

An Executive
Summary

Moving to the Cloud: Key Considerations



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The cloud has dramatically changed computing across many industries, delivering new benefits to many workflows. Despite its numerous advantages, laboratories have yet to fully embrace the cloud. This manuscript provides an overview of cloud technology, specific benefits to laboratories, and offers advice for how to transition to the cloud.

Introduction

A laboratory's fundamental job is to provide data to support an organization in answering questions and making decisions. Laboratory informatics systems help analysts perform a certain series of tasks with solutions tailored to a workflow. The goal is to help users to implement a process effectively and with high throughput.

Importantly, informatics tools are moving beyond the boundaries of simply instrument control and into the critical area of ensuring data integrity and regulatory compliance. While data integrity and compliance have long been important in the pharmaceutical industry, there has been a shift in regulators' expectations of the role of analytical laboratories in ensuring data integrity and proving analytical results are accurate, reliable, and not fraudulent. Clearly, data integrity and information security in analytical laboratories and in informatics systems is no longer optional. Informatics systems should offer this important functionality without unreasonably

high costs (including the license, deployment, maintenance, validation, and training).

Laboratory Informatics Systems Deliver Value

Current laboratory informatic systems are often limited by their "one-way street" architecture. They only capture isolated data without context, do not facilitate new queries, and cannot connect information across various systems. It is often much more productive and efficient for labs to look at contextual information collected across data sets. The cloud enables such an approach to informatics systems, with data at the center.

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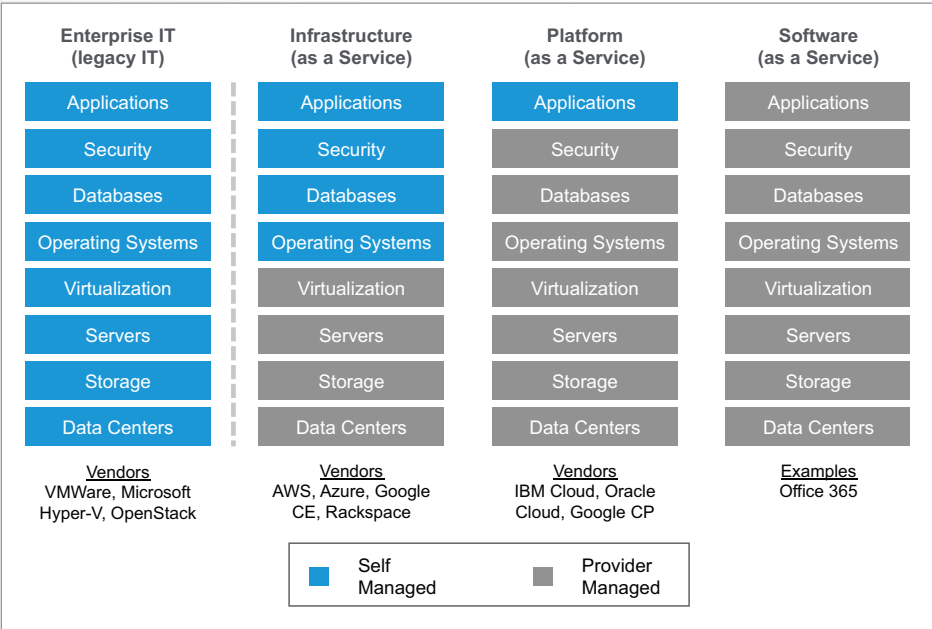
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More broadly connecting context and leveraging context from past experiences in the process enables better, proactive laboratory practice in numerous ways. Such context will not only benefit the initial use of the data, but it will also ensure previous data is available for reuse thus guiding and informing future analyses. This newer type of system is more efficient, enables automation, supports searches, helps to guide decision-making, and is secure, compliant, and redundant. It is also scalable and enables collaboration. However, an informatics system like this requires new technology and a different level of connectivity, a perfect application of the cloud.

Figure 1: How the cloud is utilized: three service models.



What Is “The Cloud”?

The cloud is an on-demand, outsourced, pay-as-you-go computing platform (see **Figure 1**). The three most common ways that the cloud can be implemented are explained in three right-hand columns:

- Infrastructure as a service, where servers are not physically in the same building as the laboratory. The laboratory manages the applications, databases, and the operating systems, but the basic management of the servers are outsourced.
- Platform as a service, where everything is outsourced except for managing the applications.
- Software as a service, where everything is outsourced for an annual or monthly fee for a user license (e.g., Office 365).

Benefits of the Cloud in the Laboratory

There are several IT benefits of the cloud that are also lab benefits: optimized costs, data security, less server maintenance time/costs from IT, and simplified data storage.

The value of the cloud to the laboratory itself are manifold, including:

- Enabling self-service of systems in the lab—an area where many laboratories have a need. This is a way for labs to pull an expert into the laboratory on demand to help troubleshoot problems or receive advice, for instance.
- Enabling analytics (e.g., artificial intelligence, visualizations, and time trending) to provide new insights for the lab.

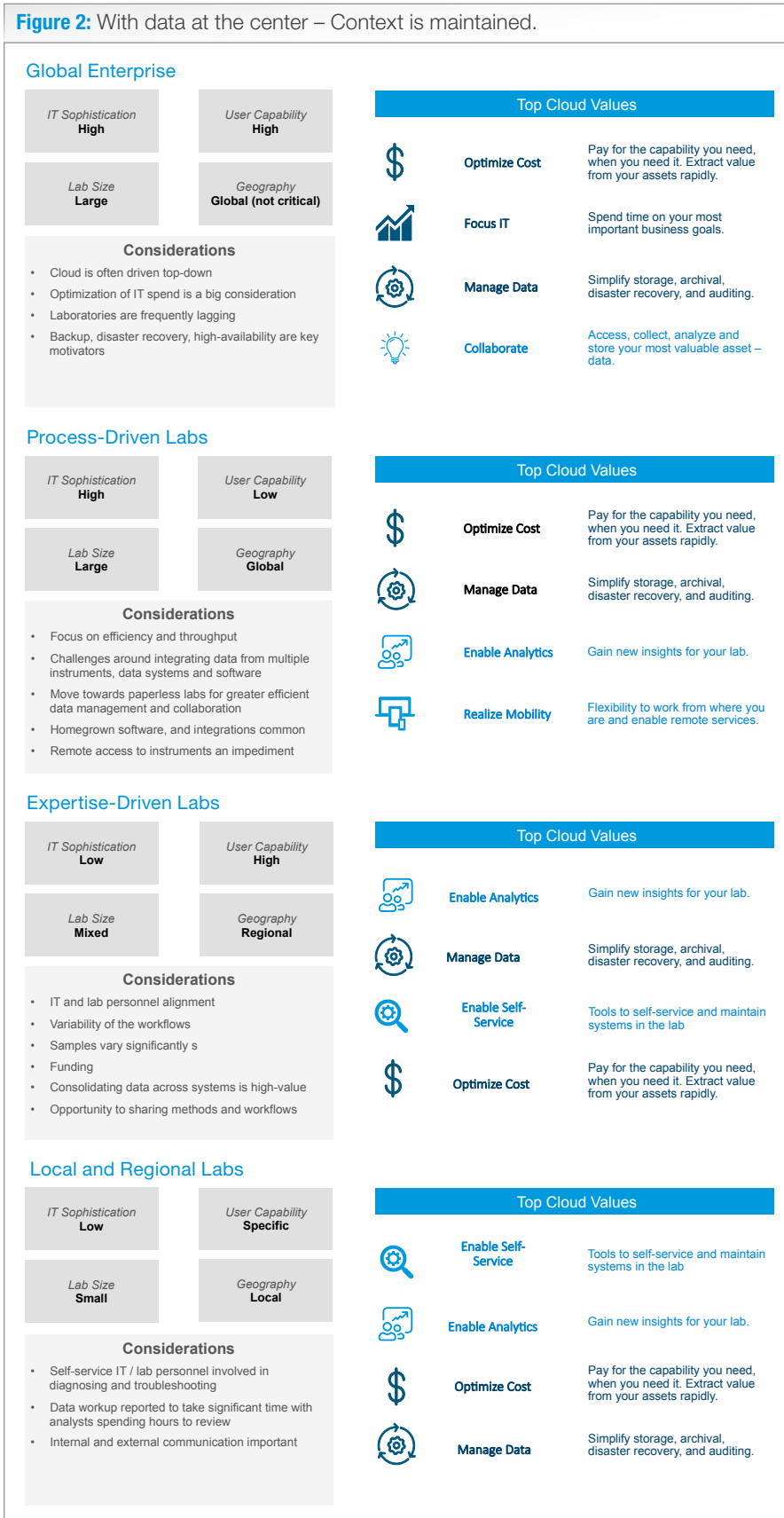
- Flexibility to work from anywhere and make decisions from off site.
- Improved collaboration with those in the organization or with partners.

In discussions with customers about critical considerations for cloud implementation, Agilent Technologies saw laboratories clustered around four critical areas. First is the sophistication of the lab’s IT department because it dictates the pace at which implementation of a cloud strategy will move forward and the resources that can be devoted to it. The size of the lab and where individuals work is another critical area because it affects how the system will be built to enable connectivity. Next is user expertise and capability, which will determine whether information will be shared across an organization internally or pulled in information from an external partner. Last is geography, referring not just to physical location, but also to area infrastructure requirements for the cloud including high-bandwidths, low-latency, high-uptime networks. Poor connections with latencies and interruptions can have a big impact on the type of solution laboratories adopt and how it fits in with their organization.

How might various types of laboratories fit into these four areas (**Figure 2**)?

Large, global enterprises often have highly sophisticated IT departments and skilled users. In most cases, the cloud is either on the roadmap or already in process. IT organizations at these companies are pushing to gain efficiency, and labs are often trying to keep up. These IT departments are driven by cost optimization (including installation, deployment, and more) and data backup/availability, but are very interested in focusing their IT teams on areas that add value and provide users with next-generation data analysis tools. Organizing

Figure 2: With data at the center – Context is maintained.



and managing data well is very important at these organizations to avoid having siloes of knowledge and to facilitate collaboration and communication.

Process-driven laboratories, like contract laboratories, are focused on efficiency and high throughput. They may have large networks where they need to leverage whatever knowledge exists because the average users are often technicians with low capability. Cost is a top concern for these margin-driven organizations. Of note, these labs are looking for excellent data storage/management options and advanced analytics because the more insightful data they can provide, the better off they are. Mobility is also important to this group. Having the flexibility to know what’s happening in the laboratory remotely can prove valuable.

There are also critical considerations for smaller labs. At expertise-driven laboratories, such as those that develop methods, the user capability is often quite high. This type of laboratory tends to be lower on the IT sophistication scale, but they need flexibility in their workflows because their samples can vary by the day. They want to be able to consolidate data and share methods and workflows across the organization, and they place a high priority on strong analytics. The cloud offers this type of organization the ability to be self-servicing to troubleshoot issues themselves, or to bring in other experts as needed.

Last, regional and local laboratories are usually smaller in size. They very often have a very specific knowledge or capability on which the lab was founded, which align with their top cloud values. They often have a lot of expertise and are selling knowledge/analytical results. Thus, they are looking for sophisticated analytical tools to gain new insight as well as tools for self-service. Although they see the opportunities that the cloud has to

offer, they are often slower to transition because there's a lot of complexity to untangle and not necessarily a lot of IT resources to help.

Before moving forward with implementation of the cloud, any laboratory is bound to have questions and concerns. Many are concerned with security and ask Agilent whether they should first move to cloud storage and then deal with applications later. Agilent recommends laboratories start off considering their end goals (perhaps even writing down these aspirations and documenting their concerns and challenges), and then determining how the change to cloud will happen. Consider milestones, potential gaps, timelines, and budgets.

Think about what resources are available, how much help can IT provide, and who in the laboratory can champion the changes. Last is the partnership piece, which isn't a simple one-time customer–vendor relationship, so it is worth taking the time to find the right team with the right capabilities to help you achieve your goals.

The pathway toward a cloud informatics platform will enable better lab practice, will allow analysts to connect various pieces of information to answer questions, will enable labs to transform data into action, and will allow the laboratory to drive efficient operation with facts and evidence so they can make the best decisions they can.

FAQs about Cloud-Based Solutions for Laboratories

During a recent *LCGC* webcast, William (Bill) Goodman, senior manager of Strategic Marketing, Software & Informatics Division, Agilent Technologies, answered several key questions posed by audience members about how laboratories can benefit from cloud-based solutions.

Does the cloud increase the risk of a data breach or data loss?

Data security is a pressing concern and moving to the cloud adds another layer of complexity into the mix. At the same time, as laboratories move to cloud services, they open the door to many advanced data integrity and loss-prevention technologies they wouldn't otherwise have access to. So, there are pros and cons.

Can the cloud provide enterprise-grade capabilities?

Yes, many cloud vendors are very focused on enterprise-class capability.

Is data backup more difficult and expensive when using cloud technology?

It's actually quite easy and doesn't have to add cost or complexity. In many cases, the cloud enables a lot more capability for data backup, reliability, disaster recovery, and the like.

Is it better to use a custom-made cloud-based LIMS or a commercial LIMS that has flexibility?

LIMS is a complex system with so many capabilities. Many of the newer LIMS offer the ability to have a configurable system, which means the software has a mainline code base that minimizes the costs associated with custom code. These systems are far more flexible than something that is more standard and off the shelf. That said, there are certainly situations where that customization is needed.

If I use cloud technology, will my laboratory be locked into one vendor's solutions?

Users need to be aware of this issue as they evaluate vendors, since the situation varies from service provider to service provider. Many vendors recognize that it is in the customer's best interest to allow data agility rather than attempting to lock users in. Nonetheless, there are certainly scenarios where laboratories are essentially locked into a vendor's solution and it is challenging to get out.

I want to move to the cloud. Where should I start?

It really starts with your goal. What do you hope your organization will gain from moving to the cloud? Is it cost savings? Is it mobility, collaboration, or expertise? The answers to these questions should be your guiding light, and then you can move forward from there. We often see laboratories simplify and centralize their data storage as their first step, which is low risk and very straightforward to do.

How easy is it to search and print a document from archived data in the cloud?

It will vary depending on the system and software and how they are deployed in the cloud.

Do you have any suggestions about how to choose a cloud partner?

Know what you want to achieve, your organization's capabilities, the higher priority applications to move to the cloud, and what your geographic spread will look like. Talk to your application vendors about what, if any, recommended partners they have, and then consider your service level and how you envision interacting and being supported and how that aligns with your goals and your resources.

Which lab informatics products do you think benefit the most from cloud technology?

The market has already demonstrated a lot of benefit to LIMS and ELN products, which seem to be the most easily transferable to the cloud. LIMS and ELN products are rapidly deployable and flexible, and LIMS transforms some of the biggest pain points of other traditional offerings. They have benefitted tremendously from the cloud. As you get closer to the instrument, it is more challenging.