Laboratory software

Accelerating science with a well-architected digital experience

Introduction

The collective response to the COVID-19 pandemic challenged longstanding notions about the efficiency of remote work, the agility of corporate IT, the rigidity of government regulators, and the willingness of customers to embrace digital interactions. The pandemic represented a fundamental shift in displaying how integrated digital technologies can lead to significant operational efficiencies and cost savings.

In 2020, McKinsey & Company reported that the pandemic drove C-level executives to accelerate the digitization of their customer and supply chain interactions, and internal operations by 3-4 years[1]. Favorable returns on digital investments during the pandemic have continued to fuel the increase in chief information officer (CIO) budgets. According to a 2022 Gartner Peer Insights survey, CIOs are prioritizing work in cybersecurity (52%) and digital transformation (46%)[2]. CIOs are investing in the implementation of key technologies that enable their organizations to reach their desired business outcomes (i.e. faster drug development, more efficient operational processes, optimized customer experience, and increased quality standards). The highest priority technology investments include artificial intelligence/machine learning, automation, integration technologies, cloud, and data analytics/business intelligence.

The implementation of a well-architected digital experience has become a strategic priority and competitive differentiator for many global leaders such as Thermo Fisher Scientific, Pfizer, AstraZeneca, and Shell. An integrated digital ecosystem provides the foundation and enablement pathway to achieving desired business strategies, such as Pfizer's, to deliver 25 drug breakthroughs by 2025[3]. A new to market, critical technology, that provides the capability to develop a cohesive digital laboratory experience is the Laboratory Orchestration Platform (LOP). A LOP builds upon existing sets of applications and technical infrastructure to provide an integrated data fabric, transformation, and compositional layer.

Maximizing operational efficiency

What is a laboratory orchestration platform?

The concept of a laboratory orchestration platform stems from the rapid success of digital platforms such as Salesforce for CRM and Adobe for create services. A keystone piece of literature for platforms, Platform Revolution, defines a platform as a technology that connects two parties for the exchange of a product[4]. The goal of a platform is to have a large network of users to drive competitiveness in the market. This strategy feeds into, and provides the foundation for partnership ecosystem models, which have demonstrated significant success (i.e. Amazon) according to analyst firms such as Deloitte and Gartner. In fact, McKinsey Insights reported in 2018 based upon a market survey (including the pharmaceutical industry) that "any type of platform play— whether through a company-owned or a third-party platform, and either cooperating or competing with a global platform—can boost earnings above the benchmark level of not playing. Companies with platforms had an annual boost in earnings before interest and taxes (EBIT) of 1.4 percent, compared with the 0.3 percent gains of nonplayers.

Companies that joined broader cooperative arrangements fared slightly better than those operating their own platforms[5]." Given the market opportunity for platform providers, this same platform concept has been applied to the research and development (pharmaceuticals, biotech, chemicals, energy, food and beverage) market.

The LOP has entered the laboratory informatics market just as organizations across all industries are increasingly challenging the value derived from their existing IT investments, such as monolithic Enterprise Resource Planning (ERP)-centric applications, custom code applications, and on-premises technology. These legacy technologies have typically created a high barrier to digital innovation (i.e. data mining and advanced analytics) and a high total cost of ownership (system maintenance and training). To maximize the outputs from legacy applications and provide a new mechanism for digital scalability, the LOP integrates with and does not replace existing IT investments such as Laboratory Information Management System(LIMS), Electronic Laboratory Notebook (ELN), Chromatography Data System (CDS), and Application Performance Monitoring (APM). LOP provides a common data layer that sources and integrates functionality from internal and external applications. LOP enables the seamless use of artificial intelligence and data mining. Together, this provides the most technologically efficient and cost-effective approach to scaling digital capabilities. This architectural approach has been outlined by organizations such as Gartner and ASTM International – Standard Guide for Laboratory Informatics, 2019[6].

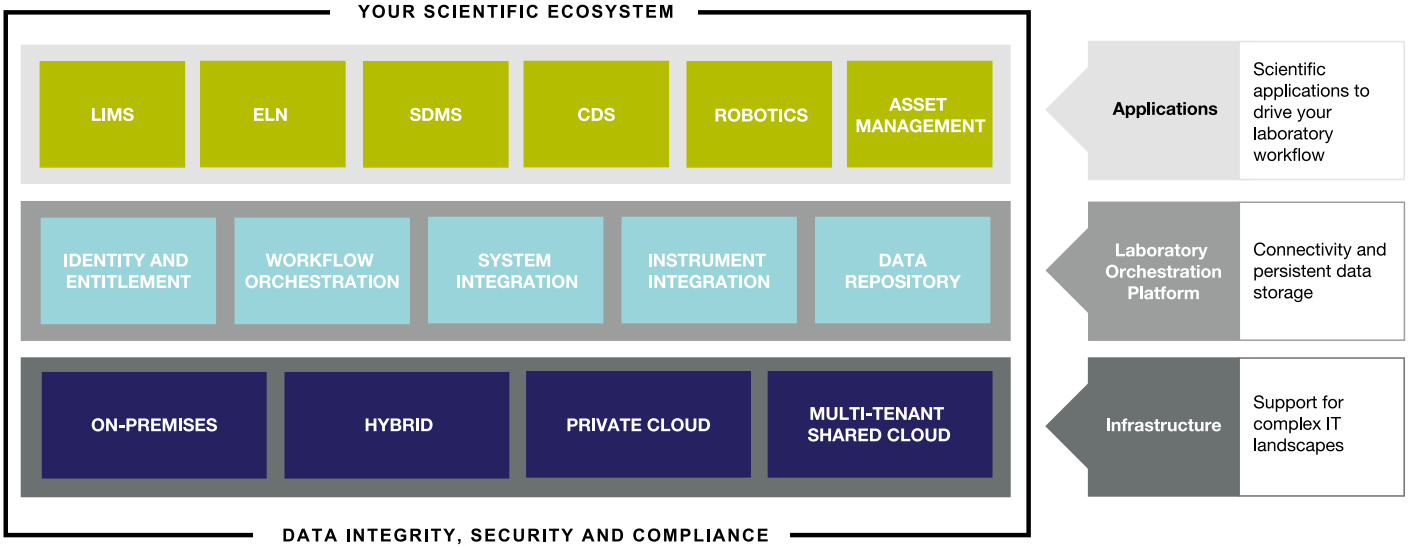

Figure 1: Representative architecture of a scientific ecosystem

The integrated data fabric within the platform layer is responsible for the exchange and governance of data from disparate core applications, services, processes, and devices, making the data ready for business exploration, within a single dynamic architecture. In addition, it automates the ingestion and linking of data from permissioned sources (i.e. third party software – LIMS, ELN, APM, ERP), manages identity, compliance and security, and facilitates agile data governance. The components of the LOP focus on assembling a coordinated digital experience (UI/UX) for its users creating increased resilience, adaptability, and flexibility.

LOP creates the environment for partnership ecosystem development

In the new digital era, tech providers who chose to act alone will struggle to keep up with the rapid pace of innovation. It has been demonstrated that ecosystem partnerships increase innovation speed, uniqueness, adoption speed, competitive advantage, and provide operational advantages. Increasingly, across the life sciences laboratory informatics market, partnership ecosystems are being developed to enhance the user experience, co-innovate, drive adoption, and reduce overheads.

According to a Gartner webinar on Platform Ecosystems, ecosystem participants, partners and independent developers add value by invoking the ecosystem provider's APIs to develop solutions that benefit all parties by making the solution more complete. The ecosystem provider encourages its partners to integrate with the application via a set of APIs. Ecosystem providers, in turn, gain competitive value from these solutions, as the partner products plus their ecosystem collectively deliver greater innovation and choice than their products could by themselves. Customers benefit from these ecosystems by more easily finding integrated solutions that meet their needs, typically via a catalog or marketplace managed by the ecosystem creator.

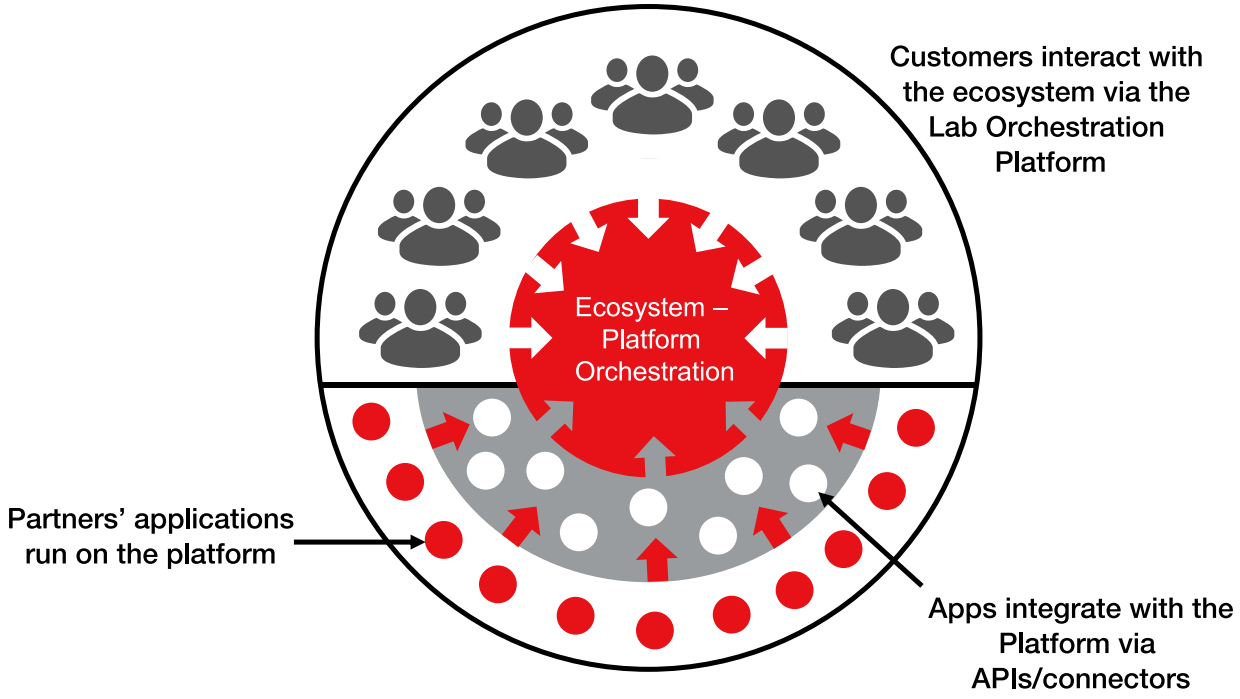

Figure 2: Example relationship model for platform ecosystem partners

The inclusion of an LOP provides many benefits to its end consumers:

	Current state	Inclusion of laboratory orchestration platform
Data	• ERP-centric digitalization • Siloed data storage and exchange • Limited use of third-party applications	• Composable architecture that provides the foundation for a connected laboratory ecosystem (IT-Ecosystem digitization-centric) • Orchestrated communication between laboratory software • Centralized data storage/liquidity for FAIR Data • Increased focus on AI/ML for data prediction to reduce the number of laboratory tests performed • Enablement of connected laboratory ecosystem
Instruments	• Disjointed fleet management • Reactive performance management • Limited instrument integrations • Unable to cohesively manage data across many instrument types	• Seamless communication between systems of records such as LIMS, ERP, and APM to manage instrument fleets • Move to inline instrumentation to minimize offline testing performed in a production lab • Connection between the physical and digital lab to understand instrument performance and health
Services	• High total cost of ownership for custom integration maintenance • Complex vendor management	• Streamlined vendor management • Ease of system upgrades due to composability and microservices architecture • No custom code for integration points
People	**Management** • Focused on system optimization • Lack of transparency of workflows across many systems • Ability to make informed decisions quickly is challenging **Contributors** • Disconnected employees with poor access to insights and collaboration tools • Inefficient data management and collation	**Management** • Focus on innovation to support optimization • Increased visibility across all laboratories – including resources, assets, instruments, and scientific data • Potential increase in EBIT due to process optimization **Contributors** • Positive digital experience • Product-focused teams • Improved collaboration and communication • Ability to focus on the science • Increased and routine use advanced data visualization and analytics

Figure 3: Example value propositions for a laboratory orchestration platform

Risks and recommendations for implementing LOP

Perceived risks	Recommendations
Executive sponsorship – unwilling to move away from traditional data management models	The LOP provides value for each organizational layer within a company. For example: • CEO – A LOP accelerates and supports the industry shift to implement business transformation and optimization in line with corporate strategy • CSO – LOP will transform scientific workflows and improve decision making to drive productivity and quality. • Functional IT – Reduction in overhead and TCO due to agility, scalability, cohesive platform security, and positive UI/UX • Lab Scientists – Ability to focus on the science, streamlined day to day operations through one application.
Existing technical debt – existing investments in monolithic and custom code applications	LOP integrates with existing informatics systems and over time will reduce the technical debt and burden on IT.
Regulatory compliance – concern to disrupt existing organizational regulatory procedures	LOP increases regulatory compliance by collating data across all systems and providing an auditable location for complete end to end data management.
Change management – shift in mindset and technical skills for IT organizations, and training of scientific workforce	Demonstrated by Pfizer, the key to any transformation effort is change management. Company employees need to be brought along the transformation journey and to share the vision for the future. As employees start to see tangible outcomes during transition, they often become the biggest proponents of new ways of working[3].

Figure 4: Risks and considerations for adopting LOP

What is the role of each laboratory informatics system?

As previously stated, a LOP is an adjacent technology to existing laboratory informatics systems such as a LIMS, CDS, ELN, and LIS (Laboratory Information System). Laboratory informatics systems can capture basic and routine information in small labs, but also drive sophisticated lab processes across the enterprise and related workflows, requiring the data and analytics strategies that support the lab of the future and smart factories. The following table outlines the role that each system plays in the laboratory software ecosystem. This analysis is supported by data from a plethora of sources including: MarketsandMarkets Laboratory Informatics Landscape, SDi Global Assessment Report, Gartner's Market Guide for Laboratory Informatics, and ASTM International – Standard Guide for Laboratory Informatics.

Application	Role
CDS	• Manages methods and interprets data from chromatography instruments and converts it into human-readable formats
ERP	• Provides project planning, management, supply chain management
ELN	• Provides experimental capabilities, calculations, and documentation of scientific experiments i.e. in silico modeling • Manages intellectual property and increases regulatory compliance • Facilitates collaboration amongst teams
LES	• Manages process procedural-centric workflows/laboratory tests
LIMS	• Manages laboratory operations (i.e. inventory, instruments, people) and data • Drives a sample-centric workflow and process • Facilitates business workflows and processes i.e- MES, ERP, QMS, EBR in quality and manufacturing environments • Captures and reports critical lab test data
LIS	• Drives patient-centric laboratory testing workflows in centralized healthcare or PoC testing – clinical diagnostics, pathology, genomic testing
LOP	• An architectural approach that enables organizations to have agility within their business operation model in response to internal or external disruptions • Provides workflow orchestration and integration between software and instrumentation, identity and entitlement, data transfer and transformation, data repository capabilities • Establishes the data frameworks for advanced data visualization and analytics
SDMS	• Primarily designed for data consolidation and knowledge asset realization • Ensures that all raw data and associated metadata is secure and accessible for the entire data life cycle with no requirement for the original instrument software
Instrument and software connectors	• Facilitates automated data transfer, method calls, and instrument data

Figure 5: Laboratory informatics applications and roles. The architectural approach for these applications is outlined in Figure 1.

Market adoption

Across many market analysis firms the laboratory orchestration platform has been identified as a technology that can provide transformational value to an organization regardless of where they sit in the molecule to market value chain (research, development, manufacturing, supply chain). Analysts such as Gartner predict that a LOP will reach its plateau in the market in roughly 5-10 years. The time is now for the implementation of an LOP to enable market competitiveness – within the pharmaceutical market this lends itself to the faster creation of life transforming treatments while still ensuring that quality is at its highest standards.

Conclusion

The mechanisms to conduct research and development across industries are rapidly evolving and thus, the architectecural approach to laboratory informatics has shifted to promote agility, flexibility, and compliance within the laboratory. The laboratory orchestration platform is a critical asset to implementing laboratory digital transformation strategies and promotes the creation of a laboratory partner ecosystem. The platform does not replace existing informatics investment but is rather an adjacent technology to bolster secure data management (transfer, transform, compose) and orchestration.

Thermo Fisher displays a unique value proposition to the market with its ability to provide complete laboratory orchestration with the use of its premier brands. Thermo Fisher has industry leading expertise across many aspects of the laboratory: informatics, instruments and consumables, and services.

As organizations attempt to accelerate their digital transformation journey through leapfrog digital innovation, they should consider:

1. Developing an organizational partnership to help drive and implement a laboratory informatics strategy with an industry leader such as Thermo Fisher.
2. Creating a purposeful portfolio of digital innovation that cohesively builds on one another to reach full digital potential (Lab of the Future, Smart Factory).
3. Designing an operating model that provides dedicated innovation resources to support desired business outcomes.
4. Implementing change management procedures to ensure the success of digital transformation efforts.

The development of a laboratory orchestration platform allows customers to reach their strategic goals and promotes Thermo Fisher's mission to enable our customers to make the world healthier, cleaner, and safer.

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