



LIMS DIY: IS A HOME-GROWN OR A PURCHASED LIMS RIGHT FOR YOUR LABORATORY?

Most laboratories today now have some form of LIMS to help manage their workflow. There are many types of LIMS, ranging in complexity from spreadsheets to intelligent programs that manage nearly every lab function. The term “LIMS” (laboratory information management system) itself is very general, essentially meaning any kind of software tool with implemented features that support processes conducted in modern laboratories.¹ These may be purchased from a company that specializes in developing software for just this purpose, or may be cobbled together by employees in the laboratory using other pre-existing data management programs.

Whether a laboratory is in need of a LIMS, or is using a home-grown LIMS and considering implementing a purchased one, there are several factors to consider. Here, we will discuss the needs of laboratories and their employees, the role of LIMS in meeting these needs, and some advantages and disadvantages of home-grown and purchased LIMS to help decide which would be best for specific laboratories.

A brief overview of LIMS

History of LIMS development

Data management, just like other laboratory processes, has evolved rapidly in recent decades. Originally, important information and experimental results were kept on notecards in a filing system, while technicians recorded observations and raw data in hand-written laboratory notebooks. Many labs still utilize individual lab notebooks for quickly jotting down methods, time points, and calculations, but data storage in a digital format has become commonplace. Digital files have the benefit of being easily duplicated, modified, and accessed. The time-consuming process of searching paper files and the very real possibility of information becoming lost or damaged have led to most laboratories keeping some form of electronic copy of their essential data.

In today’s high-capacity laboratories, the number of tasks ongoing at any one time and the amount of data being generated on a daily basis has swelled exponentially. Globally and across all industries, in 1992 a mere 100 gigabytes of data were being generated per day. By 1997, this amount of data was being generated each hour. By 2002, this amount of data was being generated every second. Now, in 2018, this has grown

to 50,000 gigabytes of data produced every single second.² As much as 30% of this data comes from the healthcare industry.³

Laboratory managers and technicians more than ever before are in need of a system that can efficiently store, organize, and analyze data, as well as keep track of vast quantities of samples and the information tied to them. Electronic laboratory notebooks (ELN) have begun replacing traditional paper notebooks, and scientific data management systems (SDMS) were developed to handle complex stores of information. Software packages and scripts were written to help automate workflows and keep track of testing schedules.¹

The reason for the wide array of LIMS types has to do with individual laboratories’ needs. Whether the lab focuses on testing environmental or biological samples, performs quality control for a manufacturing business, or conducts novel research and discovery, it has very specific data and workflow management needs. These will depend on the type of testing being performed, the scale of the organization, and its requirements for analyzing and reporting results.

For any type of laboratory, whether it is for research, diagnostics, or quality testing for a manufacturer, each is required to ensure quality for their tests and products.

Assays and protocols must be validated, equipment must be calibrated, and accuracy of results must be periodically verified. Some processes for quality assurance are required by legal/regulatory mandates, such as those required to be in compliance with the United States Department of Agriculture (USDA), Food and Drug Administration (FDA), Good Manufacturing Practice (GMP), and Clinical Laboratory Improvement Amendments (CLIA). Additionally, laboratories may need to abide by additional internal guidelines and undergo extra evaluations to ensure a high level of quality, consistency and accuracy. Data from quality monitoring over time needs to be carefully managed with accurate records, which is handled by the LIMS.

There are a few similarities that most LIMS share. At their core, a LIMS is generally capable of sample tracking, data capture, data management, and some form of workflow management. They may contain elements of an ELN, SDMS, or, for the business side of operations, an enterprise resource planning (ERP) tool for handling billing and purchasing¹ From there, the specific functions of a LIMS may be highly customized by the LIMS administrator to meet the demands of the lab.

Home-grown LIMS

How a laboratory develops a home-grown LIMS

Newer or smaller laboratories may opt to put together a functional LIMS piece-meal from other general software programs. When samples and tests are not too numerous and the complexity of processes and analytics are not too great, it is possible to perform these functions using standard workplace software. In these cases, separate programs are often used for each of the different components of laboratory operations.

One of the most commonly-utilized types of programs is a spreadsheet program, such as Microsoft Excel. Spreadsheets serve to store raw data and also can make basic charts and graphs, organize and sort data, and perform basic analyses. Workbook rules can be managed to flag problematic values and to calculate due dates and turnaround times. If a lab needs to increase their capabilities, add-ons can be downloaded or macros can be scripted to perform more complex arithmetic or to run for autonomously. Task management programs, often available online, as well as multi-user electronic calendars may be used to track schedules and equipment availability.

The benefit of spreadsheets is that they are frequently compatible with other analytical programs that can import their data. If and when a laboratory needs to perform more complex tasks, new programs can be purchased as needed. Certain statistical packages can perform a greater range of statistical analyses and create more complex and technical graphs, such as SigmaPlot or Graphpad Prism. Database software, such as Microsoft Access or Oracle Database, can import data from Excel, and can link tabs of data together for batches or repeat samples or clients.

In home-grown LIMS setups, the software that is used to operate laboratory equipment functions independently, often with their own data analysis programs. After analysis, these programs often allow the raw data and results to be exported in a file format that can be opened in other programs, such as a spreadsheet or text or photo file. To automatically import data, analyze the values,

and generate reports, a worker with technical expertise is typically required to write a code to link multiple programs and automate steps.⁴

Benefits of homegrown LIMS

The main reason why a laboratory would choose to build their own LIMS is the cost factor. A LIMS from the market can be a large cost upfront, which in the past had put purchased LIMS out of reach for smaller labs. While the cost of purchased LIMS have been falling, many labs still choose to have an IT staff member build a LIMS for themselves using software that they already own.⁵

Many laboratories and businesses also feel that their projects are too specific for their needs to be met by a pre-made LIMS. Constructing a LIMS out of other programs allows for a high degree of customization, which may be useful for labs with a very unique setup.⁶

Finally, depending on the complexity of the LIMS and how well the coding was done, one benefit of home-grown LIMS can be their usability. Workers are frequently already familiar with the basics of some of the programs used, and their interfaces are less confusing than some of the LIMS on the market. A home-grown LIMS that is simple and well-organized may take less time to train employees to use.

Limitations of Home-grown LIMS

As mentioned earlier, home-grown LIMS typically do not interface well with highly specialized types of software, such as those that operate laboratory or manufacturing equipment. Data obtained through these programs frequently must be exported, or even manually entered, into another format so it may be usable by the programs of the LIMS.

Home-grown LIMS also significantly lag behind their commercial counterparts in terms of advanced analytical applications. Statistical analysis, report building, and data interpretation for the most part must be done manually within home-grown LIMS setups. More complex applications, such as analyzing long-term trends in data or resource usage or for linking results to other information in a meaningful way are still beyond the capabilities of rudimentary LIMS and must be performed by a user.

One of the most apparent drawbacks to using a hodge-podge system of different programs to manage important data is the ease at which information can get jumbled, lost, or filed incorrectly. Manual data entry, as happens when all components are not fully integrated, has a high rate of error and inaccuracies. This is especially detrimental when working with sensitive information such as protected health information (PHI) and clients' financial information. The lack of transparency and accountability that comes with such systems makes regulatory audits significantly more difficult to conduct, and the higher likelihood of mistakes being uncovered could end up amounting to great lengths of times for corrections.⁶

Another especially problematic aspect to home-grown LIMS has to do with the way they are built. First off, they are typically constructed by an employee of the company. They would either be an IT staff member, without extensive knowledge of testing procedures and report building, or

they are a lab worker, often without significant experience in coding beyond a basic level. The few people who work with the system in its early days are its only source of technical support, as no outside personnel can understand its workings well enough to manage it. If one of these workers leaves the company, their replacement must be fully trained in the LIMS operations, or else the ability to manage the system will become lost.

Purchased LIMS

The types of LIMS available on the market are highly variable, ranging from basic data management programs up through large packages capable of managing all aspects of laboratory operations as well as performing advanced analytics. At the most expensive end are options that allow a laboratory to purchase the software and all associated instruments outright. For smaller labs unable to afford such a purchase, another option is to rent a software license or to use a “hosted” system through the internet.⁵

Benefits of a purchased LIMS

Many of the advantages of a purchased LIMS have been alluded to above in the discussion of the disadvantages of home-grown LIMS. In addition to those, there are a number of other benefits from purchasing a LIMS rather than building one.

First is the technical support. LIMS software packages can come with service packages as well, and technicians from the company are always available to provide assistance. Many LIMS automatically back-up data to an external site and provide extra digital security. Likewise, the software is routinely updated to remain secure and to keep functioning optimally.

Another major bonus is the ability to interface with multiple applications and instruments. Data can be collected from a machine and processed in real-time. There is no need to download the data separately or export it manually into different formats, as it is automatically imported into the system. This function, automatic sample tracking and test scheduling, and programmable automation of workflows provide a very streamlined service.

Finally, a purchased LIMS can come with a vast number of out-of-the-box analytical applications. Many LIMS suppliers allow their clients to customize which specific features are installed along with the base program, which enables a degree of tailoring for their lab’s specific needs. These applications can perform advanced calculations, analyze trends, and generate reports as needed.

Limitations of purchased LIMS

The major drawback to purchasing a LIMS is the cost. More advanced LIMS packages can be quite expensive, and may be difficult for smaller or newer labs with a lower budget to afford. However, the cost of LIMS has been coming down over time, and there are more affordable options available today.

Another disadvantage is the complicated user interface of many LIMS. Often, the workings of a LIMS package are not intuitive and can be confusing to laboratory employees

and managers. Along with this, it can take a long time to implement a new LIMS into a laboratory due to the hours of work it takes to interface with all equipment and to train employees on how to use it.

STARLIMS solutions: advanced, intelligent LIMS with the advantages of home-grown systems

STARLIMS solutions are an option that combines the power, efficiency, and analytical capabilities of advanced purchased LIMS with the ease of use and flexibility of one grown in the lab. Additionally, STARLIMS offers a Cloud Subscription, featuring the innovation of STARLIMS LIMS, combined with the virtually worry free, cost-effective reliability of a cloud-based solution. With STARLIMS Cloud, you do not have to purchase hardware, install software, or manage your system infrastructure when you purchase a STARLIMS solution. Cloud Services enables you to be more productive and cost efficient without compromising on security or functionality.

STARLIMS solutions, including the Cloud Solution, easily integrate with other laboratory programs and equipment and allow monitoring of tests and instrument statuses in real-time. Sample and inventory tracking, test and maintenance scheduling, client data, and test results and reports are all managed in one streamlined system.⁷

Along with integrating with pre-existing laboratory equipment, STARLIMS solutions import all previously collected data and information into one centralized database. This database is easily searchable and programmable so relevant users can access files based on clearance, and viewable on personalized dashboards from any mobile device through a secure, cloud-based storage system. An in-house ELN and SDMS are also available, fully-integrating all aspects of laboratory operations seamlessly.⁷

Advanced analytics in STARLIMS enable a laboratory to identify workflow bottlenecks, determine where resources are lacking or in excess, and automatically generate intuitive reports with interactive charts and graphs.⁷ Through intelligent data, order, and market analyses, critical business insights may be gleaned.⁷

Like home-grown LIMS setups, STARLIMS has configurable features and optional modules which allow it to be tailored to the specific needs of the laboratory. The interface is also intuitive to use, and does not require extensive time or effort to train employees to use it.⁷

An important goal of STARLIMS is to offer a LIMS that can meet all of a laboratory’s expectations, matching and exceeding what other purchased and home-grown LIMS are capable of. Now the choice does not need to be between the advanced applications and fully integrated functions of a purchased LIMS or the customization and simple-to-use format of a home-grown LIMS. STARLIMS is able to provide all of this and more, no matter what a lab’s specific needs may be.

References

1. Maier H, Schutt C, Steinkamp R, et al. Principles and application of LIMS in mouse clinics. Mammalian genome: official journal of the International Mammalian Genome Society. 2015;26(9-10):467-481.
2. Walker B. Every day big data statistics. In: big-data-infographic1.png, ed: Vouchercloud; 2015.
3. Gerrity J. Comment: Health networks- delivering the future of healthcare. Technology 2014; https://www.buildingbetterhealthcare.co.uk/technical/article_page/Comment_Health_networks__delivering_the_future_of_healthcare/94931, 2018.
4. LIMS L. Off the Shelf Packaged LIMS (e.g. LabSoft LIMS) vs In-House Home Grown LIMS. Frequently Asked Questions <https://www.labsoftlims.com/computing-solutions/faq/inhouse/>, 2018.
5. Kent JT. The Right LIMS Delivery Method. In. Bio-IT World. Vol January/February 20092009:35.
6. Segalstad SH. Build LIMS Yourself or Buy a Commercial LIMS? Cost of LIMS 2015; <https://softwarepoint.com/blog/build-lims-yourself-or-buy-commercial-lims>, 2018.
7. Laboratories A. LIMS Capabilities. STARLIMS 2016; <https://www.starlims.com/us/en/offerings/lims>, 2018.

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