Agaram TECHNOLOGIES

WHITEPAPER

HOW CLOUD IMPLEMENTATION CAN ENSURE MAXIMUM ROI

The evolution of cloud technology has helped many laboratories to increase their productivity and reliability by digitalising and automating their operations. Digitalising here means easily migrating their data saved in the form of old paper notebooks and spreadsheets to computerized storage and management systems. Hosting and using of computerized systems in cloud (which is popularly called Cloud Technology) not only helps labs to streamline lab operations and save resources, but also plays a vital role in ensuring much more productive and higher quality laboratory services thereby ensuring maximum value addition to the lab's customers or stakeholders. The laboratories SaaS models can easily take advantage of cloud technology to maximize Return on Investment (ROI) by minimizing Total Cost of Ownership (TCO) and reduced time of implementation.

We can analyze the evolution of Lab informatics software such as ELN, different types of system architecture, cloud technology and deployment models, benefits and risks of cloud computing. We can also analyze how laboratory organizations operating in the space of biobanks, clinical research, diagnostic, pathological and food & beverage testing can understand the concept of Cloud Technology and realize the benefits of an affordable lab informatics software solution (such as ELN).

Since the early and even current days, managing laboratory samples and their associated tests, studies, and reports were recorded manually on paper lab notebooks. Even though LIMS has

been in existence for the past several decades, a very big % of LIMS users are still using spreadsheets or paper notebooks for recording the test data. This hybrid model is time and paper consuming as well as a cumbersome process, often riddled with transcription errors. In later 80s and earlier 90s, subsequent generation commercial ELNs were developed to provide application specific solutions using relational databases. During that time, ELNs 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 much better evolved ELN solutions with useful features. 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 late 90s, Web-enabled ELNs emerged enabling researchers to work outside the confines of their laboratory changing the ecosystem of Laboratory informatics software.

LAB AUTOMATION – AN EFFECTIVE WAY FOR MAXIMUM ROI

Cost–Benefit Analysis (CBA) or calculating return on investment is very critical for any organization planning to automate their lab operations by implementing a laboratory informatics software. The expenses incurred in managing lab operations through notebooks, spreadsheets throughout their complete life cycle is often not calculated in a comprehensive manner. In addition to from material cost and labour cost, there are other hidden costs which laboratories usually miss out. 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.
- ✔ Typological 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 TECHNICAL ARCHITECTURE

1) Thick-client Architecture

It is one of the most basic architectures implemented for a system, which is popularly knowns as client-server. When laboratory informatics software system uses 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 major components namely, client and server. The client system takes care of bulk data processing while the server system primarily stores the data. The 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:

1. High data processing speed due to the fact that it occurs at the client's end rather than on the server.
2. Eliminating the security threats since server access is limited only to those with the client software in an organization.

There are few disadvantages or limitations such as configuring client and server within the same network environment. The other one is data loss due to server failure and natural disasters. Moreover, any customization or configurations made to the Software application should be replicated at the client level as well.

Though this type of architecture is good one from control point of view, the ROI is not of considerable one.

2) Thin-Client architecture

In this architecture, end-users can directly access full software application functionality from any system (say PC or Laptop or mobile) which uses the Internet. It has the better TCO and ROI for the organizations which implement the same. The actual software application is installed in 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 system architecture

It is the combination of thick-client architecture with additional Web browser components as add-ons. The client-side software has additional features that facilitate users to login and use software through their device's Web browser. A Web-enabled architecture allows users to access both client and server end data along with thick-client advantages/ disadvantages mentioned above. In the end, Web-enabled system has functionality much better compared to thick-client LIMS.

4) Web-based system architecture

It provides users, access to complete software functionality through a Web browser, but may however require support of standard framework (Java, .Net, etc.) to run the software 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.

CLOUD TECHNOLOGY FOR LAB INFORMATICS SYSTEMS

Cloud technology, also known as cloud computing, is a synonym for the system used with the help of internet. It is the delivery of computing as a service rather than as a software 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 subscribe the required software products, server capacity and processing capacity from third-party data hosting service providers namely Microsoft Azure, Amazon Web Services, IBM Cloud etc.

DEPLOYMENT MODELS FOR CLOUD TECHNOLOGY

There are four commonly known deployment models for cloud computing:

1) Private Cloud

It is also known as internal or on-premises cloud network. This type of architecture is deployed for exclusive use by a single organization (employees, partners, and customers) and is secured and protected

by a firewall. It may be managed internally by the organization's system administrators, and allows only their authorized users to have the control over their data.

2) Public Cloud

This model provides 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 is hosted on the premises of the service provider. These providers create a data hosting center that encompasses 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. Some government organization may host this kind of service and allows private organization users to use them.

4) Hybrid Cloud

As the name implies, it is a combination 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 WITH CLOUD – FOR MINIMUM TCO

A thin-client architecture hosted on cloud will provide the following benefits

1) High-capacity storage

Storing of data/information on the cloud gives users virtually almost unlimited storage capacity. Of course, the option to choose the amount of storage can be agreed between user organization and service provider considering the volume of data, time of storage, cost affordable, etc.

2) Cost Effectiveness

Cloud computing facilitates users to subscribe (similar to renting and not outright purchase) to required processing capacity from data hosting centers. In this case, users do not have to purchase expensive hardware to run the software application. The thin-client application is hosted on a secure server that is managed by the infrastructure service provider. Any user can operate using an Internet-ready device to access the software solution. The system accessibility is globally available on 24x7 hrs basis on 365 days from anywhere in the world, provided there is an internet access available. This essentially shifts the IT management responsibility to a third-party infra service hosting provider. This makes cloud computing the most cost-effective technology. Besides, organizations using cloud storage can significantly cut their 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.

3) Data Backup and Recovery

Most cloud providers replicate users' business data on mirror servers present at different geographical locations and take regular automated backups. Hence, cloud computing provides protect the user organizations from system failures, besides seamless and quick data recovery in the event of natural disasters like earth-quake, flood, fire, etc.

4) High Data Security

Several software application vendors host the applications on a secure cloud environment (data centers) either wholly owned and managed by them or may have engaged reputed service. Some of the Leading cloud providers such as Amazon, Microsoft, and Google devote huge resources and money to address the data security concerns of their customers. They have implemented advanced encryption algorithms to make data storage on the cloud highly secure. Industry standard encryption technology also protects data transmission across the web.

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-enabled devices. All software updates are managed by the software development vendor. 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 software application in real-time.

RISK FACTORS IN CLOUD COMPUTING ARCHITECTURE

Though there are many advantages, there are few risks or uncertainty due to which labs have been hesitating to completely change over to cloud computing. These are due to lack of regulatory compliance, security issues, unclear pricing models, associated benefits and uncertain integration of systems, instruments and inventory. However, nowadays these concerns are being carefully and keenly considered and addressed by software vendors. Hence it makes them to invest significant cost, manpower and technology in the area of research and development in order to ensure maximum satisfaction and better user experience.

SOFTWARE-AS-A-SERVICE (SAAS) - A PREFERRED DELIVERY MODEL

Software-as-a-service (SaaS) is a software delivery model in which an application 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., laptop, desktop, mobile devices, etc.). There are a few characteristics that apply to most vendors who develop and host cloud-based software applications and provide subscription services.

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

PAY AS YOU GO (PAYG) ENHANCES SAAS MODEL

Pay As You Go (PAYG) is a beneficial 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 periodic basis (Monthly/Quarterly/Annual) 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. Moreover, users gain instant access to

computational power at zero capex since there are no overhead expenses in purchasing expensive hardware or managing IT resources. One more important and vital cost benefit of cloud computing and cloud-based software application is its ability to seamlessly scale as the capacity requirements of the lab grows. This is worth considering since lab requirements are not static and vary throughout changing time periods.

CONCLUSION

With the evolution of cloud technology, organizations no longer have to procure expensive software and hardware. Organization lab users can access a thin client software systems 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.