

LIMS & Lab Automation

How can laboratories solve our greatest challenges?

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From fighting pandemics to ensuring a safe and reliable food supply, or meeting unmet medical needs and generating clean energy, the laboratory will be at the heart of solving humankind's greatest challenges.

Too many of today's labs, however, are disconnected from the larger digital transformation of the enterprise, leaving them isolated and reliant on what could be considered analogue systems. To an industry outsider, it could be surprising to find paper laboratory notebooks, word processing software and spreadsheets, or homegrown solutions as the data management tools of today's scientists.

Of course, many labs are using laboratory informatic solutions - LIMS platforms, electronic notebooks, scientific data management systems, etc. - and amassing troves of digital data. But we know that data management, storage, use, accessibility, analytics, integrity, and security all need to be transformed to meet the demands of tomorrow. The question is, what does the lab of the future look like? And who will decide?

The value of data

Laboratories have always been data factories, as everything from instruments to experiments to the lab or manufacturing environment itself produce data and metadata that should be captured and analysed for maximum benefit. But more often than not, that data, even if captured electronically, sits isolated and unmined. Experiments are repeated to avoid time wasted looking to find if anyone had done them previously. Supporting details and documents that could explain a dataset aren't part of the record, leaving more questions. Opportunities to leverage data to speed products to market, lower costs, reduce risk, or improve outcomes go unmet.

Yet, as the volume, velocity, and variety of data exponentially grows, so does the realisation of its untapped value. This has launched efforts to democratise data, unleashing its potential with new software solutions in the cloud or via software-as-a-service. Artificial intelligence and machine learning start moving into the lab. And while self-service drove IT from the lab, that skill set must re-engage to connect the lab to the internet-of-things and the greater enterprise as AI takes centre stage.

With great intentions, everyone from lab managers to the C-suite and vendors are working to gain maximum value from the vast data stores being created within labs. That led to what I call the first phase of Digital Transformation - generally where most of us are now, making sure our labs are digitally enabled and less siloed.

Continuing the digital transformation

The next phase of digital transformation is a bit harder to achieve, but more rewarding. With such things as digital twins and automation, we're able to create computer models or simulations that mirror physical lab activities to predict future results or recommend future next-best steps.

From there, we move into the third phase, where the digital native lab is designed with data at the forefront. It's enabled by augmentation, AI, ML, and algorithms to analyse data collected in an all-encompassing data mesh for far greater insights and informed decision-making than possible today. That will enable fully integrated labs to serve as both a producer and consumer of data to benefit the overall organisation, not to mention humankind.

Seeing the potential

Having spent decades in the fields of analytics, digital transformation, and AI, it is quite exciting to imagine how laboratories can benefit from these solutions. Labs are the source of innovation, and nothing of significance happens without a laboratory being somehow involved. Since solving the greatest challenges of our time will start with scientific discovery, we need to equip our labs and enterprises to take full advantage of the data produced there - and everywhere else.

Digital native labs - powered by AI and machine learning - enable us to shift from using limited data for descriptive analytics (what happened?) to accessing unlimited data for predictive and prescriptive analytics, helping to us to know what could happen, or how we can make something happen. Such transformation will certainly open doors.

This does require a strategy for your data, supported by a new data architecture (see *Figure 1*). This architecture will define the boundaries and components for implementing a robust framework necessary for a data lake, or mesh. It covers everything from your sources of data to its ingestion, the reservoir holding the data and preparing it for analytics, to data access and delivery and the application of analytics. An information portal provides a single point of entry to the analytics ecosystem, assisting users with navigation. The architecture also supports the workflows, data management, technical governance, and systems management for the lab.

Architecture Overview

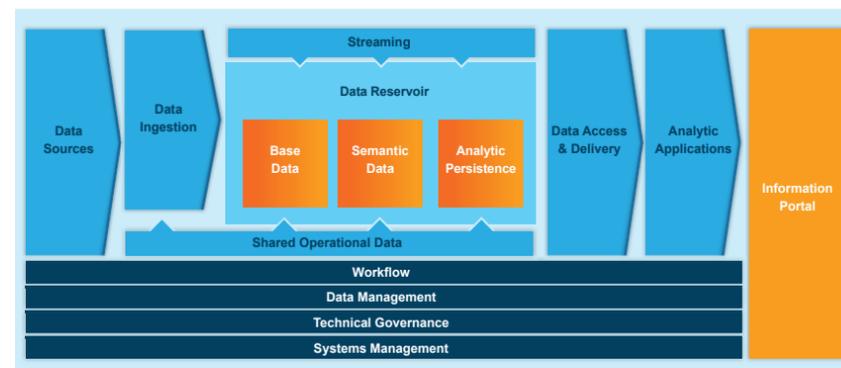


Figure 1: A modern big data and analytics reference architecture defines the boundaries and components for implementing a robust framework required for a data lake.

The immediate benefits of such a data strategy and architecture, as well as the deployment of advanced analytics in the digital lab, include speed to market and more informed decision-making. The effective and thorough analysis of a broader dataset enables organisations to quickly determine which options have the best chance of success. Once data are in a centrally hosted platform serving the enterprise, that data is now accessible to view and subject to algorithms for analysis. AI and machine learning only accelerate the ability to make critical decisions.

That's because systems can be taught to quickly spot previously undiscoverable patterns in data, allowing for additional investigation to find which are lowest risk, highest reward. As our current informatics solutions - such as ELNs and LIMS - grow in their capacity to track and store ever larger volumes and variety of data, advanced analytics will be needed to make the most of those assets. Not only for scientific advancement, but also lab productivity. AI and ML can monitor lab operations to optimise work plans, or predict process or system failures so preventive and corrective actions can be taken to reduce waste and downtime. It's hard to imagine areas of the lab that won't be enhanced by a complete digital transformation.

In fact, we're already seeing glimpses of the positive effect that AI is having - helping gas refiners to discover new revenue streams; or consumer packaged goods companies advance their carbon tracking beyond manufacturing out to product use - earning Level 4 carbon designations; while pharmaceutical companies are better able to sustain production documentation for regulatory requirements and diagnostic applications enable next-best-test decision-making.

Making the commitment

None of the benefits of digital transformation will be realised without a true commitment to AI and the process. We have seen many organisations 'play' in AI but few that have gone all in. It's understandable to a degree because so much is unknown. That saying of 'flying the plane while building it' can feel familiar in this instance.

That is why partnership is so important. Working with partners who can help you navigate this transformative journey is essential to its success. Vendors like

LabVantage Solutions have a role to play in guiding industries through universal transformations that require them to adopt new data philosophies and emerging technologies. Embracing a data mesh, a weaving together of data that is consistent and every-ready for digital use and analysis, will bring industries from pharmaceuticals to food and beverage, energy to chemicals and more into the future, better equipped to solve the challenges we face.

Since the lab of the future will look nothing like today's environment, our intent at LabVantage Solutions is to work closely with our customers to understand their goals, aspirations, and challenges to devise the informatics solutions that enable future scientists to more easily and more productively discover and innovate.

About the author

Mikael Hagstroem is Chief Executive Officer of LabVantage Solutions, a provider of laboratory informatics solutions. A respected strategist in the fields of analytics, digital transformation, and AI, Mr Hagstroem has helped global enterprises use analytics to harness data, reimagining their business models, achieving better performance, and creating long-term sustainable advantage. Formerly the Chief Operating Officer of McKinsey Analytics and President at SAS International, he was CEO and President at MetricStream prior to joining LabVantage in March 2021.