

CLOUD TECHNOLOGY MAXIMIZES ROI BY REDUCING TCO



The advent of cloud technology has helped many labs to automate by easily migrating their data saved in the form of old paper notebooks and spreadsheets. Cloud Technology not only helped labs to streamline lab operations and save resources, but also paved the way for offering personalized LIMS services on demand guaranteeing maximum user satisfaction. This white paper underlines the evolution of LIMS, different types of LIMS architecture, cloud technology and deployment models, benefits and risks of cloud computing, and how SaaS models leverage cloud technology to maximize Return on Investment (ROI) by minimizing Total Cost of Ownership (TCO). This white paper will help biobanks, clinical research, diagnostic, pathological and food & beverage testing labs to become familiar with the concept of Cloud Technology and realize the benefits of an affordable LIMS solution.

LIMS JOURNEY

Since the late 1970s, managing laboratory samples and their associated tests, studies, and reports were being recorded manually using spreadsheets and laboratory notebooks. This was an extremely time consuming and cumbersome process, often riddled with transcription errors. Tracing back, the development of first generation LIMS dates to the year 1982. The first generation LIMS evolved in the form of a single centralized minicomputer,

which facilitated automated reporting for the first time with greater lab productivity. Late 1980s witnessed the era of second generation commercial LIMS, to provide application specific solutions using relational databases. Commercial LIMS still relied on minicomputers though, as PC-based solutions were just starting to emerge. In the 1990's, personal computers and software databases made programming and documentation easier. This paved way for the advent of third generation commercial LIMS. It combined the power of PC's easy to use interface and desktop tools with client/server configuration model of minicomputer servers to advance data processing. In 1996, Web-enabled LIMS debuted, enabling researchers to work outside the confines of their laboratory changing the entire picture of LIMS industry.

BENEFITS OF ADOPTING A LABORATORY AUTOMATION SOLUTION TO STREAMLINE LAB OPERATIONS AND INCREASE RETURN ON INVESTMENT

Cost-Benefit Analysis (CBA) or calculating return on investment is quintessential for any organization planning to automate their lab operations by implementing a LIMS software. It is important to consider a few points while conducting CBA. The expenses incurred in managing lab operations through notebooks, spreadsheets throughout their complete life cycle is often improperly calculated or

comprehended. Apart from material cost, there are hidden costs which laboratories usually forget to consider. The time taken in writing by hand, cutting, pasting, correcting handwritten lab notebooks, in addition to the time required for managing cumbersome spreadsheets significantly contributes to this hidden cost. By switching to an automated solution, a researcher can save considerable time and use CBA for progressing research activities.

Some of the non-quantifiable benefits of switching to an automated LIMS solution are:

- Researchers can spend more time in the laboratory working on their research projects.
- Easier and quicker to manage patient records, samples, lab inventory using a LIMS solution.
- Easier to generate instantaneous report(s) in desired format to share with colleagues.
- Typographical errors can be minimized by using an automation solution.
- Legibility of data is improved.
- There is often smooth transition when an employee leaves the organization.
- Laboratory management workflows can be streamlined using a LIMS solution, thereby saving considerable time and effort.

TYPES OF ARCHITECTURE AVAILABLE WHILE SELECTING A LIMS

1) Thick-client LIMS: Is one of the most elementary architectures implemented into a

LIMS. When LIMS is a thick client, it means that the lab's overall IT functions relies heavily on its own computers and systems. It can be divided into two parts, client and server. The client system, also sometimes referred to as a fat client, takes care of bulk data processing while the server system primarily stores the data. The LIMS software is installed on the computer or workstation of the user or client, which is responsible for data processing. The processed data is then transferred to the server for storage.

There are a couple of advantages of owning a thick-client LIMS. They are: high data processing speed due to the fact that it occurs at the client's end rather than on the server. Second is eliminating the security threats since server access is limited only to those with the client software in an organization.

Thick-client LIMS, however, has some major limitations such as configuring client and server within the same network area. The other is data loss due to server failure and natural calamities. Additionally, any customization or configurations made to the LIMS application should be replicated at the client level as well.

Of all the LIMS architectures, Thick client LIMS provides the least ROI (Return on Investment) and dramatically increases the TCO (Total Cost of Ownership).

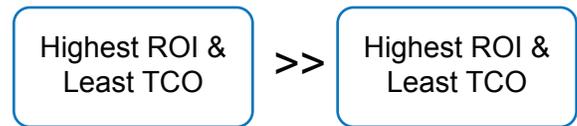
2) **Thin-Client LIMS:** In this architecture, end-users can seamlessly access full LIMS functionality from any device which uses the Internet. It has the least TCO and maximum ROI amongst all the LIMS architectures listed. The actual LIMS software resides on a highly secure remote computer (or a Web server) which processes information, eliminating pre-installation requisites at the users' client. End-users don't have to worry about LIMS configuration or hardware specifications such as hard disk space, RAM, or interference with other applications installed on their computer. Modifications and upgrades are all done at the server end which hosts the LIMS software. Users' browser simply displays configured product that is located on these remote servers.

3) **Web-enabled LIMS:** Is an amalgam of thick-client architecture with a few Web browser components as add-ons. The client side software has a bunch of additional features that facilitate users to interface with the software through their device's Web browser. A Web-enabled LIMS architecture allows users to access both client and server end data along with thick-client advantages/ disadvantages mentioned above. In conclusion, Web-enabled LIMS is functionality enriched compared to thick-client LIMS, and does not offer a better ROI.

4) **Web-based LIMS:** Provides users, access to complete LIMS functionality through a Web

browser, but may however require support of .Net framework to run the LIMS application on client's device, besides connecting to the server.

The bulk of the data processing work is carried out by a "thick" client which increases hardware costs.



Thin Client LIMS > Web Based LIMS > Web Enabled LIMS > Thick Client LIMS

CLOUD TECHNOLOGY FOR LIMS

Cloud technology, also known as cloud computing, is a synonym for the internet, and is the delivery of computing as a service rather than as a LIMS product. Cloud computing allows data storage and access, resource sharing over the Internet instead of individual devices or local server resources. This technology facilitates users to rent required software products, server capacity and processing capacity from third-party data hosting centers such as Amazon Web Services (AWS), Microsoft Azure, IBM Cloud etc.

DEPLOYMENT MODELS FOR CLOUD TECHNOLOGY

There are four commonly known deployment

models for cloud computing:

1) **Private Cloud:** Also known as internal cloud, this cloud architecture is deployed for exclusive use by a single organization (employees, partners, and customers) and is safeguarded by a firewall. It may be managed internally by the organization, and permits only their authorized users complete control over their data.

2) **Public Cloud:** This model facilitates unrestricted usage by the general public and the services are delivered over the network. It may be managed and owned by a corporate, academic, or any government organization, third party, or a hybrid of them (for e.g., both commercial entity and government organization that may have partial holdings). It resides on the premises of the service provider. These providers create a data hosting center that conceals the underlying infrastructure details from the users. Public cloud is generally considered a more cost effective model compared to private cloud.

3) **Community Cloud:** As the name suggests, this cloud infrastructure is for use by a specific community. The community can be a specific group of users from different organizations that share similar privacy, performance and security concerns (e.g., banking, security, trading, compliance etc). It can be managed by one or more than one organization that are a part of the

community, any third party, or both and it can be hosted within or outside premises.

4) **Hybrid Cloud:** As the name implies, it is a mix of two or more different cloud models (i.e. private, community, or public) to create a unified and well-managed computing environment that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability.

THIN-CLIENT COUPLED WITH CLOUD COMPUTING BENEFITS TO ACCELERATE ROI BY DECREASING TOTAL COST OF OWNERSHIP (TCO)

Benefits are as follows:

1) **Cost Efficient:** Cloud computing facilitates users to rent required processing capacity from data hosting centers. It means that users do not have to purchase high configuration hardware to run the application. The thin-client LIMS application is hosted on a secure server that is managed by the infrastructure provider. All a user needs is an Internet-ready device to access the LIMS solution. The LIMS accessibility is globally available 24x7x365 days from anywhere in the world. This essentially shifts the IT management burden to a third-party provider, thereby making cloud computing the most cost effective technology. Besides, organizations using cloud storage can significantly cut their

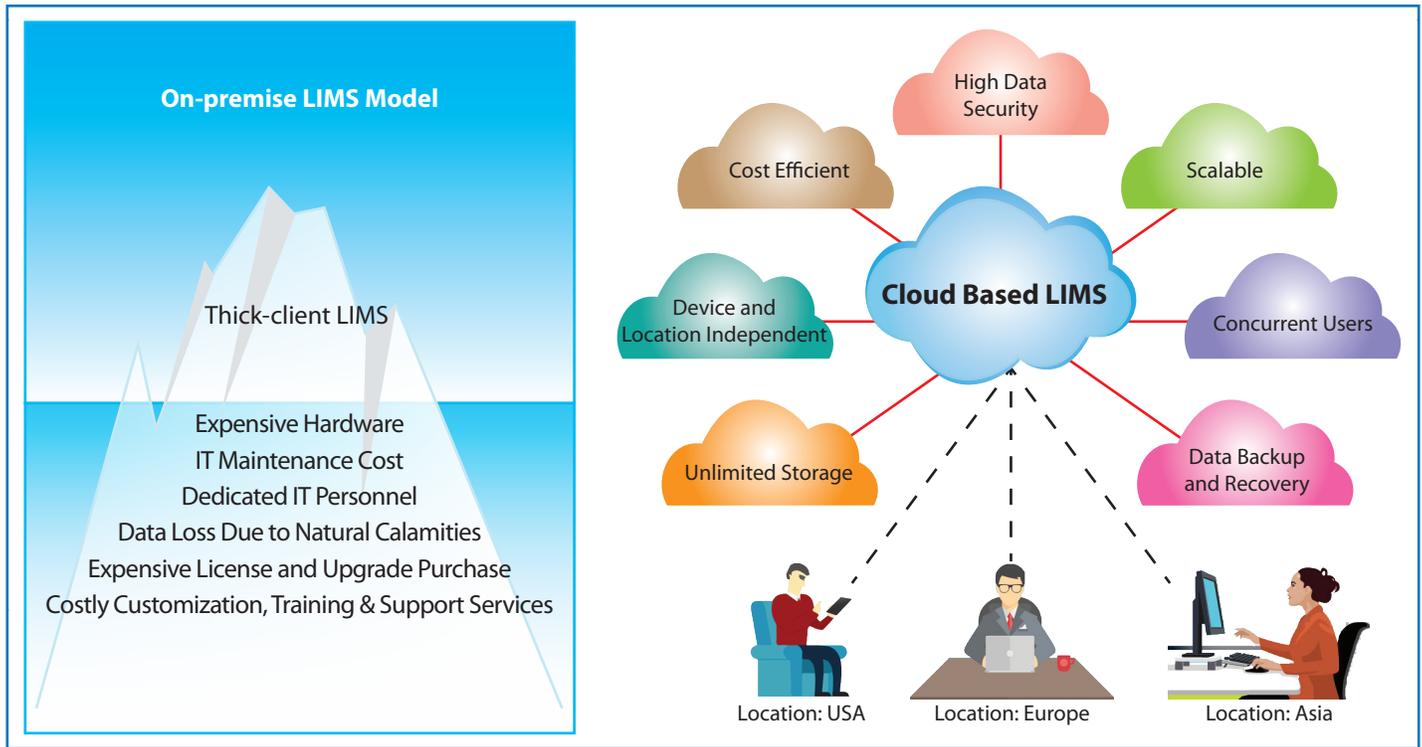


Figure 1: A schematic representation highlighting the benefits of Cloud based LIMS over on-premise LIMS model

electricity consumption by up to 70%, thereby reducing expenses incurred onto pay their electricity bills. Cloud computing has made thin-client LIMS a reality, thereby maximizing ROI.

2) Almost Unlimited Storage: Storing LIMS information on the cloud gives users virtually almost unlimited storage capacity.

3) High Data Security: Several LIMS vendors host the server-end LIMS on a secure cloud environment. Some of the Leading cloud providers such as Amazon, Microsoft, Google devote huge resources and money to address

data security concerns of their customers. They employ advanced encryption algorithms to make data storage on the cloud highly secure. Industry standard encryption technology also protects data transmission across the web.

4) Data Backup and Recovery: Most cloud providers replicate users' LIMS data on mirror servers present at different geographical locations and take regular backups. Thus, cloud computing provides independence from system failures, besides seamless and quick data recovery in the event of natural calamities.

5) **Simultaneous Use by Multiple Users:** Since users' data is stored on the cloud, multiple users can access it simultaneously from same or different geographic locations using their own Internet-ready devices. All software updates are managed by the LIMS provider. Hence, all users will always have access to the most recent release of the software. Additionally, all users can simultaneously view any configurational changes done to the server-side LIMS in real time.

CURRENT RISK SCENARIO FOR CLOUD COMPUTING

Despite many advantages, there are certain risks or uncertainty due to which labs have not completely switched to cloud computing. These are due to lack of regulatory compliance, security issues, unclear pricing models, associated benefits and undefined integration of systems, instruments and inventory. In times, these concerns will be aggressively addressed by software vendors investing significant chunks of money to deliver utmost satisfaction and user experience.

SOFTWARE-AS-A SERVICE (SAAS), A PREFERRED DELIVERY MODEL FOR THIN CLIENT LIMS

Software-as-a service (SaaS) is a software delivery model in which an application (or LIMS)

and its associated data are stored centrally on the cloud by the service provider and users can access the product and their data using a Web browser on any Internet-ready device (for e.g., tablet, PC etc.). There are a few characteristics that applies to most vendors who use the SaaS model for delivery of their LIMS product to their customers:

- All application updates are applied automatically without any customer intervention or inconvenience.
- The service is purchased on a subscription basis.
- No hardware or software is required to be installed by the customer, thereby imparting zero footprint on the client's computer.

PAY AS YOU GO (PAYG) LEVERAGES SAAS PLATFORM

Pay As You Go (PAYG) is a very popular payment model generally associated with SaaS. In this case, a user is actually billed only for the usage and resources that are needed on a monthly basis which makes SaaS quite an attractive investment.

One major advantage of PAYG method is that the users only pay for the services availed to them, rather than spending a significant amount over resources that may or may not be utilized. Besides, users gain instant access to computational power at zero capex since there

are no overhead expenses in purchasing expensive hardware or managing IT resources. Another prime cost benefit of cloud computing and cloud based LIMS is its ability to seamlessly scale as the requirements of the lab grows. This is worth considering since lab requirements aren't static and vary throughout changing time periods.

CONCLUSION

With the advent of cloud technology, organizations no longer have to procure

expensive software and hardware. Users can access thin client LIMS hosted on the cloud anytime and anywhere with an Internet-ready device. Thin-client LIMS harnesses the power of cloud technology to maximize your investment returns. At the same time, cloud computing ensures the highest level security and safety of users' data by making use of strong encryption technology. The SaaS model facilitates users to take advantage of the PAYG model, thereby relieving them from the burden of allocating massive budgets to maintain IT resources.