



WHITE PAPER:

Moving your Lab Software to the Cloud

In the quest to attain the digitally connected laboratory of the future, organizations are faced with seemingly insurmountable decisions regarding the scope and strategy that should be deployed to achieve this endeavor. Many organizations have advanced down one path or another towards digital transformation, only to encounter roadblocks along the way. Legacy systems, manual processes, data silos, and outdated technology pose a multitude of problems throughout this journey. The vast array of new technologies, advances in artificial intelligence (AI) and machine learning (ML), and cloud-based solutions open the door to endless possibilities for transforming your current laboratory environment. The dilemma lies within choosing the right combination of solutions to meet your current needs while creating bandwidth for the future state of your organization.

In recent years, organizations have been adopting a ‘cloud-first’ or ‘cloud-only’ approach to bringing in new technologies. Cloud based computing provides considerable game-changing technological advances and cost effective solutions to the modern laboratory. While there are numerous proven approaches to automating manual processes and eliminating data silos as part of your digital transformation efforts, developing the right cloud IT infrastructure for your unique laboratory environment requires careful consideration and thoughtful planning.

Current State of the Traditional LIMS

A laboratory information management system (LIMS) represents a centralized hub for managing many of the processes within the laboratory. LIMS were originally designed as a basic sample tracking tool, enabling the systematic control of workflows in GxP environments.

To support the changing needs of the modern laboratory, LIMS platforms have evolved into an enterprise resource planning tool, capable of managing a wide range of laboratory informatics needs. Resource management and scheduling, data management and analysis, and integrated electronic laboratory notebook (ELN) capabilities are now standard features within most LIMS deployments. With this increased functionality, LIMS have become a business-critical system central to all laboratory operations.

The traditional or legacy LIMS requires software to be installed on the organization’s own server and is supported by company managed IT resources. The perpetual license fee is generally paid at the time of issue, often requiring an annual maintenance fee to access software updates and new features. Systems that are not

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properly maintained and upgraded on an on-going basis can become obsolete as technology changes, presenting significant support challenges both to the vendor and the organization itself. Internal IT support resources can also be costly and difficult to scale with your changing business needs.

However, there are a number of perceived benefits of the on-premise LIMS model. With cybersecurity being of vital importance across all computer based enterprises, having internal control over your organization's IT infrastructure and storage of data allows for enhanced security behind a fire-wall along with a company sanctioned back-up and recovery plan. Other considerations include system reliability, not having to rely on an internet connection for connectivity to your LIMS reduces your overall reliability risk. On-premise LIMS are also often viewed as having a higher degree of data security, regulatory compliance and more control over system validation due to internal ownership and management of the hardware and support processes.

With this static enterprise LIMS model, the ability to meet the ever changing needs of the organization become significantly diminished as the technology becomes outdated in favor of more agile cloud-based solutions and game changing software applications such as AI and ML solutions.

Benefits of Migrating to the Cloud

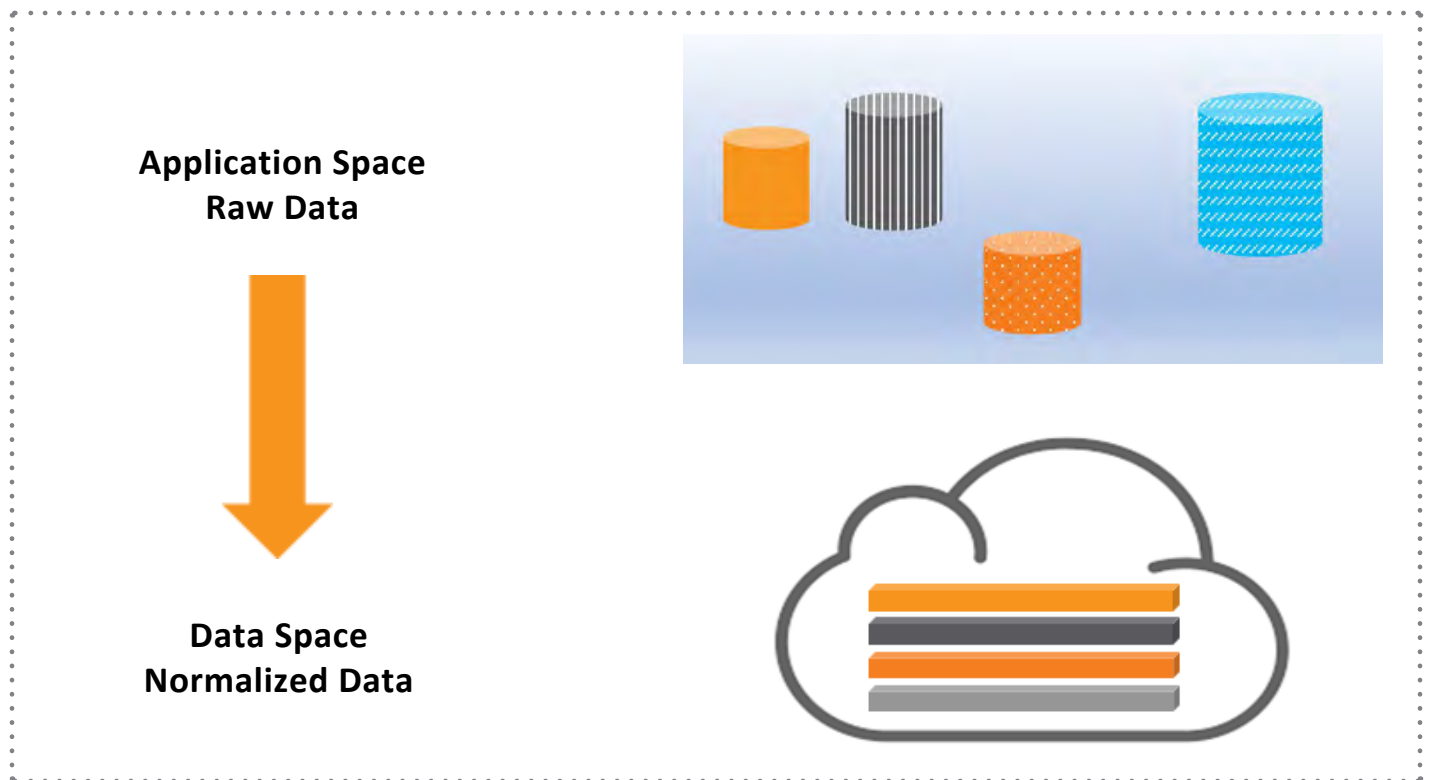
Cloud-based solutions offer a multitude of options and benefits for the scientific laboratory that is looking to migrate their traditional LIMS to a more adaptable environment. In today's digitally enabled world, the landscape of the modern laboratory is continuously evolving with the availability of new technologies, the increasing complexity of workflows, a massive surge in the amount of data, and the the requirement for these data to be readily accessible and include rich context. Collaborations between sites, external business partners, and global operations require moving enormous amounts of data quickly and securely across the enterprise. The need for an agile, cost-effective IT infrastructure and the right technology in place to support these efforts is a vital requirement for designing the lab of the future.

Migrating your traditional LIMS to a cloud environment has the following benefits:

- **Disaster recovery** – built into the system for business continuity assurance
- **Easy access** - allows laboratory staff to work from anywhere that an internet connection is available
- **Reduced cost** – eliminates high fixed cost of both hardware and software, excess IT overhead, and ongoing maintenance costs
- **Global availability** – allows seamless integration across the enterprise
- **Scalable services** – you only pay for the time and functionality you use
- **Highly configurable** – customizable for workflow optimization

When choosing your next generation LIMS strategy, it is important to consider the requirements necessary for addressing your current needs as well as having the flexibility to adapt to the future state of your organization.

Fig. 1: Siloed data from individual applications combined for contextualized search in the cloud



Architectural Considerations for Optimizing your Cloud Migration

As organizations are planning to migrate their LIMS to a cloud environment, understanding the scope of hosting options that are available will guide you in choosing the right service provider for your current and long term needs. The first important step in your selection process is deciding on public cloud versus private cloud services.

With the public cloud model, all software, hardware and supporting infrastructure is owned and managed by the service provider. This software delivery model, known as SaaS (software as a service), is charged based upon the amount of service used and the cloud resources are shared amongst multiple customers.

Private cloud computing service offerings are available over the internet or via an internal network and are dedicated to an individual customer. The private cloud model has many of the same advantages of the public cloud but offers more direct control, data security, and customization of resources. Internally hosted private cloud computing requires the organization to provide, maintain and support all software and hardware resources, including data storage and backup. The ongoing operating costs associated with the internal private cloud model can be significantly higher than the externally hosted cloud based options. The up-front software and hardware investment of this model also results in capacity limitations due to its fixed architecture infrastructure.

The third type of cloud computing architecture that is commonly used is the hybrid cloud model. The hybrid cloud is a computing environment that combines private cloud or on-premise services with the public cloud. This structure allows the sharing of data and applications across a unified cloud computing enterprise. Many organizations are adopting this strategy to gain the benefits that both cloud architectures have to offer. This hybrid mixture of services provides the control, speed and data security of a private cloud with the cost-effective scalability and agility of the public cloud. While organizations stand to gain significant benefits using the hybrid approach, the cost of initially deploying the hybrid model will exceed the setup cost associated with the public cloud and will require the ongoing monitoring and management of multiple platforms to ensure the success of your operations.

The hybrid cloud is ‘the weapon of choice for 45% of enterprises’ as reported in the Cloud Adoption Statistics for 2021 by Hosting Tribunal.¹ “In 2019, 45% of enterprises prioritized some sort of hybrid solution. 31% of enterprises see the public cloud as their top priority. 9% of enterprises prioritize an on-premises private cloud, while 6% will strive for a hosted private cloud.”

The final element of the cloud based service offering to be considered prior to determining your cloud transformation strategy is single-tenant versus multi-tenant solution architectures. The single-tenant cloud server hosts and provides access to only one customer (tenant). This allows for a greater degree of control over system performance and data security and storage. In a multi-tenant cloud, customers share the resource infrastructure, and the provider allocates a separate but secure space for storing information in the cloud. The multi-tenant cloud has a greater pool of resources available to all users while maintaining the privacy of your data but may limit system agility as it pertains to the individual needs of an organization. Tenant level changes to the multi-tenant system environment will affect all users which limits control over your enterprise and hinders customized solutions.

In a recent market report from Gartner, four key lessons can be learned from cloud Infrastructure adopters and operations leader to mitigate cloud risks, speed adoption, and maximize cost savings.²

- Implement a cloud strategy across the organization
- Establish a cloud center of excellence and a cloud architect role
- Identify the right cloud candidate workloads and the right cloud service provider
- Adopt management practices suited for growing cloud maturity

Incorporating these industry best practices into your cloud strategy will enable you to streamline and optimize your cloud deployment.

Preserving Data Integrity During Transition

Preserving data integrity during the transition of your traditional LIMS to a cloud based environment is of critical importance throughout the migration process. Data migrations can be a complex endeavor, requiring a number of industry best practices to be in place to facilitate a successful data migration. Developing a comprehensive data migration strategy will ensure an efficient process while maintaining business continuity and the integrity of your data.

To create your data migration plan, the following best practices should be incorporated:

■ Risk Assessment

It is imperative to perform a risk assessment prior to starting any data migration effort. This will serve to minimize or eliminate the risk of data loss, alteration or corruption of data during the migration process. Cybersecurity considerations and data backup strategies should also be included as areas of risk exposure. Identifying the potential areas of risk and developing a risk mitigation and disaster recovery plan, will prepare you for the highest degree of success during your data migration.

■ Data Quality

To promote data quality, it is important to conduct a thorough audit of your existing LIMS data lake. Inaccurate or redundant data, outdated forms, and the elimination of data that is no longer needed or outside of the record retention period should be 'cleansed' prior to transfer to its new target location.

■ **Data Mapping**

The next stage of the process focuses on the mapping of data from the source fields to the destination fields within the cloud platform. Data sets may require transformation or mediation to facilitate its transfer to the new environment. The data mapping process should include an analysis not only of the data lake but also the flow of data across your processes.

■ **Data Validation**

Your data migration plan should include a written document detailing the method and deliverables that will be used for data verification throughout the process as well as the protocol and plan for validating the data in the target system once the migration is complete. Errors and failures that occur during the process must also be documented and investigated, and include a remediation plan.

Maintaining the integrity of your data as part of your LIMS data migration strategy is a mandatory regulatory requirement. Your cloud service supplier should be able to provide current documentation supporting the validation SOP's, substantiating compliance with regulatory guidelines. Automated tools and cloud data migration services are available to assist you with this important effort. These utilities will help to streamline the data mapping and implementation process as well as the migration of data from legacy systems. Following the above recommended guidelines will serve as the roadmap to your successful LIMS migration while protecting and preserving the integrity of your valuable data.

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Conclusion:

Migrating your traditional LIMS to a cloud based environment will provide a multitude of benefits for your organization as you continue down your path of digital transformation towards the lab of the future. The cloud has effectively enabled the outsourcing of IT functions to third parties, providing a cost effective, scalable business model with increased capacity and performance.

As businesses grow, having the right technology in place to support this evolution is imperative to maintain a competitive edge. A recent trend for organizations is the adoption of a 'Cloud First' approach for on-boarding new technologies, requiring legacy systems to follow suit or risk obsolescence. LIMS is the central hub of most laboratory operations and is quickly becoming the next area of focus for migration to the cloud.

Adopting a cloud based strategy for your traditional LIMS will benefit from the following best practices:

- Understanding the full scope of hosting options that are available to guide you in choosing the right service provider to sustain the long term growth of your organization
- Determining that the service providers can offer an environment that is compliant and secure before moving your LIMS to the cloud
- Developing a comprehensive data migration strategy to ensure an efficient process while maintaining business continuity and the integrity of your data

- Evaluating and cleansing your data prior to migration and mapping the data from the source to the target destination in the cloud to promote data integrity
- Including a written document detailing the method and deliverables that will be used for data verification and validation throughout the process to support regulatory compliance

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While a cloud-forward approach is the wave of the future, it is critically important to select the appropriate cloud based solution for your operations followed by a meticulously planned migration strategy for optimum success. Automated migration tools and third party professional services can help you architect the right solution and best approach for your business. With your data center, software applications and servers hosted in the cloud and managed by third party IT resources, organizations will benefit from lower operational costs and a more flexible computing environment to focus on delivering the next generation of scientific breakthroughs.

References:

¹N. Galov, “Cloud Adoptions Statistics for 2021”, Hosting Tribunal, Jan. 19, 2021, www.hostingtribunal.com/blog/cloud-adoption-statistics/#gref, accessed Apr. 22, 2021.

²M. Rimol, “4 Lessons Learned From Cloud Infrastructure Adopters”, Gartner, Jun. 30, 2020, www.gartner.com/smarterwithgartner/4-lessons-learned-from-cloud-infrastructure-adopters/, accessed Apr. 22, 2021.

About Astrix:

Astrix has been an industry leader for over 25 years in helping scientific organizations implement and integrate improved informatics systems in the laboratory. Our experienced team of expert informatics consultants bring together technical, strategic, regulatory and content knowledge to provide the most effective solutions to problems faced by scientific organizations. Our domain experts have helped hundreds of companies globally effectively navigate their digital transformation journey. Visit astrixinc.com for more information.