An Executive Summary

Managing Experiments and Projects Beyond Spreadsheets

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This summary addresses handling laboratory needs and available resources through effective lab operation strategies, measuring and tracking laboratory resource allocation/cost, and assessments of equipment usage, utilization rates, and resource needs.

Introduction

As laboratories are under ever-increasing pressure to increase productivity, this discussion focuses on strategies for improving laboratory efficiency using database tools that go beyond spreadsheets, time-limited charts, and manual daily workflow tracking on whiteboards. Such database technology can be used to identify, consolidate, track, and leverage resources across laboratory platforms that can then provide resource insights, build out projects, create experiment strategies/plans (via structure), and track the use of instruments and other laboratory resources. The result is an assessment of resource needs versus laboratory output, which can be used to refine operations to meet project goals and timelines as well as improve innovation.

Laboratory Operations Strategies

Laboratories require a large amount of equipment and resources—along with spare parts and other components—to analyze samples accurately and efficiently. A variety of manual tools (i.e., software applications) including notebooks, whiteboards, and spreadsheets are available to manage these supplies, inventory, and other consumable resources.

Figure 1 is a consolidated list of supplies that can be managed using a manual tool such as Microsoft Excel; maintaining such a spreadsheet, however, can consume a significant amount of time that is taken from personnel resources. Laboratory operations can be streamlined by using a system that can provide a consolidated view of supplies in the inventory and is automatically updated when the details of an asset, sample, or item are used or changed. Using tools that can be integrated into other lab management tools is highly desirable.

Software used to manage supplies data should be easy to use, highly configurable, and provide information at the granularity required to truly understand the supplies and samples available on hand and where the most critical items are located. In the example illustrated in **Figure 2**, assets on hand are displayed, including the asset name along with who owns it, when it was received or created, when the item was last updated, the asset/item type, and an inventory count. Additional details can be viewed by drilling down through the layers of the database system.

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The first asset displayed (anti-CD20) contains the name and the inventory count for that sample. Systems that have more layers for each asset contain additional details such as the location of all aliquots of this sample. This level of detail assists in determining the samples or supplies on hand. In this example, the sample is located in freezer #1, the top shelf in that freezer; the box measures 9"x9". It also displays the specific slot of each sample as well as how much of the contents have been used. Additional details about that sample aliquot include the sample label, amount left of the aliquot, expiration date, and sample concentration. Software systems such as the Agilent CrossLab iLab Operations Software are intended to help manage data storage locations and to connect with other relevant information, not to analyze the samples or sample data. Most electronic lab notebooks (ELNs) and laboratory information management systems (LIMS) can be connected to a network of systems to manage samples, supplies inventory, lab operations data, and cost-tracking data in conjunction with the data generated by lab instruments.

Implementing a network of software is critical for keeping data organized. Laboratories that adopt this approach have consistently shown an increase in the time dedicated for scientific research.

After identifying how to track supplies to support laboratory functions and where to store data generated, experiment and project management must be addressed. Excel, Word, and PowerPoint are sufficient to communicate the intent of each project or experiment; however, connecting these file types with other systems is highly manual wherein tracking down specific activities, experiments, and projects becomes unorganized or time consuming.

Figure 1: Supplies that can be managed using a manual tool.

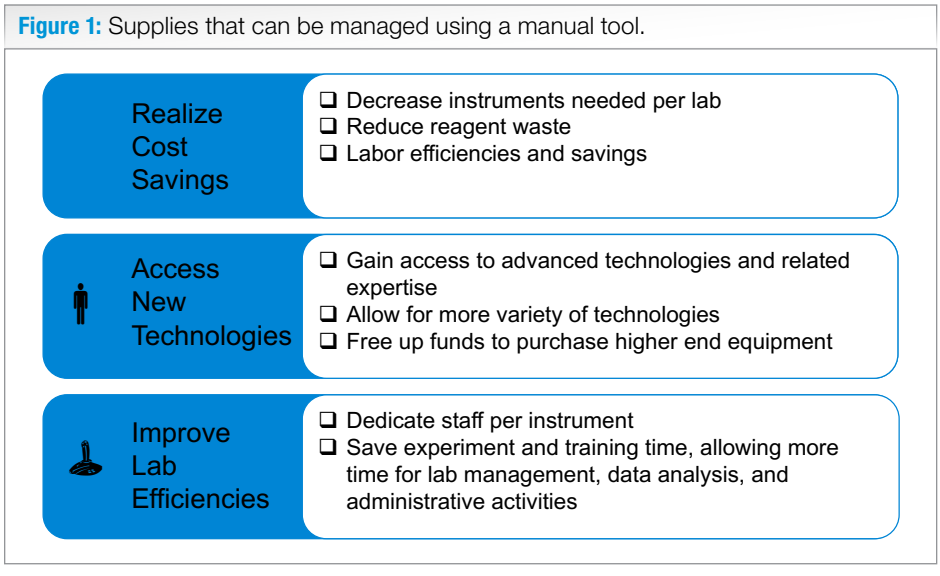
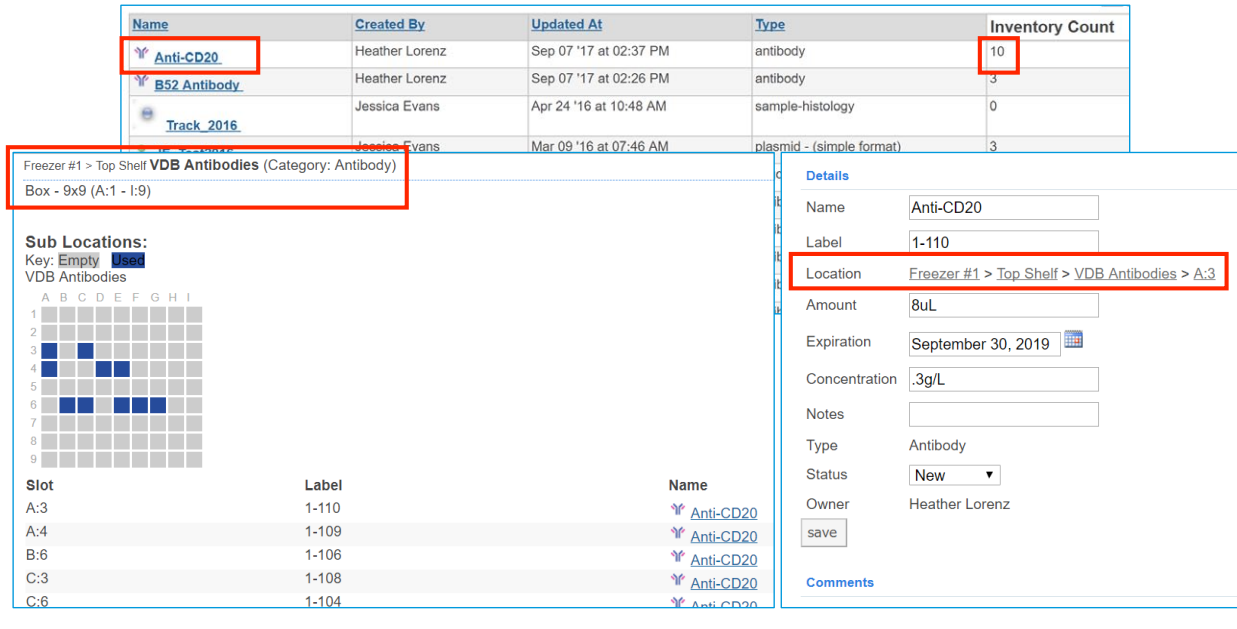


Figure 2: Using an integrated lab management system, view of information about supplies on hand.

Improving efficiency is all about the tools and processes established for the daily operations of the lab.



Project organization is critical to achieve improved lab efficiency. Project management through software should allow for work assignment, tracking activities, tracking timelines, tracking project/experiment status, and assigning experiments to a specific project or all in a single system or a network of systems (see **Figure 3**). This should include sufficient detail to allow for personnel assignment to projects (i.e., ensuring analysts are not an overloaded resource, **Figure 4**), timeline/deadline review, and status of any assigned experiments.

LIMS is often used for tracking laboratory information and covers details for the status of each sample; however, most LIMS store details about activities that come before and after setting up each method within that LIMS, but do not function

Figure 3: Tracking resource allocation for improving laboratory efficiency.

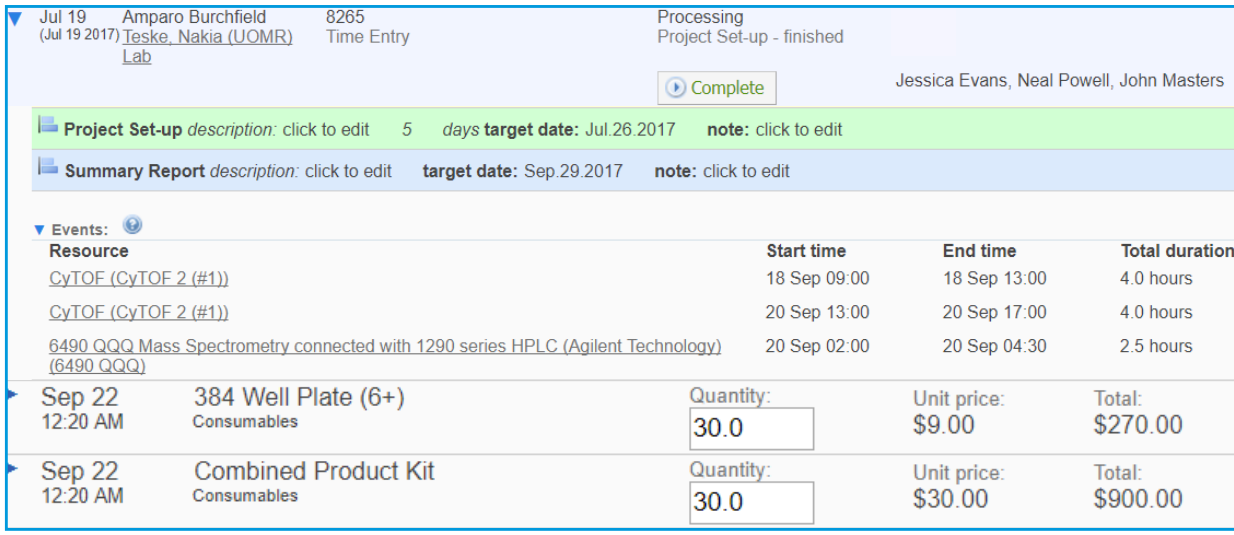
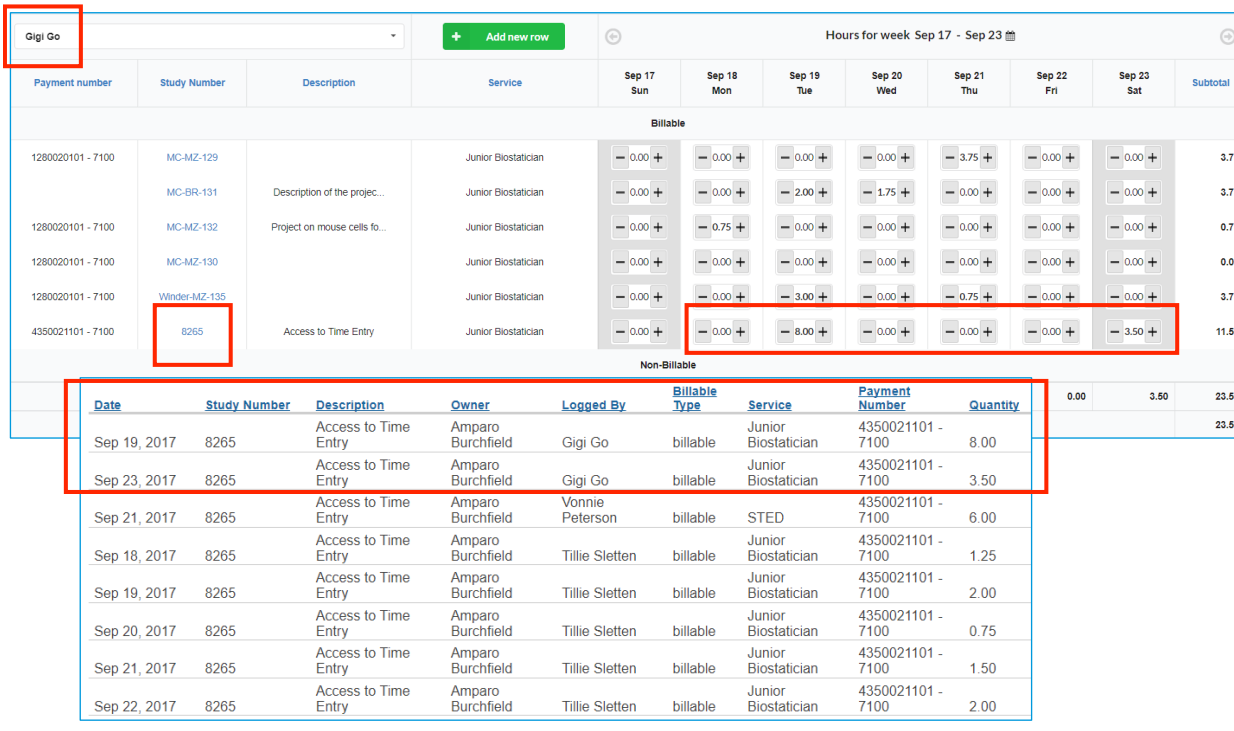


Figure 4: Tracking staff time.



as an interface for lab collaborators/customers. Software tools such as iLab should integrate with the LIMS or ELN to minimize or eliminate data reentry.

Effective lab operations strategies also allow for companies to consolidate resources into specific labs and shared resource programs. This consolidation requires each laboratory to focus on the supplies and equipment required for one or two technologies and then collaborate with other groups running different technologies to fill testing needs. This increases access to more technology, drives better data, and reduces costs as each lab will no longer need 10 instruments or expertise for all technologies, their respective reagents, and consumables in every lab. This approach also improves labor efficiencies by reducing knowledge gaps because technicians and researchers are focusing on a deeper understanding of fewer technologies rather than a cursory knowledge of numerous technologies. Additionally, having dedicated staff for each instrument type saves on training and experiment times.

This sharing of resources also increases access to new technologies and, through collaborations, all laboratories can have access to the staff and equipment in other labs that can lead to scientific advancement at a much faster pace.

Resource Allocation and Project Costs

Resource allocation and project costs are two additional areas of efficiency where software like iLab can be beneficial. Tracking resource allocation, though, is more of a workflow tool where everyday consumables and other day-to-day items are set up in a single place for the relevant details to be monitored and trended.

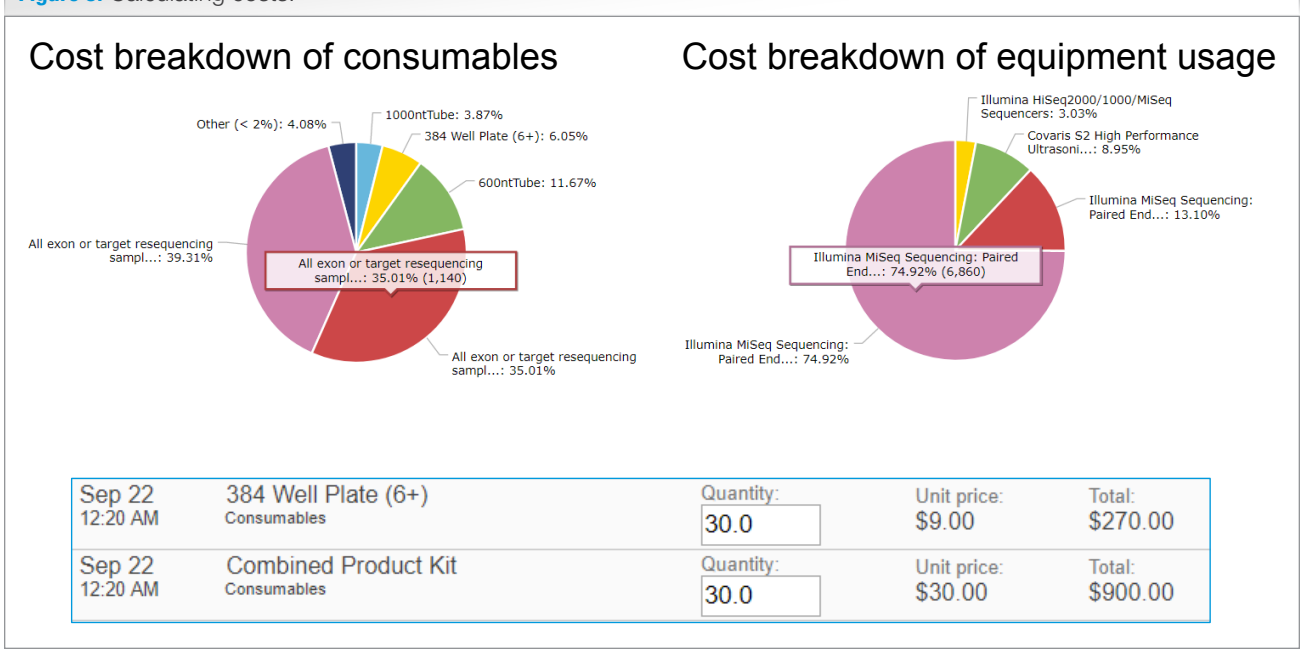
Although some potential software solutions can serve as workflow tools, they do not always keep all of the necessary data in a single place. The intent here is to provide a workflow management tool as well as a system that allows labs to track the items that are attached to each lab or project.

Associating different items within the project or laboratory parameter can allow for this trending. **Figure 5** is a screenshot in which the display shows that the project is in process and several items are associated with it. The software also incorporates a tracker with which the lab can associate staff with the project and check the status of the project and milestones. Managing a particular workflow can be driven by a template or by a standard kind of associated view. Having the flexibility to go in and associate items that will match the workflow is important in choosing the solution for a particular lab.

In addition, items can be associated to the project in question with different quantities. Different quantities lead to different rates calculated such that the laboratory can understand the activities performed against certain projects; the data can then be extracted from the database and reported.

Workflow hours spent on projects can also be tracked and trended to see personnel efforts against various projects. It is also important to trend other resources, such as equipment usage, in particular, and when this usage reaches instrument capacity. Business insight can be obtained based on this trending and used to support a lab's unique needs and determine project resources used across multiple labs. Understanding total equipment utilization requires the ability to track different aspects of equipment usage including when the equipment is unavailable, if it is not running, and its actual

Figure 5: Calculating costs.



run time. Having a comprehensive calendaring tool can be utilized for this.

This is important to allow labs to budget for and estimate the hours a project requires, and it is also important that this be an integrated tool. Having the ability to just compare the planned time for a project versus the actual time needed is useful. A system that can automatically capture the delta between those times is helpful and provides data that can be used in future project planning and workflow management.

The overall picture from this data assists in building a larger understanding of experiments that are performed in each lab and what kind of activities are necessary for them to be completed and improve business processing. It is important that this data be reportable and robust as possible.

Consumables used per project and lab should also be tracked and the system should have the ability to automatically associate standard items as well as ad hoc items to a project request and also have the flexibility to easily add new items or quantities in case the project changes as it progresses. Data must be acquired and interpreted to determine changes needed for current and future projects/labs. Whichever system/solution that is chosen should provide incentive as a workflow tool and also have that data available on the backend for reporting and insight purposes as costing and understanding efforts put into projects is important.

Inside the system, different elements have been associated such as labor time, reagents, and equipment hours with the goal breakdown and drill down into the details of these elements such that quantities of materials and the costs of these materials can be determined.

The ability of a system to associate rates within it can facilitate these determinations more efficiently. These rates can then be charged through to the actual users or laboratories; however, it is more important that the system provides the tools required to know that a single experiment may incur some costs from various parts of the company and track efforts against these costs.

Some tools can track an instrument's run time and/or on/off time. These tools will sometimes allow laboratories to measure specifics about each run such as the method used, the number of injections for the run, the length of each activity within the run, and other details as well. Various methods, as captured in equipment utilization, can be used as standalone tools or in conjunction with other tools to provide a full picture of instrument availability, usage, and accessibility. This allows for better decision-making regarding the use and purchase of equipment, and how to manage these shared resources. The utilization rates calculated from this data can provide the frequency of runs, how often the instrument needs maintenance, provide instrument life expectancy, and whether an instrument is available for use. This data can be used to calculate the utilization with respect to availability and flexibility of instruments.

Summary

The routes for assessing resource needs should include the value of understanding resource allocation, ease of tracking project costs with the right tools and processes in place, and what utilization data can indicate about lab efficiency (or lack thereof).

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