A photograph of a person wearing a white lab coat and blue nitrile gloves, holding a multi-well plate filled with small white vials. The image is partially obscured by a large, semi-transparent white circle.

Taking stock - going beyond the spreadsheet for accurate Cell Line Inventory Management

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v2.0

INTRODUCTION

Cell lines are fundamental tools in life science research. Because cell lines can be highly valuable assets and are cultured over many generations, laboratories need to accurately track cell line information, inventory and lineage from inception through passaging, storage, distribution and end use. For example, it may be essential to be able to relate a result to the provenance of the cells used.

Due to the challenges inherent in tracking cell lines and the need for a robust audit trail, spreadsheets are inadequate for this process.

KEY CHALLENGES FOR CELL LINE TRACKING

Examples of the challenges that laboratories face in the day-to-day management of cell line samples include:

Maintaining a record of sample lineage

- It is hard to maintain a record of lineage between cell line generations and passage numbers, especially when managing many different cell lines. However, the reproducibility of your experiments may rely on the accurate recording of this information.

Handling cell lines consistently

- Variations in the process used for cell counting, or even in the passage number used for experiments, can introduce inconsistencies to the data gathered from your experiments.

Recording information accurately

- It is difficult to search for samples electronically if information is missing or recorded in inconsistent ways.
- Inaccurate tracking of sample amounts and concentrations makes it hard to know what is available for an experiment.



Managing diverse container types

- Both cryovial stocks and flasks of cultures are commonly used for cell lines but require different handling and storage, so these should be barcoded and tracked carefully.

Managing the storage and retrieval of cells in multiple storage locations

- Keeping track of cell line samples distributed across a combination of LN2 tanks and manual or automated Ultra Low Temperature (ULT) stores can be challenging.
- Finding free space for storing new samples can involve time-consuming manual inspection of LN2 tanks for free slots.

Managing access to cell lines

Supporting different means of access to samples may be required:

- Where cell lines are managed centrally, scientists need a way to easily make requests for samples and track their progress. Sample bank managers need to easily manage the workflow of dispensing samples and arranging delivery.
- Scientists may need to manage local cell line stocks, including being able to search for and locate them for self-service retrieval



USING A SAMPLE MANAGEMENT LIMS FOR CELL LINE MANAGEMENT

Specialist sample management software, and some LIMS (Laboratory Information Management System) applications, are designed to accurately and automatically track a variety of sample types through lab workflows, monitor stock levels and record labware locations and movements. Such software also offers an audit trail of actions performed on samples. Several systems, such as Titian's Mosaic software, include additional features for cell line management.

Mosaic offers a range of general and specific features that improve cell line handling, including:

- Maintaining a record of sample lineage as new cell banks are created. This makes it easy to trace all the ancestor samples of any cell line.
- Recording a full audit trail of actions, to help ensure consistency and accountability
- Ensuring materials are described in consistent ways, using controlled vocabularies and validated data entry, making it easier to manage, find and share and materials.
- Recording ancillary information, such as certificates of analysis, datasheets or morphology images, using hyperlinks and file attachments
- Managing any type of labware, including those commonly used for cell lines:
 - Flasks – any type e.g. T-75, T-175 etc.
 - Cryovials – 2 mL, 5 mL etc.
 - Multiwell plates
- Accurately modelling and managing the entire hierarchy of sample storage from sites, buildings and laboratories down to the positions of tubes in boxes or flasks on shelves.
- Storage management tools to:
 - identify free space for samples based on business rules
 - manage storage or retrieval in bulk
 - provide reports on the utilisation of freezer space
- Easy integrations with leading brands of automated stores
- Support for both distributed or centralised cell line management – or a combination of each – in a single application.
- Controlled access to specific stocks to allow for example that master stocks can be reserved.



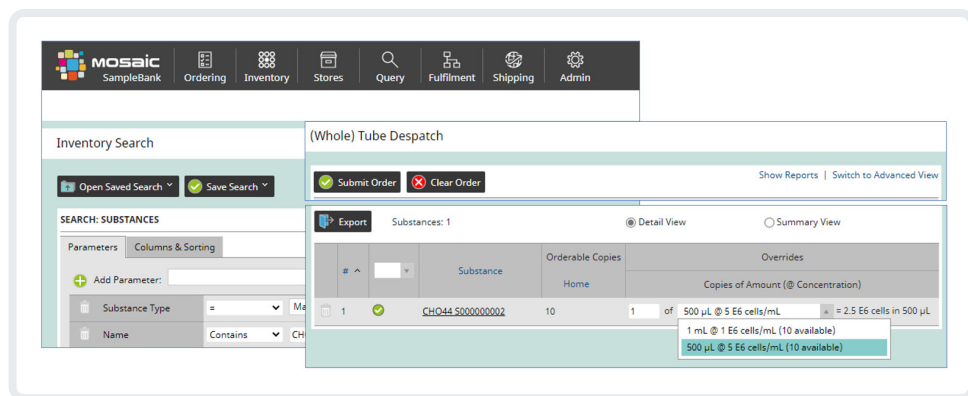
BUSINESS PROCESSES

The benefits of using sample management software such as Mosaic for managing cell lines can be illustrated by outlining some common business processes.

1. Managing Distribution of Cell Lines Requested by Scientists

Companies with large numbers of samples frequently prefer a centralised sample bank as the most efficient and secure way to manage and maintain stocks. Scientists' requests for cell lines are fulfilled by this central group. Tracking and maintaining the inventory associated with passages of multiple cell lines is a specialist job.

Scientists want to be able to search for and request cell lines themselves, and not rely on cell line custodians. Mosaic software offers dedicated tools so scientists can easily order cell lines in terms they understand.

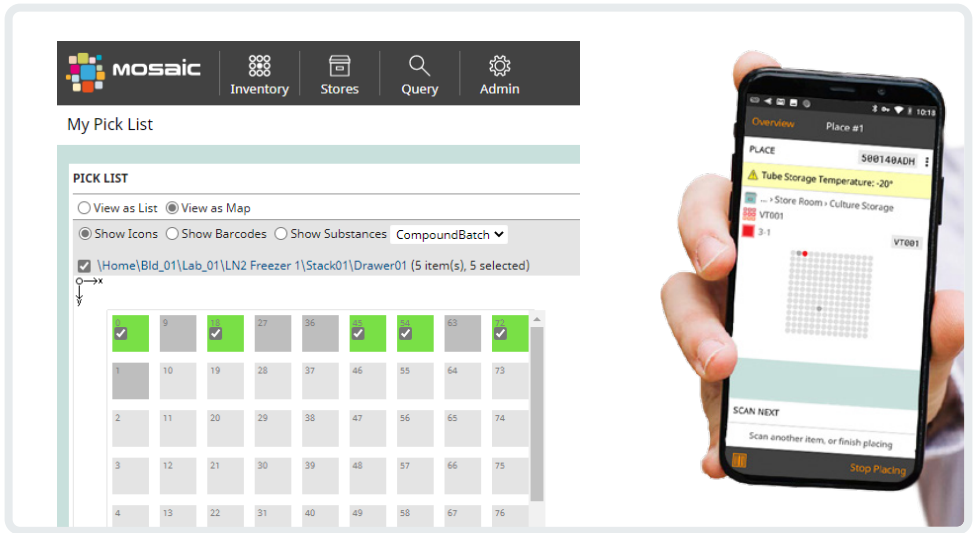


The screenshot displays the Mosaic SampleBank software interface. The top navigation bar includes icons for SampleBank, Ordering, Inventory, Stores, Query, Fulfillment, Shipping, and Admin. The main content area is split into two panels. The left panel, titled 'Inventory Search', shows search filters for 'Substances' and 'Name'. The right panel, titled '(Whole) Tube Despatch', features a table with columns for 'Substance', 'Orderable Copies', and 'Overrides'. A table row is visible with the following data:

Substance	Orderable Copies	Overrides
CHO44 5000000002	10	1 of 500 µL @ 5 E6 cells/mL = 2.5 E6 cells in 500 µL 1 mL @ 1 E6 cells/mL (10 available) 500 µL @ 5 E6 cells/mL (10 available)

This request for cells is then converted into a workflow of actions required for the centralised sample bank to pick and despatch the right samples to each requestor.

Fast and accurate retrieval of samples using Pick Lists or integrated mobile devices means no time is lost manually searching through LN2 dewars to find the right vials. Operators are guided straight to them, or an automated store is instructed to retrieve them. The removal of each sample is recorded and inventory records updated:



Sample management software should also help your sample bank keep on top of the logistical challenge of who has requested which sample and whether it has been delivered. Mosaic tracks the entire process from request to delivery. Automated alerts mean one less thing to do for busy sample bank operators. These alerts notify the scientist their samples are ready for collection, or in transit, and ensure samples are not overlooked or lost.

Sample Despatch Note

This despatch contains items for the following order:

Delivery Location	\\Titian\London\Labs\GDA\Pickup
Order	291
Order Type	Despatch (by Barcode)
Recipient	Green, Gary (GeneralUser)
Comment	
Placed	16 January 2021 12:12
Delivered	19 January 2021 16:56
# Items in Order	1

This despatch contains the following tube:

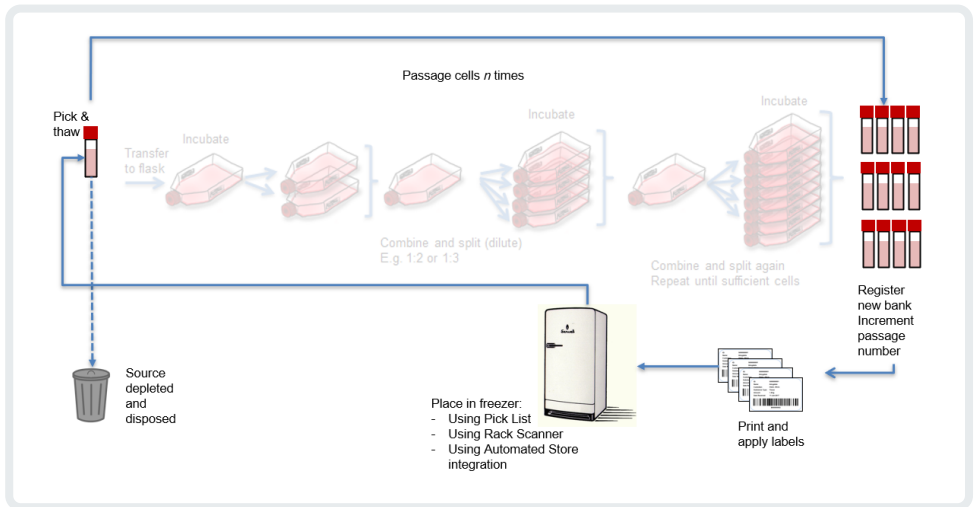
Barcode	Substance	Amount	Conc
DTUBE010	MOS00000046	0.5 mL	5 E6 cells/mL

2. Maintaining Cell Line Stocks, Creating New Banks

Ensuring constant availability of stocks of cell lines is a key role of a centralised cell line group. Your sample management software should provide tools for on-demand reporting on cell line stock levels and sending notifications when stocks of cell lines fall below a set level.



The process of creating a new cell line bank is summarised in the diagram below:



Because tracking the lineage between new passage and tubes and prior passage is essential to a good quality laboratory process, Mosaic software automatically creates a new lot and increments the passage number as new tubes are added to the inventory:

The screenshot shows the Mosaic software interface for Tube AB0031. The interface is divided into several sections: DETAILS, LOCATION, and SAMPLE. The DETAILS section includes fields for Barcode (AB0031), Labware Type (2mL CryoVial), Creation Date (24/08/2020 13:00:45), Expiry Date, Thaw Count (0), Comment, Requires Secure Storage (No), and Despatched (No). The LOCATION section shows the Location Path (\\Home[Bld_01]\Lab_01\LN2 Freezer 1) and Storage Description (Stack01\Drawer01\0). The SAMPLE section displays Substance Type (Mammalian Cells), CompoundBatch, Name (CHO-h-Beta 2), ID (50004), Amount (1.5 mL), Concentration (4 E6 cells/mL), and Total Thaw Count (0). A 'Create Child Tubes' button is highlighted in red, and a 'Create new' radio button is selected in the Substance section. The Passage Number is set to 5.

As part of this process, the source vial's removal from storage and its disposal is recorded.



Printing labels for the new vials is done directly from the web page, using accurate real time data. Mosaic is integrated with industry leading BarTender® software for label printing, which means it supports almost any design of label and is compatible with almost any model of label printer.

The remaining step of placing the new vials into stores is managed intuitively using Mosaic web pages. Tools to aid placing to storage include:

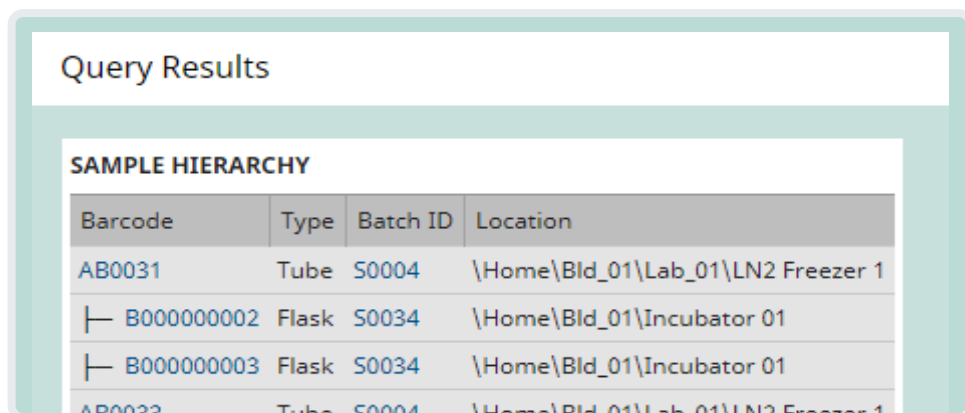
- Free space finder, to identify and suggest available slots automatically
- Place list for manual bulk-placing of items
- Mosaic Mobile application to guide and record storage in real time using a handheld device
- Integration with 2D barcode rack scanners to scan new vials directly into storage boxes

OTHER CONSIDERATIONS FOR MANAGING CELL LINES

Other important benefits which are needed for cell line management are listed below. These are provided by Mosaic software.

Inventory reporting tools

- Making it simple to run reports on distribution or any other aspect of management of samples.



The screenshot displays a 'Query Results' window with a table titled 'SAMPLE HIERARCHY'. The table has four columns: Barcode, Type, Batch ID, and Location. The data rows are as follows:

Barcode	Type	Batch ID	Location
AB0031	Tube	S0004	\Home\Bld_01\Lab_01\LN2 Freezer 1
└ B000000002	Flask	S0034	\Home\Bld_01\Incubator 01
└ B000000003	Flask	S0034	\Home\Bld_01\Incubator 01
AB0032	Tube	S0004	\Home\Bld_01\Lab_01\LN2 Freezer 1



Flexible deployment options

- Choose software that is available either hosted in the cloud, or installed in your IT environment to give you options to suit different budgets and growth needs.
- Web-based user interfaces make deployment easy.

Comprehensive audit trail

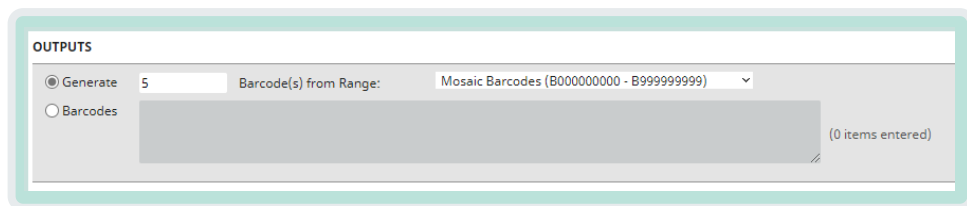
- Every action needs to be captured in a comprehensive audit trail. This is important for regulated environments or metrics reporting.

Control access to cell lines

- A system of permissions and restrictions so that access to specific stocks can be controlled to ensure that master stocks can be reserved, or location information restricted to authorised users.

Barcode management

- One of the main culprits of cell line misidentification is mis-labelled and hard to identify labware. Barcoding is vital to the unambiguous identification of samples. Barcodes are easy to scan automatically, making it easy to track the movements of cells in and out of storage or around a lab.
- You can use pre-barcoded labware or let your sample management software manage one or many barcode ranges for you. Mosaic software incorporates barcode management and label printing to ensure all labware has a unique ID, as well as accommodating pre-barcoded or even unbarcoded tubes, plates or flasks. Being able to create these in inventory ensures nothing goes untracked – right to down to the well level.



OUTPUTS

Generate 5 Barcode(s) from Range: Mosaic Barcodes (B000000000 - B999999999) ▾

Barcodes (0 items entered)

Rack scanner integration

- Integration with rack scanners provides automated tube handling and tracking for reliable inventory data. Mosaic software offers easy integration with a variety of rack scanners, detailed in our app note: Enhance your Tube Handling with Mosaic's Tube Position Verifier (TPV) Application.



SUMMARY

Cell line samples need robust sample tracking software that includes managing registration, labware, passages, searching, requesting and delivery.

Mosaic software helps you realise efficiency gains at every step of the cells' lifecycle, through identification of samples, management of picking, tracking movements and distribution. With Mosaic you can:

- Maintain sample lineage records and track passage number and freeze/thaw cycles
- Handle cell lines consistently by recording and repeating workflows
- Record information accurately
- Manage and track diverse container types
- Manage the storage and retrieval of cells in multiple storage locations
- Control access to cell line master stocks

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Marcus Oxer worked for GlaxoSmithKline for 23 years, originally as a scientist working in molecular biology, later transitioning to bioinformatics and then R&D IT. He joined Titian Software in 2012 where he specialises in addressing the challenges of biological sample management.



ABOUT TITIAN SOFTWARE

Titian Software works closely with customers and industry partners to explore future enhancements, such as integration with a range of ultra-low temperature automated storage or using a mobile application for convenience and traceability.

We also use our extensive experience in interfacing laboratory instrumentation and robotic systems with our software to ensure that customers make best use of their investment in research and development technologies. We pride ourselves on taking into account customer feedback for all of our Mosaic applications to drive our product to be the best it can be. It's all part of Titian's commitment to providing innovative solutions that make life easier for sample management professionals.





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