Laboratory software

Lab of the future

Connecting the scientific ecosystem

Foreword

The scientific world is evolving; laboratory processes that were once entirely manual are being optimized through automation and data connectivity. While documents previously had to be printed, signed and physically stored in boxes, the recent emergence of data management systems and software platforms is enabling scientists to sign and store electronic records in a secure and future-proof format. Likewise, advanced analytics solutions, such as artificial intelligence and machine learning, are being used to connect, collate and analyze data from different facilities across the globe.

Yet, the decision to digitally transform the laboratory is not without its challenges. New methodologies must be assessed and approved by the relevant regulatory body, for every new application in the manufacturing process. The diverse scope of applications across the globe makes it difficult for organizations looking to adopt such capabilities, despite the potential benefits. Many large pharmaceutical organizations are leading the charge, using a Pharma 4.0 strategy to enable the delivery of critical medicines, therefore the pressure is mounting for regulatory bodies to come together and ease the application process.

In addition to exploring the benefits and challenges of digital transformation, this eBook will demonstrate how novel and practical solutions can be integrated to increase laboratory productivity and accelerate scientific research.

Contents

What is digital transformation?

Digital transformation can be broadly defined as the process of integrating digital technology to create or modify business processes, operations, culture, and improve organizational results, deliverables and customer experiences.[1]

Virtual globalization, and the subsequent exponential growth of data, processes and technologies, has made it almost unsustainable for companies to continue operating with analog-based models. This was made evident throughout the first year of the COVID-19 pandemic, whereby organizations were forced to accelerate digital adoption and implement deeper, company-wide changes to ensure successful transformation.[2] A report by the International Data Corporation (IDC), showed a 10.4% growth worldwide in digital investment in 2020, predicting that by 2023, digitally transformed organizations will contribute to more than 50% of global GDP.[3]

Disruption of the scientific ecosystem

Digital transformation involves a deep change in the management of technology, data, and associated processes (Figure 1).[2] The increased use of digital technologies is creating unique opportunities; tools such as the internet of things (IoT) and machine learning (ML) are drastically changing lab processes and workflows. Furthermore, the adoption of such technologies is integral to ensuring that all instruments, operations, workers and partners are connected.

Companies must transform the way they create, manage and store data to ensure the transparent flow of information. Since an increase in connectivity can create challenges across multiple regulatory regimes, laboratories must develop comprehensive strategies that comply with regulatory guidelines to enforce and maintain data security.[4] The increased use and dependence on electronic records, laboratory information systems, -omics technologies and digital applications is generating significantly large volumes of data and strenghtening the role of artificial intelligence (AI) across the scientific field. For example, with regard to laboratory efficiency and sustainability, AI can be used to identify areas of waste, improve processes and protocols and enable more rational laboratory test ordering. AI has also been used more specifically to extract comprehensive phenotypic information from imaging and laboratory data to (1) explore novel genotypes and phenotypes in existing chronic diseases, (2) improve the quality of patient care and thus (3) reduce readmission and mortality rates. Furthermore, it is enabling personalized medicine by enhancing early risk prediction, prevention and therapeutic intervention.[5]

New data channels as well as more agile and adaptable processes are crucial to achieving more intelligent services. Moreover, with the increase in collaboration and outsourcing strategies, companies require global platform approaches to remain dynamic. Digital ecosystems should ultimately be extended across labs and institutions, building up a cloud-based system through which to exchange data.

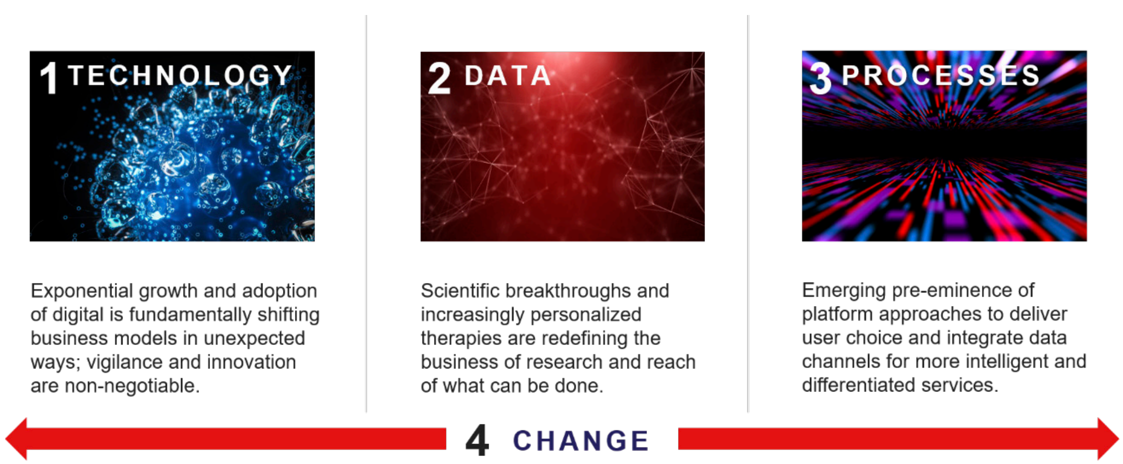

Figure 1. Disruption of the scientific ecosystem

Digitization vs digitalization

Digitization refers to the transition from analog to digital data, for example, replacing paper records with digital records, using electronic tracking systems such as laboratory notebooks (ELN), and establishing an electronic database of Standard Operating Procedures (SOPs). Put simply, digitization refers to information, whereas *digitalization* refers to the physical processes that enable the conversion to digital technologies; for example, connecting instruments, reconciling software and data, harmonizing processes and workflows, as well as integrating other lab components and employees to achieve full digital transformation.[6] Table 1 explores both terms in more detail.

Incorporating digital technologies

Given their impact across organizations, digital enablers should be robust enough to support the entire lifecycle of highly regulated processes (e.g. manufacturing and quality control), while offering flexibility to adapt to varying workflow and data management needs. Some prominent digital technologies are discussed below:

- **IoLT :** Refers to devices used to collect and share data via the internet. IoLT (Internet of Laboratory Things) can be used in the continous monitoring of instruments and parameters, inventory management and data collection. The reduction in manual tasks, and subsequent lower risk of human errors increases productivity and lowers costs.[7] 30% of the top 20 pharma companies have already adopted IoT technologies in their manufacturing processes, implementing tools such as automated guided vehicles, RFID tracking, sorting and process flow tracking to ensure batch consistency.[8]

- **Cloud computing**: Refers to remote technologies (e.g., servers, databases, software, analytics) that store, manage and centralize data and connect disparate instruments across different locations and organizations. Cloud-based solutions are more easily scalable and cost effective in organizations which might need to extend a solution beyond its initial application, or where there are challenges in significant hardware investment or in-house IT support.

- **Informatics**: Refers to computational systems that process data for storage and retrieval. For example, LIMS and electronic lab notebooks (ELNs) can be used together to track samples from receipt to result reporting, and secure the introduction of methodological and results data as well as metadata to the digital ecosystem. Typically, a LIMS is best suited for dealing with more structured data, such as in a manufacturing or process environment, whereas an ELN is generally applied to manage less structured data, often in a discovery or research application. Notably, the combination of multiple informatics technologies (e.g. LIMS/SDMS/ELN/LES) allows the interpersonal sharing of workflows, as well as comprehensive data mining and analytics.[9,10]

- **Scientific data management systems (SDMS):** Provide a centralized database for data collection, organization and storage. Data sources can be diverse (from any analytical instruments or equipment) and are restructured to facilitate data analysis. With its ability to generate audit logs and diligent reports, SDMS is crucial for quality control, ensuring data integrity and thus compliance with regulatory guidelines.

Table 1. Digitization versus digitalization

Digitization	Digitalization
Reduce/eliminate paper, move toward a paperless lab	Process automation, application of business intelligence
Results reported in pdf format	Complete original instrument data including metadata, in a searchable table format, ready for further analysis
Scanning of paper results	Image analysis, data extraction (using optical character recognition, OCR), validation of results and reporting into cloud databases
Provides limited context and understanding	Provides the full scientific story
Online instrument booking	Analysis of instrument usage and telemetry data to plan maintenance and improve uptime
Electronic training records	In-process checks of analyst training for SOPs, instruments, and equipment to drive compliance
Automate QA result transfer on finished products to the production system to expedite the release	Digital twins with in-line analysis enable continuous process improvement and machine learning to optimize production
Recording manual actions in laboratory information management systems (LIMS)	Automated systems perform and record actions automatically
Creation of electronic SOPs	Stepping through SOPs using a Lab Execution System (LES) to record actions as they happen with in-process checks on instrument and equipment availability and analyst training
Electronic inventory	Digital inventory tracking system is connected to supply chain such as ecommerce, enabling scientists to easily reorder supplies as they run low.

- **Artificial intelligence (AI)**: Refers to “smart” technologies which perform tasks that typically require human intelligence (e.g. decision-making). AI not only allows the live-monitoring of processes and data interpretation, but also real-time troubleshooting of all the networked systems. With this predictive and responsive intelligence, AI can be used as a holistic lab manager for many tasks including inventory management, equipment maintenance and supply chain activities.

- **Automation:** The shift towards integrated modular automation systems (e.g. robots, liquid handling devices, detectors, etc.) not only improves the reliability and reproducibility of processes, workflows and data and sample management (e.g., in-line troubleshooting, pre-/post-analytical tasks), but enables the execution of such tasks with minimal intervention from laboratory personnel.[11,12]

Conclusion

The transition to a harmonized digital lab of the future is not a trivial task; it often requires adjustments to company culture and a comprehensive digital strategy that accounts for all data, processes and people involved. However, in addition to increased productivity, enhanced organizational performance and improved communication, the decision to digitally transform the laboratory will enable the optimization of processes and workflows, increased throughput and simplified quality control and compliance,[13] ultimately advancing scientific discovery and understanding.

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The benefits of digital transformation

Digital transformation refers to an organization's full-scale shift to digital data storage, management and interpretation, in order to save time, money and bring treatments to market faster.[1] The value of implementing digitally-enabled processes is becoming more evident; it is predicted that companies which adopt automation will gain a competitive edge through engaged and creative workforces, improved productivity and greater transparency.[2]

A recent study* found that 77% of respondents incorporated Internet of Things (IoT) technologies in their laboratory environment, which resulted in the following benefits:

*A commissioned study conducted by Forrester Consulting on behalf of Thermo Fisher Scientific, November 2020.

Advancing your digital transformation journey

The emergence of new digital technologies such as cloud computing, the Internet of things (IoT) and artificial intelligence (AI), has had a significant impact on various sectors and organizations.[1] According to the International Data Corporation (IDC), 85% of enterprise decision-makers believe that they must make significant inroads into digital transformation within two years to avoid falling behind their competitors and suffering financially.[2] In the context of science, digital transformation connects all aspects of the laboratory (e.g., people, consumables/reagents, software and instruments) to improve productivity and transparency, and ultimately accelerate science.

Yet, the transformation to a fully digital lab goes beyond just data and digital technologies; it relies on the ability to address issues such as human resources, business efficiency and process redesign.[3] Laboratories must therefore develop and execute a comprehensive digital transformation strategy to overcome challenges and gain a competitive edge.

Benefits of digital transformation

Although a certain amount of disruption is required to transform an analogue lab to one that is fully digital, connected and 'smart', the organizational benefits significantly outweigh the challenges.

Increased efficiency and productivity

Digital transformation enables scientists to communicate within groups and between departments, share data continuously across the organization in real-time, and remain in sync with the evolving requirements of customers across their journey. Furthermore, extended reality, voice recognition technology and AI can be used to access software and systems without the need to stop lab work to record actions or check next steps. This further enhances data and process integrity, improving efficiency whilst saving time, money and resources.[4]

Increased transparency

Automating data workflows increases transparency by identifying trends in processes and practices that lead to small, incremental and consistent improvements across all aspects of the organization.

Cost savings

Immersive solutions enable more effective collaboration both within and across organizations. This makes training, troubleshooting and maintenance much easier for personnel, ultimately saving costs by improving instrument and equipment uptime.

Improved profitability

Minimizing costs, identifying inefficiencies and improving best practices will drive revenue growth – 80% of organizations report that digital transformation has resulted in increased profitability.[5]

Improved customer experience

Technological innovations allow organizations to collect and analyze customer data to improve existing products and create new products and services.[6]

Increased flexibility and resilience

The COVID-19 pandemic put an increased emphasis on the need for organizations to be versatile and resilient. For many, this involved embracing data analytics, automation and other digital tools that enabled them to use and share on-demand resources online to keep their businesses moving.[7]

Better inventory management

An integrated inventory management process provides visibility by connecting valuable information about raw materials, vendors, delivery methods, and ultimately customer experience. Integrated systems which monitor resource usage and provide the ability to reorder stocks as required enable organizations to drive advanced procurement.

Key considerations for a digital transformation strategy

The move to paperless systems coupled with the pressure to integrate data-driven technologies is forcing laboratories to become 'smarter'. Yet, there are many factors that influence how the laboratory environment will change over time and therefore they should be considered as part of any digital transformation strategy (Figure 1).[8]

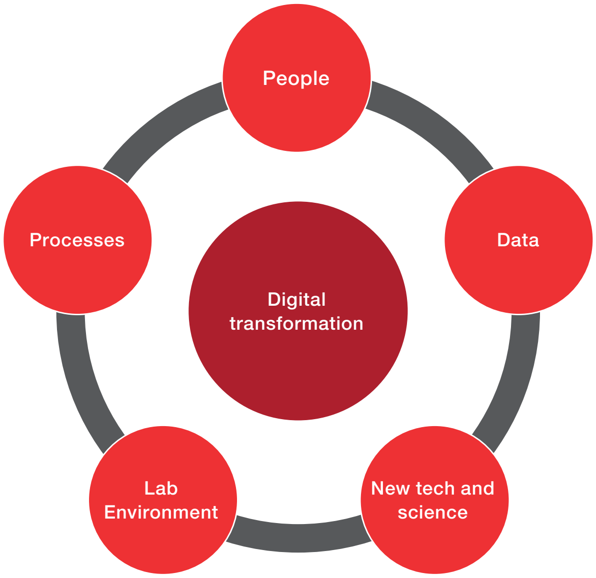

Figure 1. The complex and multi-faceted concept of digital transformation.[8]

People and culture

The lab of the future will place increasing importance on global and cross-organizational cooperation. Researchers will be more familiar with the work of others, thereby removing barriers to collaboration and increasing the uptake of new methods as they become available. Importantly, a significant proportion of manual work will be eliminated with the adoption of robotics and automation, allowing scientists to focus on the key aspects and complex facets of their work.

Process developments

The integration of robotics and automation will continue to enhance production rates, efficiency and the overall quality of laboratory processes and experiments, by replacing a significant proportion of manual tasks.[9] Yet, the digital lab will also be increasingly driven by environmental and sustainability goals; experiments that currently involve toxic and noxious materials will be redesigned to minimize their usage during both the experimental and clean-up phases. The increasing use of climate-friendly solvents, catalysts and reagents will further support sustainability across a range of applications.

Data security and management

The Internet of Things (IoT) refers to the integration of smart devices with the internet. The availability of affordable and connected technology is allowing laboratories to optimize their operations and combine instruments and data more efficiently.[10] This inevitably generates large amounts of data (Volume) from different sources (Variety) as close to real-time as possible (Velocity). These '3 Vs of Big Data' are key to understanding the challenges of (big) data management.[11]

Laboratories commonly manage and store data in separate 'silos', which can lead to data being unused or inaccessible and cause concerns for data security. Data must be harmonized and standardized before it can be used to optimum effect; the use of FAIR data principles (findable, accessible, interoperable, reusable) makes it easier to navigate, manage, analyze and use internal and external data.[12]

Lab environment

The lab of the future is under pressure to design more open co-working areas that foster collaboration and teamwork, rather than the traditional siloed culture of small groups and departments. Additionally, the labs of the future can minimize their impact on the environment, while increasing efficiency and reducing costs by focusing on sustainability. This includes the use of energy-efficient instruments and equipment, sourcing more environmentally responsible products and considering eco-friendly methods for manufacturing, packaging and shipping.

Novel solutions

Future labs will benefit from the emergence of innovative technologies. For example, in addition to automation, the integration of voice recognition, augmented reality and biometric authentication into experimental workflows will increase the consistency of processes and enhance data quality and security by reducing human interaction and automating data capture.

Many labs are combining advanced analytics with automation and robotics for faster and more focused scientific discovery. For example, labs can use robotics and automated systems to generate high-quality data, which is interpreted by machine learning (ML) and used by AI to select the next optimal experiment to conduct.[13] Equally, R&D labs have been using AI algorithms and automation in these same closed loop approaches to identify, synthesize and validate novel molecules.

Lastly, the increasing use of organ-on-a-chip and stem cells within research, will eliminate the need for animal models in research, offering new approaches for predictive *in vitro* modelling and personalized medicine, respectively.

The key steps of a digital transformation strategy

As outlined in Figure 2, there are three main steps to driving digital transformation. The first involves connecting everything to make data available. Taking a step back to analyze the existing infrastructure will enable labs to determine where any problems lie. Having high-quality FAIR data that can be

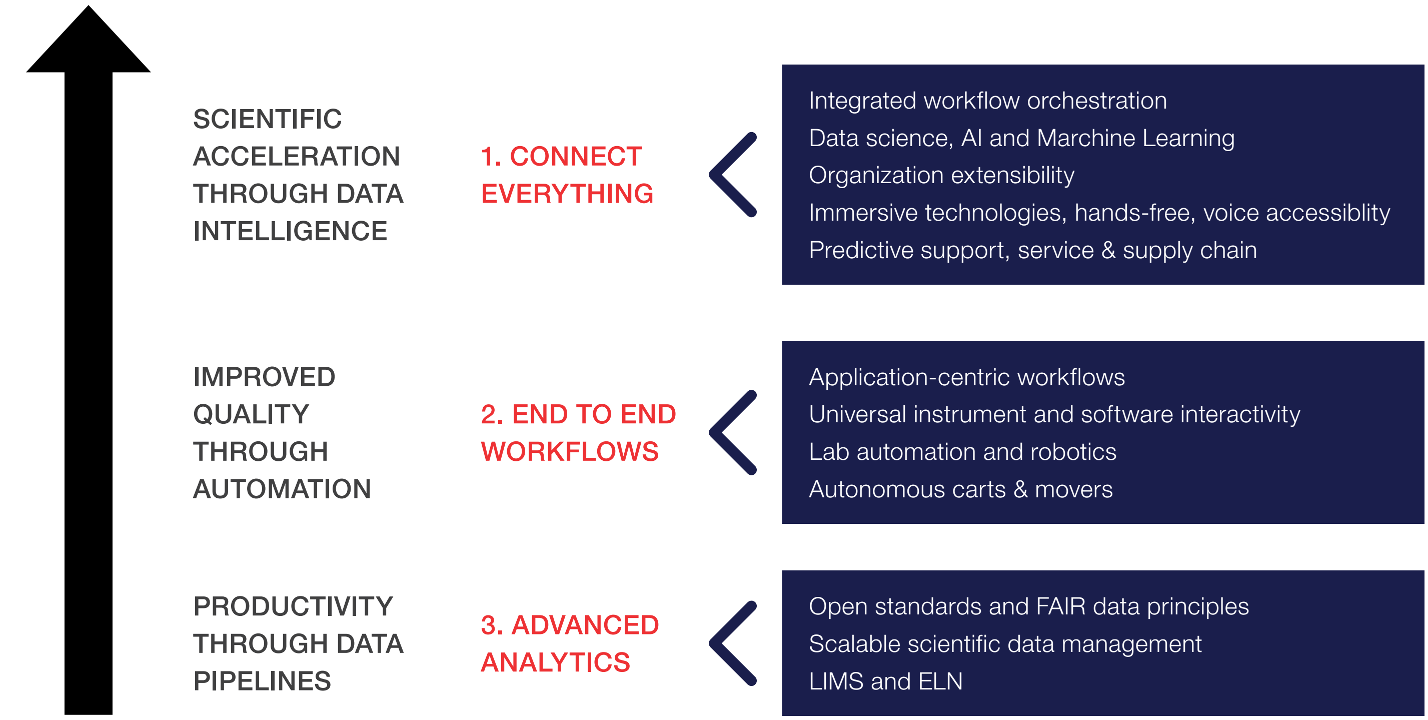

Figure 2. The three layers of future laboratories

reused with confidence is also key – this includes experimental and operational (instrument) data. Connecting both types of data will enhance data integrity, compliance and productivity. Connected laboratories represent the foundational layer of digital transformation.

The second step involves automating end-to-end, application-centric workflows to maximize throughput, enhance reproducibility and ultimately enable labs to adapt to changing workflows and technology so that scientists can focus on the tasks that bring value. Automated laboratories constitute the second layer of digital transformation.

The last step of the digital transformation journey is the transition to an intelligent laboratory; one that makes use of data and advanced analytics tools (e.g. ML and AI), as well as immersive technologies (e.g. hands-free voice accessibility and virtual reality systems) to make informed decisions on data and downstream activities to continually improve processes and accelerate science. These laboratories represent the third and final layer of digital transformation.

A roadmap to the future

Digital transformation requires more than the transformation of one lab; the entire end-to-end process must be transformed to reap the benefits. However, integrating automation and hardware only provides so much; organizations must align their objectives with business goals, putting people at the heart of their digital strategy. Considering how workflows may evolve in the future will allow facilities to adopt the right informatics solutions and provide the necessary training for employees to facilitate the transition. Equally, while emerging technologies such as AI reduce production costs and enable more individualized products and services, their disruptive nature highlights the need for businesses to be operationally agile. By defining your goals, picking strategic partners and maintaining customer- and application-centric workflows and processes, organizations can create a clear roadmap for digital transformation.

Figure 3. The roadmap to lab of the future

Conclusion

Disruption to the scientific terrain, the emergence of digital and novel technologies and the pressure to increase efficiency and sustainability are driving labs to embrace digital transformation. Yet, the process is broad, and the digital transformation journey is a continual process. Different labs will have different requirements and experience unique barriers to success. Implementing a comprehensive digital strategy is key to building a connected scientific ecosystem. However, it can require adjustments to company culture, and must consider the people, instruments, processes and data within an organization.

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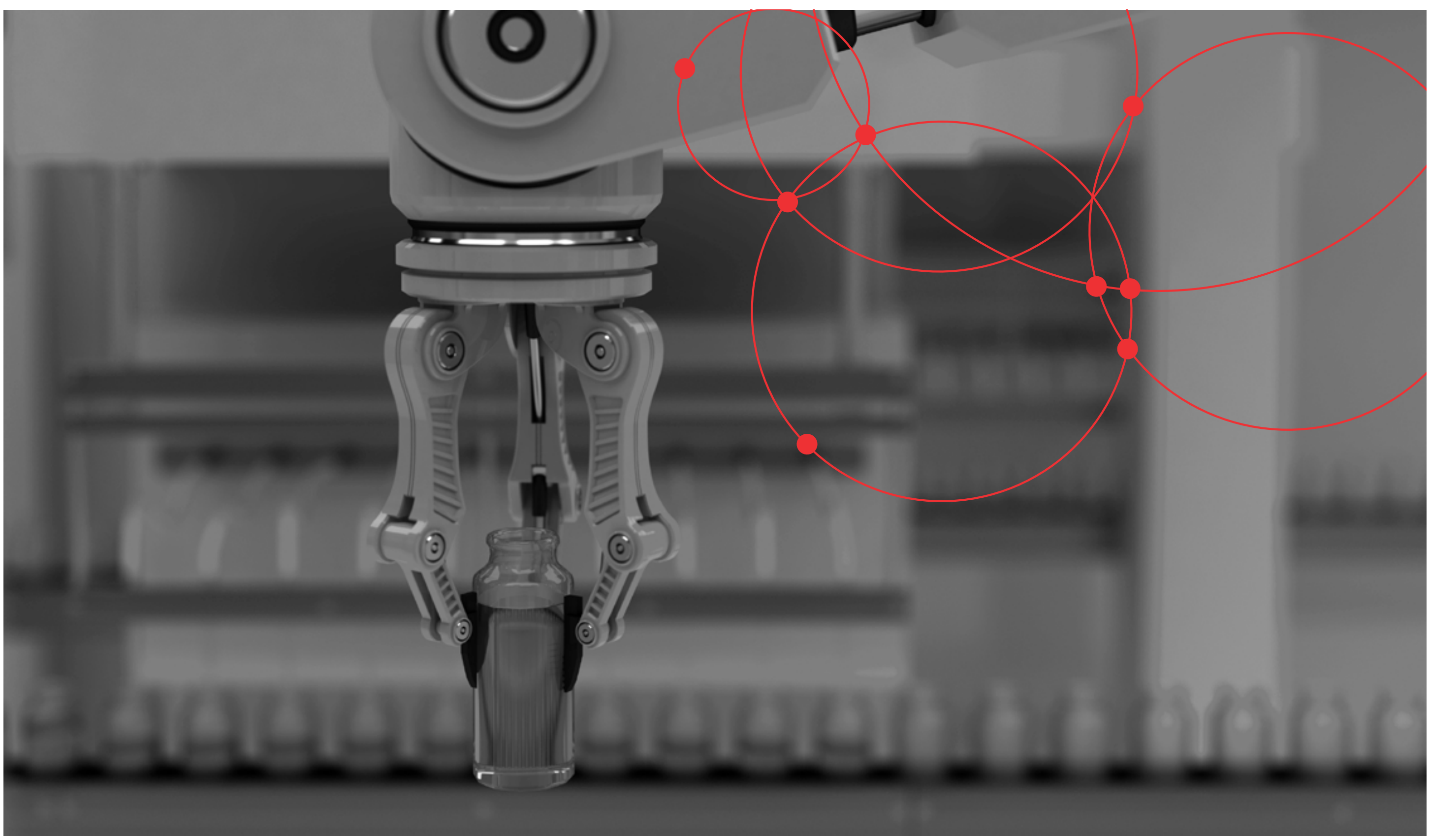


The challenges of digital transformation

Digital transformation allows scientists to focus on more meaningful and scientifically valuable work. However, despite the many advantages, it is often very difficult for labs to seamlessly integrate changes in company culture, processes and technology.
A 2020 study* revealed the following challenges faced by many organizations:

Technological challenges

71% said that the current laboratory software prevents automation in the laboratory environment.

69% said the current data infrastructure prevents access to insights from lab work.

67% said that current equipment prevents automation of laboratory equipment at scale.

64% of respondents said that decision makers are not investing enough in intelligent connected technology.

People challenges

66% said balancing capitalizing on new technology opportunities while maintaining the legacy technology environment takes a lot of reskilling effort.

65% said the culture of innovation decreases as laboratory workers interact less often.

64% said that high-technology firms have highly skilled workers and it is difficult for some laboratories to compete.

64% said the organization is restricted in their ability to collaborate across different laboratories due to strict accreditation rules and regulations.

A commissioned study conducted by Forrester Consulting on behalf of Thermo Fisher Scientific, November 2020.

Case study: Connecting the scientific ecosystem at a top 20 global pharmaceutical organization

Background

It is important that data is findable, accessible, interoperable and reusable (FAIR). A global pharmaceutical company standardized their processes to ensure that their data was FAIR, by harmonizing and integrating existing tools, systems, and technologies across their chemical and pharmaceutical development organization.

The problem

The Chemical and Pharmaceutical Development (CPD) department, like many other organizations, was using six disconnected systems and over 1,000 disconnected instruments. As a result, there were large differences between sites and departments, heterogeneous IT landscapes and inconsistent laboratory information management system (LIMS) usage. Additionally, the reliance on paper documentation, with limited electronic support, made sharing, comparing, reusing, and processing data particularly difficult.

The solution

To create a single digital strategy that incorporated all systems and drove integration across existing instruments and software, the project leaders examined existing pain points and performed a multi-moment analysis to identify unknown bottlenecks in the process. As a result, they were able to create a workflow connecting all the major systems in their process (Figure 1) and determine a set of outcomes that addressed the needs of the business and the employees.

Thermo Scientific™ SampleManager™ LIMS, LES (Laboratory Execution System) and SDMS (Scientific Data Management System) was chosen to manage laboratory, data and procedural workflows. This implementation allowed the department to become a connected team. The implementation covered important workflows, such as:

- End-to-end sample management from preparation to certification
- Management of stability studies and testing such as content uniformity and dissolution
- Control of reagents and assets including columns
- Integration of instruments and instrument logbooks
- Development of drug product formulations

The result

The implementation had a transformative impact on the business; the department now has a system which connects LIMS, ERP, ELN, CDS and over 1,000 instruments. By improving integration, they increased their efficiency by 20% – with additional improvements in data quality and integrity.

Users reported improvements in data accessibility, more logical workflows and enhanced data management and traceability. Overall, the implemented system offered greater flexibility and through increased connectivity, the project brought benefits to the whole department by facilitating a seamless flow of information through the development, scale-up and manufacturing process, without introducing unnecessary changes.

Find out how integration technology can help you and your laboratory

Read the full case study here

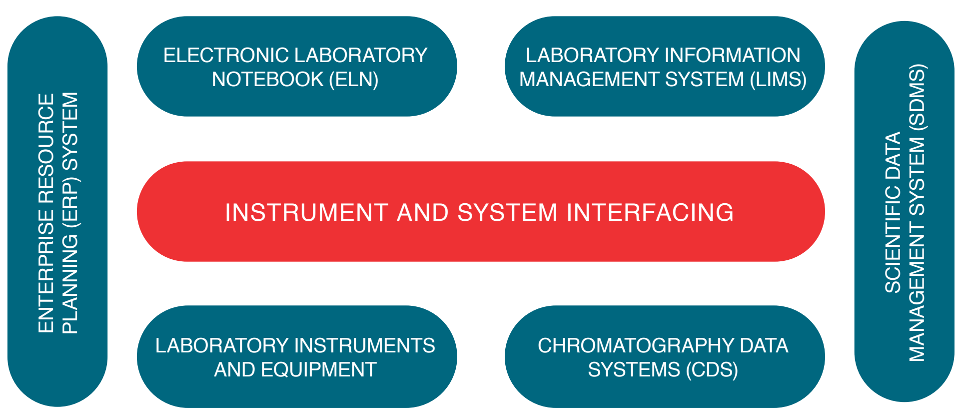


Figure 1. Instruments, equipment and legacy enterprise systems were connected to SampleManager software to create a complete, connected ecosystem.

The importance of digital transformation for industry

Digital transformation is reshaping every aspect of scientific research. While all industries will benefit from general improvements in ongoing processes, data integrity and instrument uptime, some industries will experience more specific benefits:

Pharma R&D

Reduced testing.

Machine learning provides insights on potential medicines.

Faster development.

Pharma QA/QC

Uninterrupted and secure supply chain.

More innovative, high-quality treatments.

Chem/petrochem

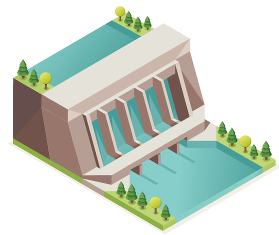
Reduced R&D testing.

Data analysis can provide insights into future compounds.

Metals/mining

Fully automated metals accounting process from exploration to production.

Machine learning used to automate core sample analysis.



Water and environmental

Complete traceability of all sampling from point of sample through to data archival.

Automatic checks against regional and national contaminant limits can flag issues.

Contract testing

Remote portals can register samples for testing, track analysis, and validate results.

Contract management simplifies workload and accounting.

Food and beverage

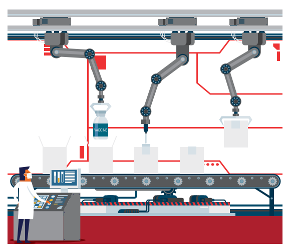
Automated HACCP testing and monitoring drives down costs and provides complete traceability from farm to fork.

Forensic testing

Unquestionable chain of custody and data integrity from sample acquisition through to reporting.

R&D

AI and machine learning predicts outcomes to discover potential products faster from previously untapped data.



Manufacturing

In-line testing and connection between the lab and production enables continual improvements and faster product release.

Case study: A digital revolution in the pharmaceutical industry

Although digital transformation is necessary to connect global teams and partners and avoid the creation of data silos, the biggest driver for pharmaceutical companies is placing new, possibly life transforming treatments into the hands of patients as quickly as possible.

A digital strategy is not only important for the research, development, and manufacturing process but also for patient connectivity. Companies are under enormous pressure to be more transparent, and creating a connected digital ecosystem enables them to do so.

Optimizing data security

Data security – particularly for patient data – is a top concern for stakeholders when moving to the cloud. Amazon Web Services (AWS) provides best-in-class security capabilities and services that increase privacy and control network access. The key components for implementing a well-architected cloud environment include:

- Operational excellence
- Security reliability
- Performance efficiency
- Cost optimization
- Ensuring regulatory compliance

It is important that new digital systems comply with regulatory requirements for electronic data systems; using thoughtful implementations supports compliance with regulations while providing a mechanism for streamlining the audit process.

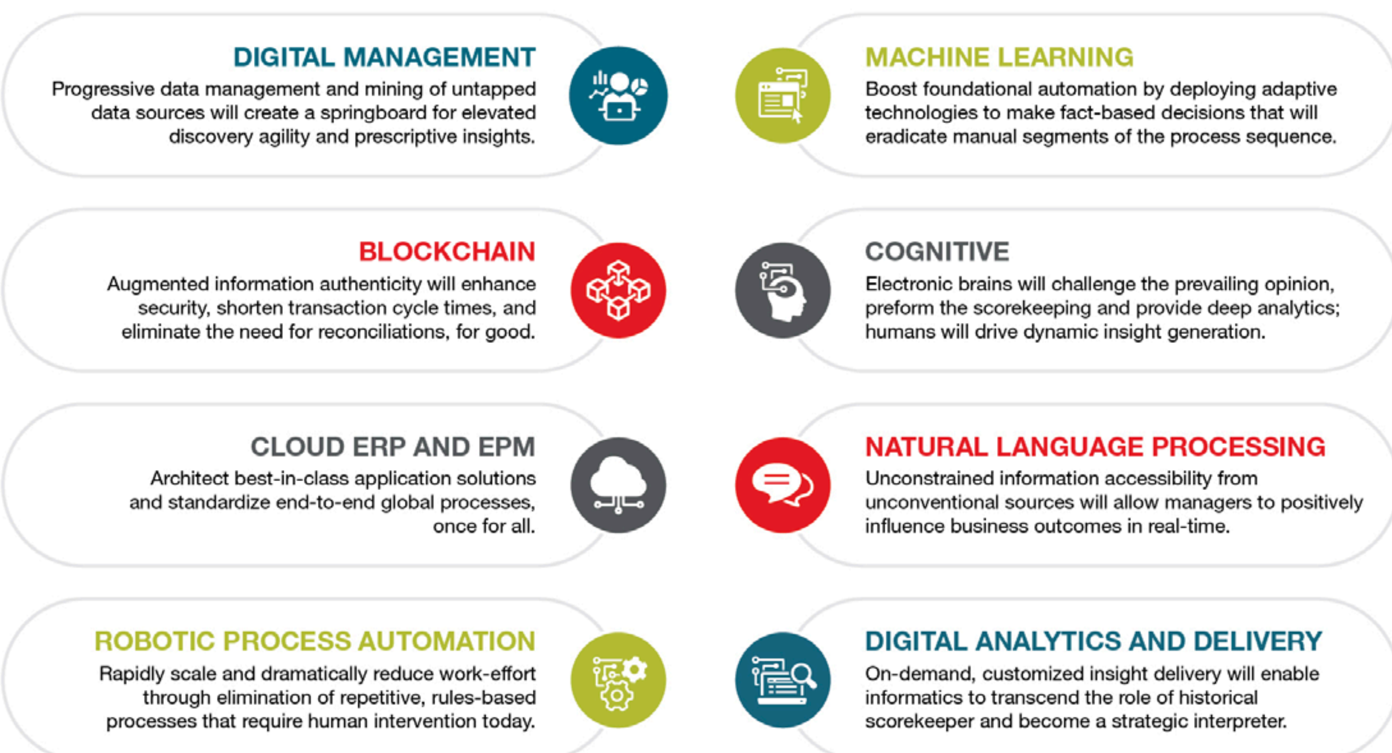


Figure 1. Technology disruptors that deliver innovation.

The implementation of laboratory information management systems (LIMS) into the drug development process, allows researchers to provide audit records for sample management, assay performance and execution, equipment management, and assay approvals quickly and more easily. Whereas, during the manufacturing process, blockchain can be used to track and trace drug product and raw materials throughout the supply chain process, reducing the complexity of adhering to the Drug Supply Chain and Security Act (DSCSA).

Innovative digital solutions

The American Pharmaceutical review outlined eight disruptive life science technologies that deliver innovative value for businesses:

The first step in implementing a connected digital ecosystem should be to set goals, and evaluate current challenges and digital enablers. Figure 2 shows an example of goals, challenges, and digital enablers that a pharmaceutical company may identify for R&D and manufacturing processes.

Pharmaceutical companies need to embrace digital transformation to ensure that they are innovative, address patent expirations, reduce R&D costs and manufacturing, whilst being a connected business.

Read the full case study here

Table 1. Breakdown of goals, challenges and digital enablers.

Goal	Current challenges	Digital enablers
More agile R&D process	• Getting drug to the market is a long and expensive process • Data within R&D teams is siloed and not easily accessible, slowing knowledge share/transfer • Filtering through genomic data to find relevant information is time consuming • Biosimilars are reducing profits made by large pharmaceutical companies	• AI • Big data • Data lakes • Platform technologies • IoT • LIMS • Automated workflows • Digital analytics • Cloud technologies
Streamlined manufacturing	• Manufacturing and supply chain operate in silos • Data sharing across stakeholders and process is limited • Maintaining documentation and processes to meet regulatory standards	• AI • Big data • IoT • Cloud technologies • Blockchain • Digital analytics • LIMS • Automation

Case study: The role of digital transformation and laboratory orchestration platforms post-COVID-19

The COVID-19 pandemic has highlighted the need for imminent digital transformation in laboratories, especially in the pharmaceutical industry. A recent report indicated that for 77% of CEOs, the COVID-19 pandemic has significantly accelerated their digital transformation plans.

The impact of the pandemic on digital transformation in the life sciences industry

Due to patent expirations and the overwhelming cost of research and development (R&D) programs, pharmaceutical companies are being forced to find ways to shorten timelines.

The implementation of a laboratory information management system (LIMS), scientific data management system (SDMS), electronic laboratory notebook (ELN), and laboratory execution system (LES) with advanced data visualization capabilities can offer significant benefits for laboratories wanting to improve their connectivity. However, there is an increasing need to consolidate existing systems and data workflows to meet the needs of large organizations.

Life science and pharmaceutical organizations are prioritizing data as a strategic asset. Data transformation can be driven by laboratory orchestration engines. These engines are comprehensive platform solutions that (regardless of vendor) use transformational data layers to connect services, instruments and equipment, consumables and reagents and people.

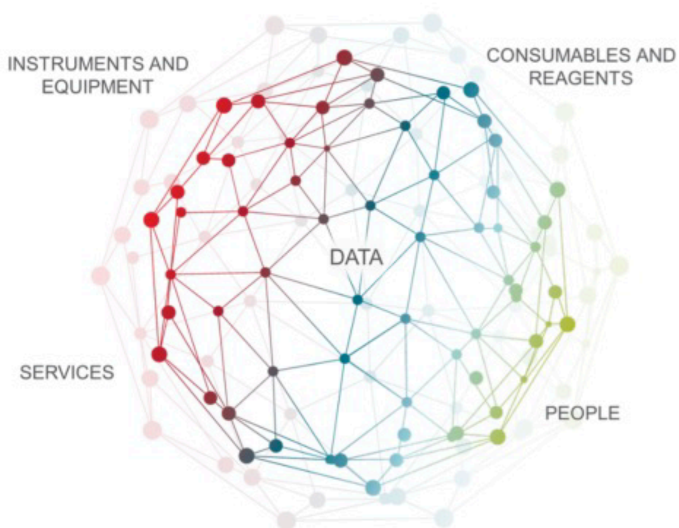


Figure 1. The five main components of the laboratory to consider connecting within a digital transformation strategy

This capability differentiates platform technologies from traditional integrated LIMS offerings (figure 1).

Visionary leaders in digital transformation

For successful execution of a digital transformation strategy, a partner is needed who can guide your organization in creating a connected ecosystem, serving as a strategic collaborator, and executing on the implementation of a laboratory orchestration platform.

Thermo Fisher Scientific is currently developing technologies that connect disparate software systems and laboratory instruments to provide a workflow engine for laboratory processes. Customers will have the ability to orchestrate and automate workflows, store data from multiple business systems in one location, monitor experiments in real time, and completely visualize and manage data. With these capabilities, Thermo Fisher is uniquely positioned to support its customers with a vendor agnostic platform approach to laboratory orchestration.

Read the full case study here

Case study: Accelerating the future of scientific progress through digitalization and laboratory automation

Background

Automation is vital for any laboratory looking to increase efficiency, maximize capacity, and enable processes that are not feasible using traditional, manual methods. By removing the human element of many daily processes, automation can significantly reduce errors and subjectivity, which in turn makes such processes more reliable and reproducible.

Three pillars of laboratory automation

Laboratory automation fundamentally helps drive the speed of discovery. The three foundational pillars (Figure 1), enable labs to achieve digital transformation and deliver automated science.

The three pillars comprise of lab automation, digital solutions, and artificial intelligence. While an automated laboratory often relies on physical automation (such as analytical instruments, automated reagent supply and robotic sample handling), they can be also connected through digital solutions (including laboratory information management systems (LIMS), electronic laboratory notebooks (ELNs), internet capable devices and dedicated connectivity tools, such as Thermo Scientific Momentum workflow scheduling software). An intelligent laboratory is one that uses artificial intelligence (AI) and machine learning (ML) to drive discovery and push science forward.

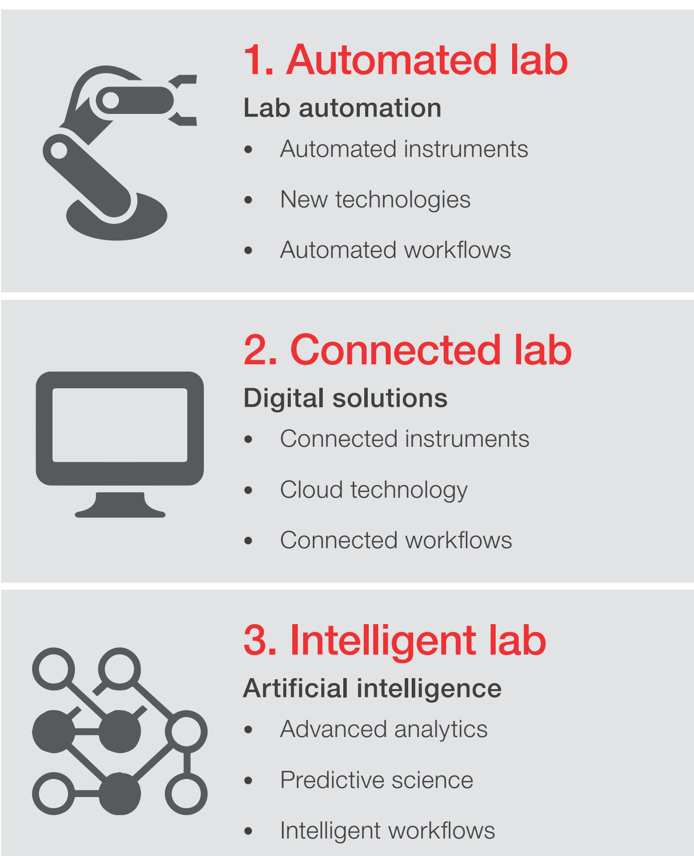


Figure 1: The three pillars of automation

Using digitalization to drive automated science

The second pillar – connected lab – is essential in driving automated science. However, digital solutions are dependable on data being FAIR, i.e., findable, accessible, interoperable, and reusable. Internet of things (IoT) technologies provide tools that generate huge volumes of research data and metadata, whilst integrated physical and digital automation allows facilities to collaborate under standardized conditions, using reliable high-quality data, that can be shared and accessed across different platforms. Strategically driven laboratory automation requires effective change management and implementation and configurable solutions that can be adapted for multiple purposes.

From scope to implementation – choosing the right vendor

An automation vendor takes a laboratory's goal and turns it into reality.

When considering the right vendor, you should consider the following:

- Does the vendor understand your science?
- Can the vendor provide training for a wide range of people?
- Does the vendor have the necessary solutions for a multi-disciplinary application?
- Is there post-installation service and support for all users?
- Can this vendor help reduce environmental impact?

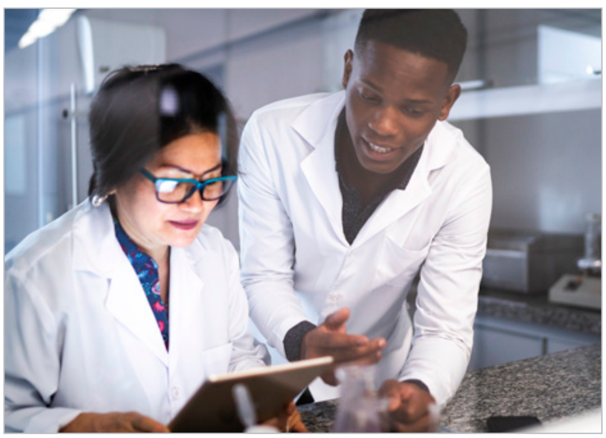
Find out how automation can help to future-proof your laboratory

On-demand resources

How data integrity is your first step toward a Pharma 4.0 strategy

Watch this webinar to gain further insights into:

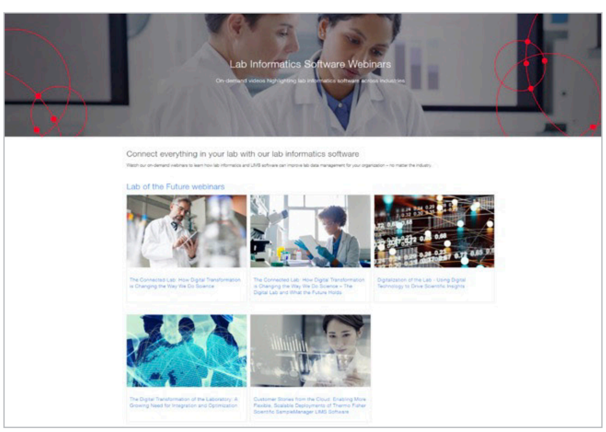
- Why manufacturing innovation is critical to maintaining a robust global supply chain
- The importance of data integrity in achieving Pharma 4.0
- How to overcome technical challenges to innovation in pharmaceutical manufacturing
- Digital transformation insights from a world leading CDMO



The orchestrated lab webinar series

The orchestrated lab webinar series explores topics such as:

- Automation and cloud capabilities
- Connected laboratory workflows and infrastructure
- Artificial intelligence
- Leveraging data



Lab of the future webinars

Watch these on-demand webinars to learn how lab informatics and LIMS software can improve lab data management for your organization across many industries, including:

- Pharma and biopharma
- Food and beverage
- Genomics
- Mining
- Oil and gas

Benefits of using SampleManager LIMS software for customers

Watch this video to learn how customers are benefiting from SampleManager LIMS.

Benefits of using SampleManager LIMS software for scientists

Watch this video to learn how SampleManager LIMS is benefiting scientists.

Future benefits of using SampleManager LIMS software at Thermo Fisher pharma services

Watch this video to explore the impact of SampleManager LIMS on the future of pharma.

Organizational benefits of using SampleManager LIMS software at Thermo Fisher pharma services

Watch this video to learn more about the organizational benefits of implementing SampleManager LIMS software.

Digital transformation strategy

Read this blog to discover how to create and implement a comprehensive digital transformation strategy.

Automated science to create the lab of the future

Read this blog to learn more about:

- The drivers for automated science
- The key steps to digital transformation
- The roadmap to the lab of the future

From strategy to action: How to accelerate your lab's digital transformation

Read this blog to explore:

- The barriers to a connected lab
- How to build a connected scientific ecosystem

Learn more at **thermofisher.com/informatics**