouping:** Ability to offer automated grouping and rearrangement of samples by study to boost throughput.
- **Scalability:** Possibility for future expansion of input/output capacity.

The solution

GSK sought a partner that could deliver a scalable, flexible, and future-proof solution, evaluating candidates based on both quantitative performance and qualitative expertise. Azenta emerged as the ideal choice due to its strong existing relationship with GSK and a proven track record, with large installations already in place across the UK and USA.

Two SampleArc Flex automated storage systems were installed.

- **Ambient system:** A smaller system storing 44,000 solid powder samples, operating 24/7, and processing approximately 3,000 customer orders annually.
- **-20°C system with liquid handling:** A larger facility currently housing 4 million samples and integrated with a High-Volume Liquid Handling (HVLH) Cell. The HVLH Cell enhances automation by enabling precise sample preparation, validation, thawing, nanolitre to microliter aspiration, dilutions, liquid transfers, and tube and plate consolidation - streamlining workflows and ensuring accuracy in sample management.

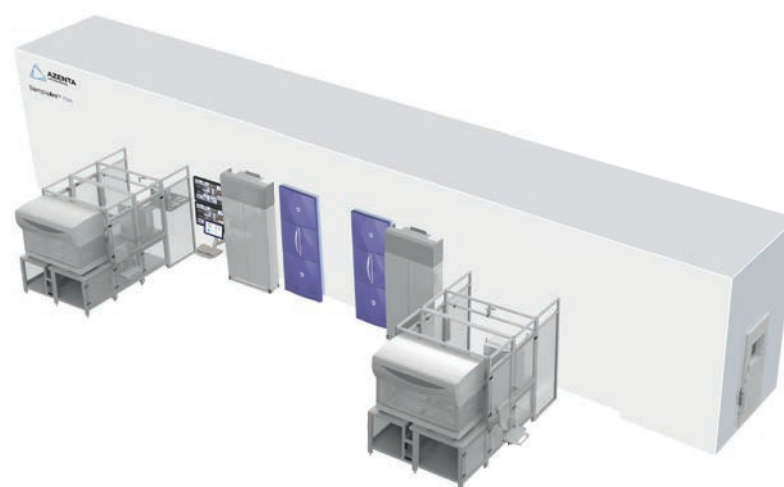


Figure 1: The Solution SampleArc Flex -20°C System with Integrated HVLH Cell

Storage capacity

The GSK SampleArc Flex -20°C System with Integrated HVLH Cell offers a maximum storage capacity of 14 million FluidX Acoustic Tubes or a configurable number of 1.2 mL AbGene tubes, allowing for a flexible combination of both. The store control software dynamically optimises tube placement, minimising wasted space while ensuring efficient retrieval.

Designed for versatility, the system supports multiple labware types and can be easily adapted to accommodate new formats in the future. Each plate and tube feature a unique 1D barcode, positioned both horizontally and vertically on the side, as well as a 2D matrix code located on the bottom of the tube for streamlined tracking and automation integration.

The high-volume liquid handling (HVLH) cell

The SampleArc Flex System seamlessly transfers labware from storage to the operations area via a connecting Automation Interface Module (AIM). This automated workflow enables the direct transfer of samples into new plates or tubes from tube sets delivered to the HVLH Cell, minimising exposure to external environments and reducing contamination risks.

The HVLH Cell is equipped to handle thawing, liquid transfer, dilution, and plate sealing, ensuring efficient and precise sample processing. Orders are managed through the ARCON™ Store Controller Software (formerly Strata), which integrates with the GSK LIMS.

Controller software

The ARCON Store Controller Software supervises all equipment within the system, coordinating task scheduling and sequencing for assay operations.

Operators can monitor real-time run progress, sample status, and instrument performance, with the system dynamically adjusting schedules based on available resources to maintain optimal efficiency.

Barcodes

Each destination plate or tube is labelled with a unique barcode and human-readable order details, ensuring full traceability. The liquid transfer instrument transmits operational results to ARCON and the GSK LIMS, generating reports on tube locations, order progress, total compound inventory, and flagged errors.

Functions

The HVLH cell can perform the following sample transfer processes:

- Tube-to-plate transfer with plate sealing to create new sample plates.
- Tube-to-tube transfer to generate copy tubes for expansion.
- Optional dilution by adding a specified volume of dimethyl sulfoxide (DMSO) to each plate well or destination tube.

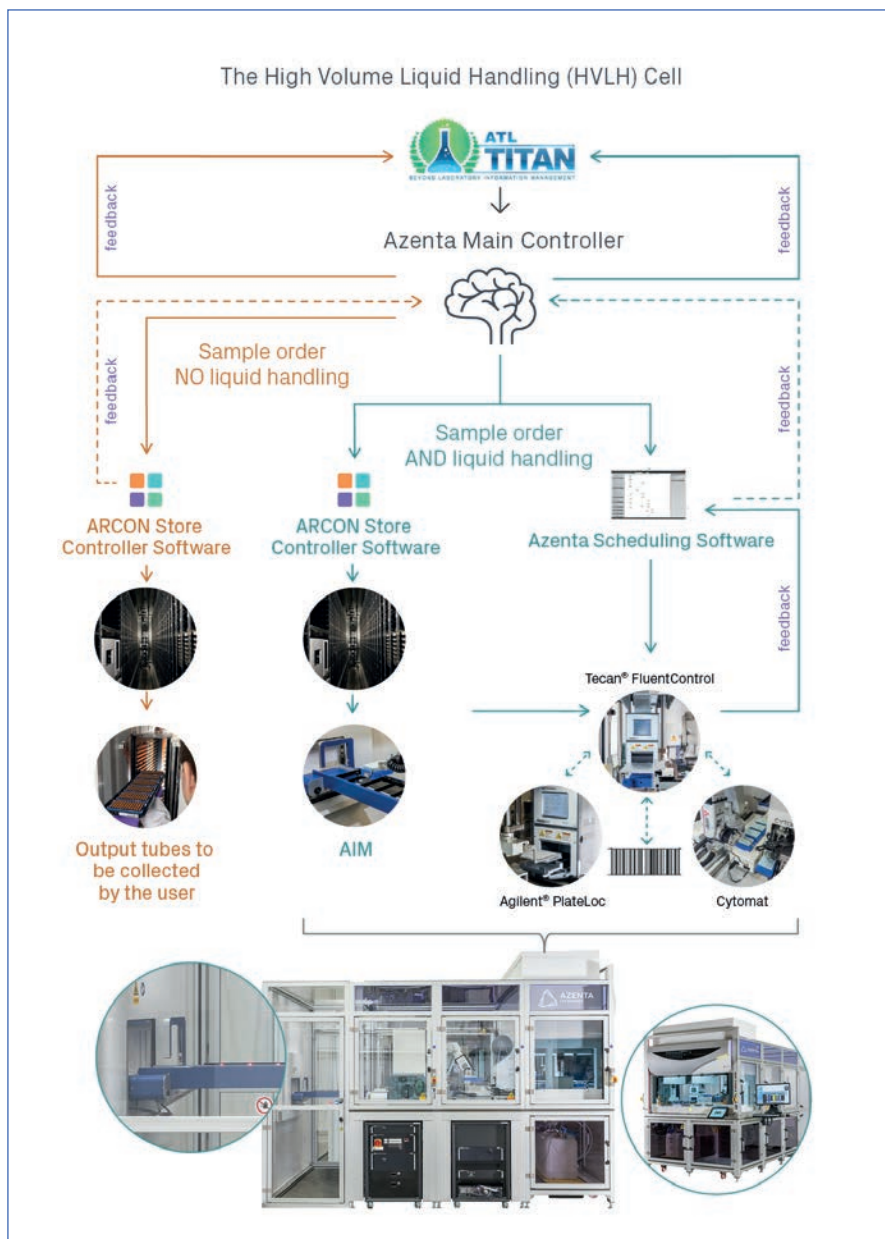


Figure 2: The High-Volume Liquid Handling (HVLH) Cell

Results

Order grouping

The GSK site receives about 8-10 orders daily, averaging between 2 and several thousand tubes per order. The requests for orders are managed by 3-4 operators based at the GSK Harlow facility (1FTE equivalent to manage the store). Below is an example of 10 orders performed on the same day.

Throughput optimisation

To maximise throughput, the SampleArc Flex System offers the option to allocate sample locations based on groups. For example, aliquoting liquid from 1,408 source tubes scattered across a compound set of 3.5 million tubes could take 15 hours.

However, if the same order is processed from a designated group of 100,000 tubes, the task is completed in under 2 hours due to a higher hit rate per tray entering the selector.

Additionally, the system supports prioritisation, allowing urgent orders to interrupt ongoing tasks. Priority levels can be assigned during order placement, enabling high-priority requests to be processed ahead of normal orders. For example, at the GSK site, a 40,000-tube standard-priority order can be paused mid-process to accommodate a smaller, urgent request.

The SampleArc Flex System is equipped with three multi-tube selectors (MTS), ensuring uninterrupted operation even if one tube picker is unavailable. If either the input/output module or the imager fails, the system continues functioning via redundancy.

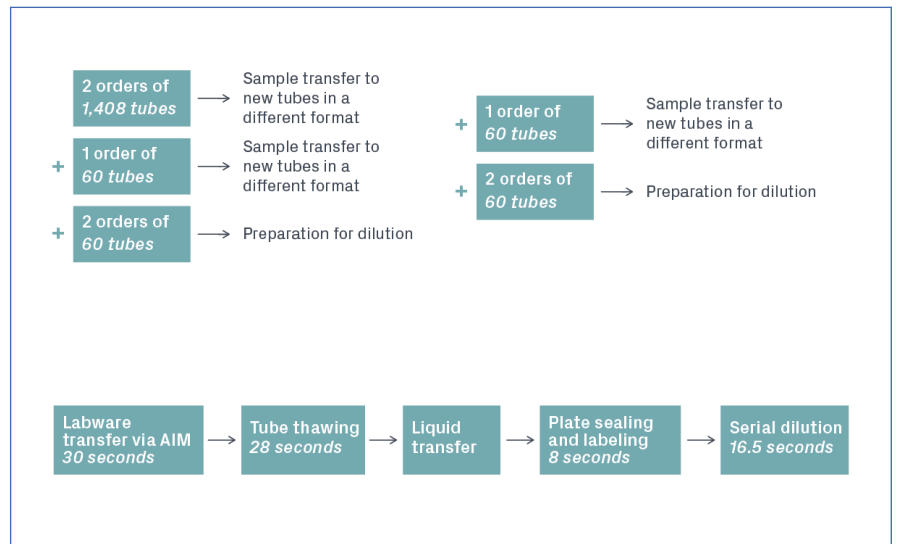


Figure 3: Example of 10 orders performed on the SampleArc Flex System on the same day (top) and a request for preparing a set of samples for serial dilution (bottom).

Results

At the GSK site, the SampleArc Flex System supports global operations, dispensing one million samples annually and fulfilling 3,000 orders - resulting in over three million pick, place, and reshuffling operations per year. This is double the throughput achieved before its installation.

For example, during a week-long holiday period, 170,000 handlings were executed entirely unattended. The system enables 24/7 operation with minimal labour requirements, facilitating out-of-hours picking and maximising efficiency.

Future-proofing and flexibility

In 2019, an upgrade was done that activated the Acoustic Tube Selector (ATS), enabling acoustic tube workflows alongside the existing AbGene workflow. This enhancement supports the Azenta FluidX Acoustic Sample Tube, an Echo-qualified consumable featuring 2D4 Quad Codes. These tubes are stored in ultra-high-density trays, maximising sample density and enabling conservation of compound compared to conventional storage methods. The system integrates with acoustic liquid handling, operating with a working volume of 85 μ L and a dead volume of 15 μ L.

The system's capacity can be further expanded by adding additional selector modules and attaching a second HVLH Cell to the spare AIM location. Additionally, modifications can be made to accommodate workflows using capped tubes instead of split septa, ensuring continued adaptability to evolving operational needs.

In summary

GSK reported exceptional support and engagement from Azenta, highlighting the ease of use and intuitive design of the SampleArc Flex -20°C Automated Storage System with Liquid Handling. Minimal training was required, enabling seamless adoption and immediate operational efficiency. This success underscores Azenta's commitment to delivering scalable, user-friendly solutions that support the evolving needs of biopharma and research organisations.

Increased throughput – Streamlined processes drive faster sample retrieval and storage efficiency.

Accelerated therapeutic discovery, development, and delivery – Optimised workflows reduce bottlenecks, expediting scientific breakthroughs.

Cost savings – Lower operating expenses through automation and improved resource utilisation.

Increased scientific productivity – Reduced time spent on inventory management allows researchers to focus on innovation.

A GSK Team Leader said: "Azenta has been a strong partner to GSK over many years. The interactions to understand and design the system to our precise requirements was key to building an automation platform that meets our needs for today and the future."

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