2022 Laboratory Informatics

Progress Snapshot on

Enabling the Digital Lab of the Future

astrix

Contents

Executive Summary

From the adoption of electronic laboratory notebooks (ELN) to fully-converted cloud-based data storage, the steps toward achieving a Lab of the Future (LoF) are numerous and involve changes at both the organizational and individual levels that can—at best—take many months (if not years) to complete but can deliver substantial gains leading to impactful innovation. Moreover, as business analysts have observed, when demands for metric improvement confront the often-limiting realities of funding, and human behavior, the result can be somewhat frustrating to everyone from enterprise leaders to laboratory bench technicians.

This report assesses the progress achieved and plans for near-term activities among laboratories in six subsectors within the broader classification of Life Sciences organizations:

- Biotechnology
- Biomedical Research
- Clinical Research Institutions
- Contract Manufacturing Organizations
- Contract Research Organizations
- Pharmaceutical Research and Manufacturing

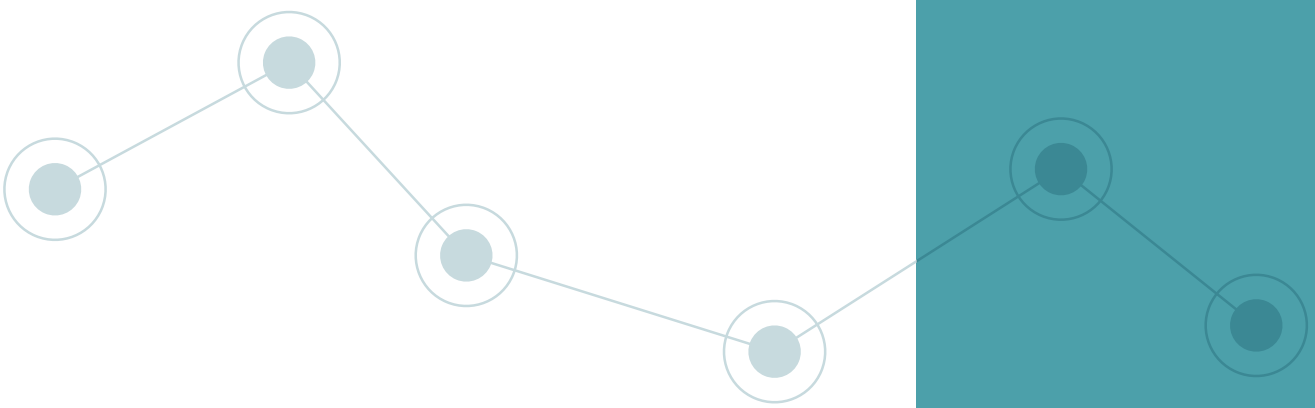
Combined, these six enterprise types comprise the majority of laboratory environments and missions among the Life Science professionals participating in this year's survey.

"2022 is a year to be bold. The old ways of working no longer work. The future is up for grabs. Leading firms will use the crucibles of 2020 and 2021 to forge a path to an agile, creative, and resilient tomorrow."

– "Predictions 2022", Forrester Research[1]

"Core to a LoF strategy is treating lab-related information as an essential asset. This is accomplished by linking lab data and activities across platforms and diverse business processes, while expanding into new ecosystems."

– "Your Lab of the Future Strategy", Gartner[2]



To gauge a laboratory's status in comparison with others of its type requires an informed understanding of the pace of change in the world of laboratory operations, so a sense of perspective is essential. The evolution of data collection, from mechanical pencils and clipboards to wirelessly-connected and cloud-enabled electronic tablets, may be breathtakingly rapid from a distant vantage point but—within individual organizations—there are typically unevenly-paced movements toward modernization impacted by realities of organizational change that are common, according to laboratory professionals who shared their experiences through our survey.

There are numerous models through which we can view the process of personal and organizational change. As many experts in organizational psychology and management observe, it is possible—and even helpful—to examine organizations in human terms because they are led by—and comprised of—people in various social situations. Through the process of evaluating our survey responses, we have concluded that movement towards a Laboratory of the Future is evolving in a non-linear path that is similar to the way in which psychologists explain the adoption of new technologies and behaviors such as the Transtheoretical Model, which posits movement through five stages of change:

- Precontemplation
- Contemplation
- Preparation
- Action
- Maintenance

– "Stages and processes of self-change", Prochaska and DiClemente[3]

"Digital transformation is not just about technology. It's the necessary but challenging journey of operating digital-first with the speed and nimbleness to change rapidly, exploit technology to create lean operations, and free people to do more complex tasks."

—Forrester[4]

A Model for Staging Modernization

We have developed the following process to illustrate what we are seeing among laboratory professionals:

Awareness, Interest, Consideration, Investigation, Information Gathering (Shopping and Selection)**, Acquisition** (Purchase)**, Installation, Training, Adoption/Conversion, Implementation,** and **Prevalence** (throughout the organization)**.**

These stages describe the process of modernizing an operation and, irrespective of size, appear to be common to laboratories across the spectrum of type, function, and setting represented in this snapshot.

> ***"Early Adopters, a term coined by Everett Rogers in his work on Diffusion of Innovation (DOI) Theory, describes how innovations are initially perceived as uncertain and even risky."***
>
> —"Diffusion of Innovations", Everett[5]

We see that early adopters of Lab of the Future technologies, sometimes driven by economic necessity, are predominantly enjoying real and positive impacts on their operations thanks to continuous innovation in technology. However, even professionals in the most sophisticated and well-funded laboratories are aware that progress is needed to fully capitalize on the breadth of capabilities afforded by tools designed to deliver on the promise of a Lab of the Future (LoF).

Further back in the arc of adopting new processes, among "Fast Follower" laboratories that have implemented a few key technologies earlier on the road to a LoF environment, progress becomes less clear-cut. While migration to cloud-based data storage and distribution—perhaps *the* essential step toward the full realization of LoF capability—is well underway among most of the participants in this year's survey, there are significant disparities in the progress of implementing or modernizing other mission-critical functions.

One hypothesis for the disparate rates of milestone achievement would be that an *absence* of legacy systems among younger organizations in the rapidly expanding Biotech sector has the effect of *fostering the acquisition and adoption* of LoF technologies. Meanwhile, those larger organizations saddled with older, legacy systems are prioritizing investments in digitalization to acquire technologies that can speed operations and enable increased capacity and competitiveness.

In the following table (Fig. 1), we depict the ways in which a company's size is apparently influencing (if not determining) both priorities for, and targeted outcomes of, investment in new technologies.

Company Size	Top priority driving digital transformation	Top outcome targeted under strategic plan
< 500	Enhance Regulatory Compliance	Increased productivity / throughput
500 – 1,000	Calculate, prepare, and disseminate results	Improvement in calculation errors (%CE)
1,001 – 10,000	Automate and manage lab processes	Improve data governance
10,000+	Aggregate and analyze lab data	Improve compliance

Fig. 1: Priorities driving digital transformation versus the top outcome targeted under strategic plan as a function of company size.

About the Survey Respondents

This annual market research report is based upon a survey conducted by Astrix in March 2022. The survey was completed by laboratory professionals from a wide cross-section of science-based industries, including:

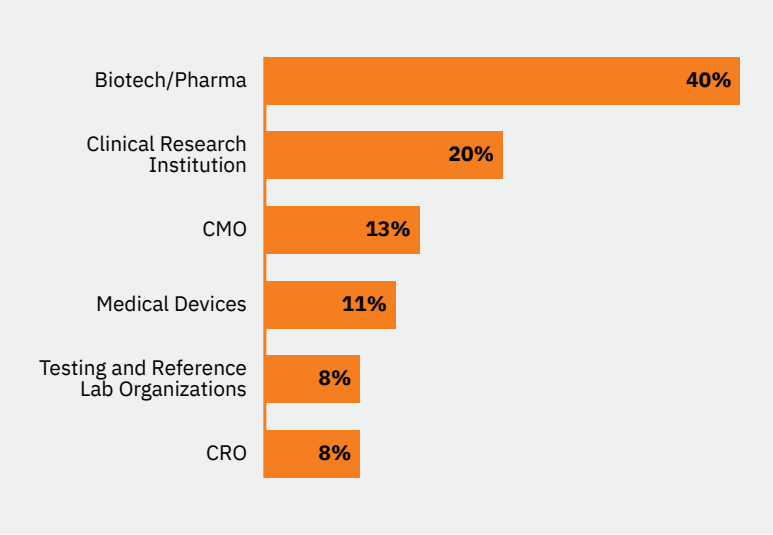
Biotech/Pharma
CRO/CMO
Clinical Care and Research

Consumer Products
Chemicals
Diagnostics

Food and Beverage
Government

1 Industries Represented

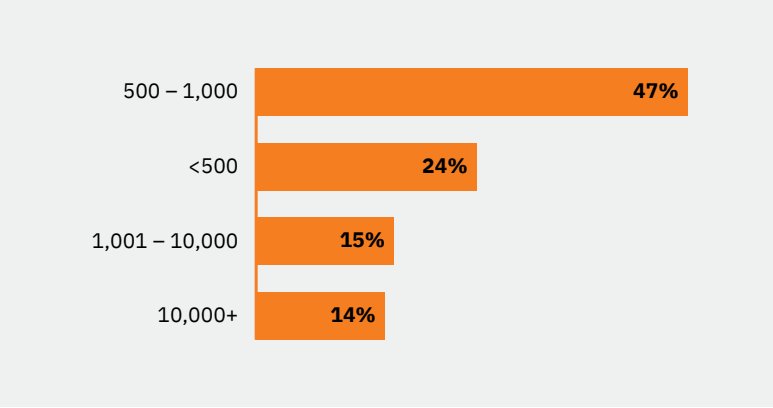
Professionals from at least 20 sectors participated in the survey, representing business, government, and academic laboratories. Within these 20+ sectors most survey participants focus on activities chiefly concerned with research and development to improve human and animal health. The influence of these respondents is magnified when professionals' input from other sectors are segregated. In this report we focus on the information obtained from respondent professionals in the six Life Sciences settings listed in the accompanying chart.



2 Size of Companies

With nearly half of respondents (47%) reporting their organization size as >1,000 employees, and nearly a quarter (24%) reporting size between 500 and 1,000 employees, the insights developed through this survey reflect the state of laboratory modernization among some of the largest facilities in the U.S.

We are pleased to have the representation of over a dozen of the largest (10,000+ employees) laboratory-equipped organizations, as well as some of the fastest growing in their respective sectors.



This is a substantive pool from which to report on status, perceptions, and plans for progress toward fully realized Lab of the Future capabilities. We are confident that the views expressed by the laboratory professionals who contributed their input to this study, provide a snapshot of the state of laboratory informatics that is, at the time of this report's release, reliably illustrative.

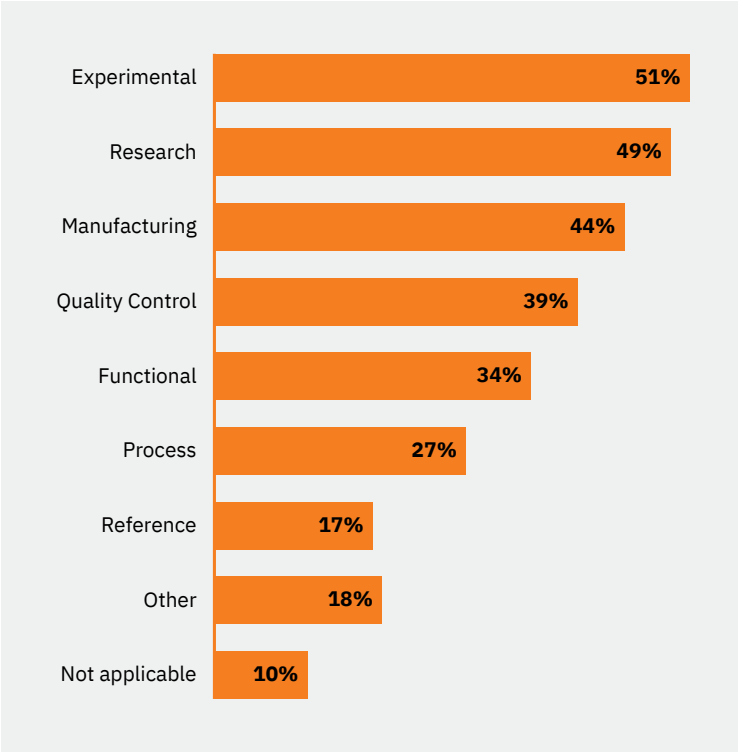
3 Types of Laboratories

(Checked all that applied)

Since laboratories in all sectors can be tasked with, or fully dedicated to *research*, it is important to note that elements of research work can—and often do—entail multiple functions including experimentation, other foci, and tasks.

We are pleased to see that, among the various roles in which our laboratory professionals are engaged, Research (49%) is second in prevalence to Experimental (51%), with Manufacturing (44%) and Quality Control (39%) rounding out the top four most prominent types of laboratories contributing their input to this survey.

The survey team reviewed the composition of various national associations and trade organizations in each of seven categories to select the *types* of laboratories offered to participants to choose the lab classification that would best describe their organization. Given the nature and scope of our snapshot, respondents were not limited to a single, or chief, function. The result enabled participants to select the multiple functions in which their labs are engaged at the time of the survey.

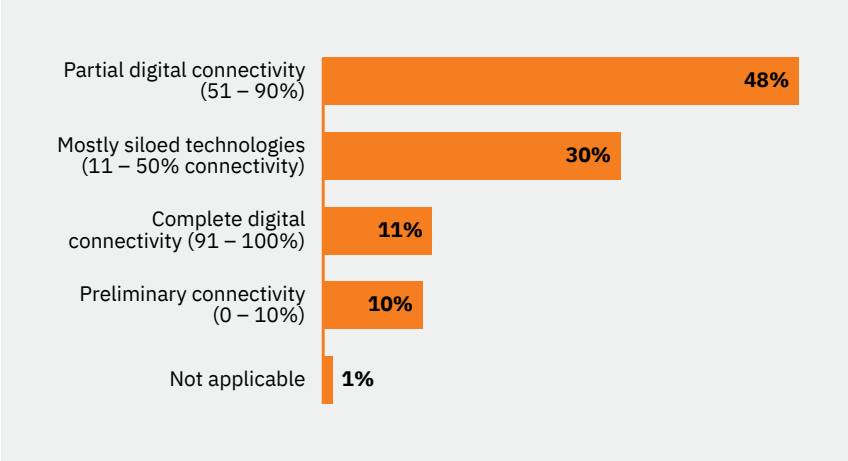


The Current State of Digital Connectivity

This report provides a snapshot of the state of laboratories in Life Science-based organizations as they consider, implement, and increase steps to modernize operations via digitalization and the adoption of new technologies designed to capitalize on advancements in data capture, collection, storage, retrieval, secure transmission, and integration with other processes. The findings are based solely on the facts and opinions as provided by laboratory professionals in their pursuit of progress towards achieving the digitally enabled Lab of the Future in the Life Science sector.

4 Organizations self-reported status as a digitally connected lab informatics platform

Eleven percent of the respondents in our survey report that they have completed their laboratory's digital connectivity (11%). Those lab professionals reporting partial connectivity (48%) or a mostly siloed connectivity (30%) comprise the largest segment of participants.



Considering that 10% of participants report having achieved preliminary connectivity (between zero and 10% connectivity), it appears from our survey that most laboratories are enjoying some benefit from their investment in connectivity. This would be consistent with what is likely a rolling implementation process based upon the prioritization of investments that can positively impact laboratory capacity, speed, and reporting of data.

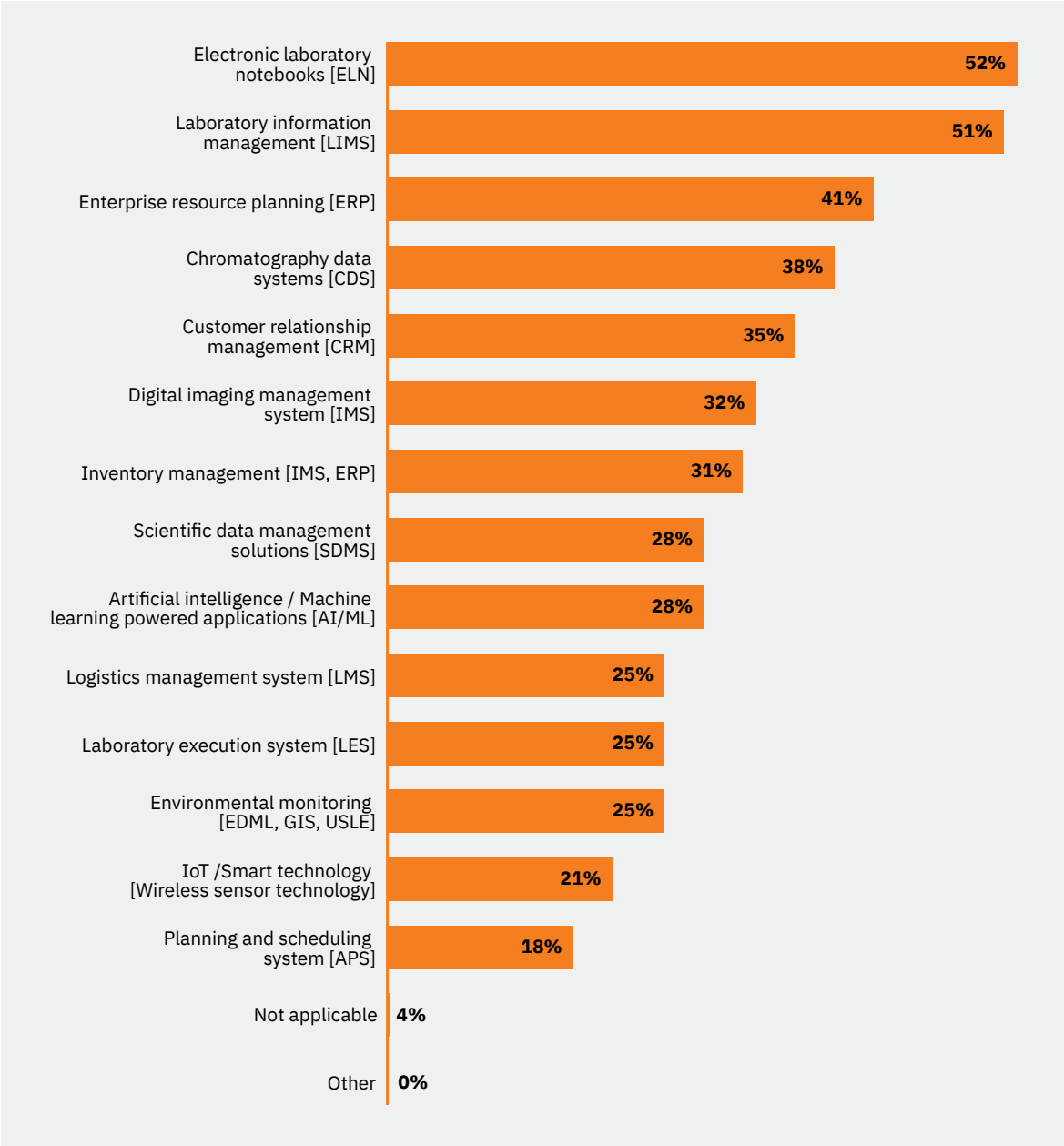
5 Technologies in place today at respondents' facilities

(Checked all that applied)

The predominant technologies in place across the Life Science-based organizations surveyed include Electronic Laboratory Notebooks (52%), LIMS (51%), Enterprise Resource Planning (41%), Customer Relationship Management (40%), and Chromatography Data Systems (38%).

On the average, just over a quarter of our survey respondents had incorporated Artificial Intelligence/Machine Learning powered technologies (28%).

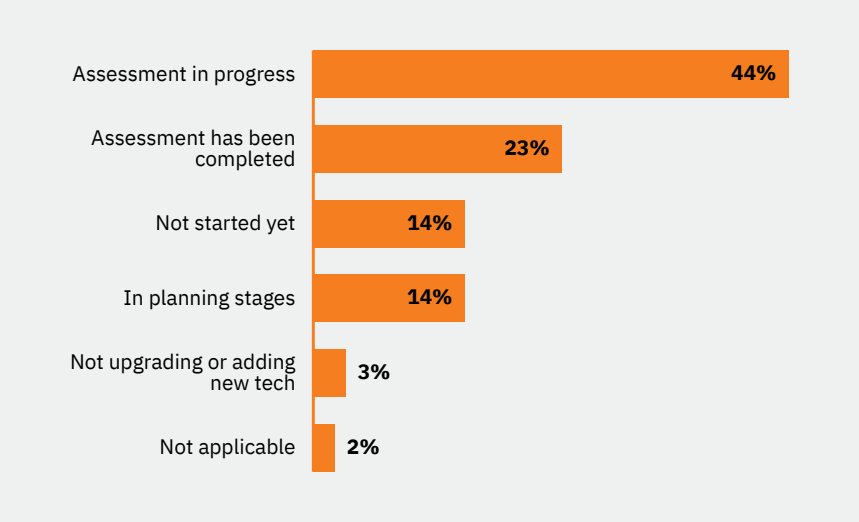
Interestingly, only a quarter of participants in our survey (25%) reported implementing Logistics Management Systems, Laboratory Execution Systems, and Environmental Monitoring (including EDML, GIS, and USLE), and only just over a fifth of our survey participants (21%) report utilizing Internet of Things (IoT)/Smart technology. It is noteworthy that, among our respondent pool, twice as many organizations report having implemented LIMS than LES, and relatively few have yet to implement wireless sensor enabled technologies. This would appear to indicate that digitalization is being introduced first in those areas where throughput volume had been the higher priority for investment than, for example, scientific data management.



Planning for the Lab of the Future

6 The extent to which organizations perform a measured assessment of priorities for advancing current state of laboratory technology

Over two-thirds of the survey respondents (67%) report having either started or completed a measured assessment of priorities for advancing their laboratory technology. Less than 10% of survey participants working in labs report that they are neither planning to upgrade or add modern technologies, and 14% have yet to begin an assessment—which could occur this year. Interestingly, only 3% of participants report that they have no plans to either add to, or upgrade, their technologies.

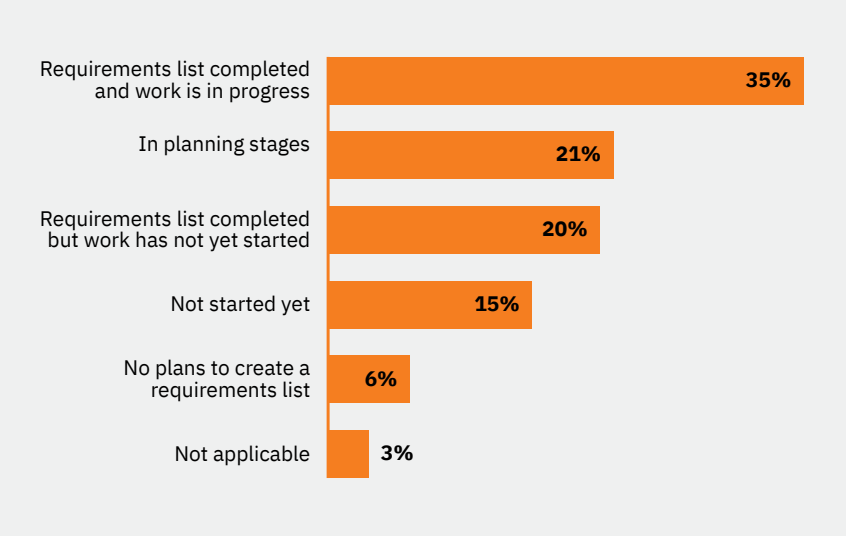


The key takeaway is that, for the majority of laboratories represented in our survey pool, 2022 portends a year of modernization characterized by acquisition and implementation of digitally enabling technology.

7 The extent to which organizations created a set of requirements for a digital lab of the future

Just over three quarters of our survey respondents (76%) report their labs are engaged in planning, preparation of, or have completed, their work in creating a set of requirements for a digital Lab of the Future.

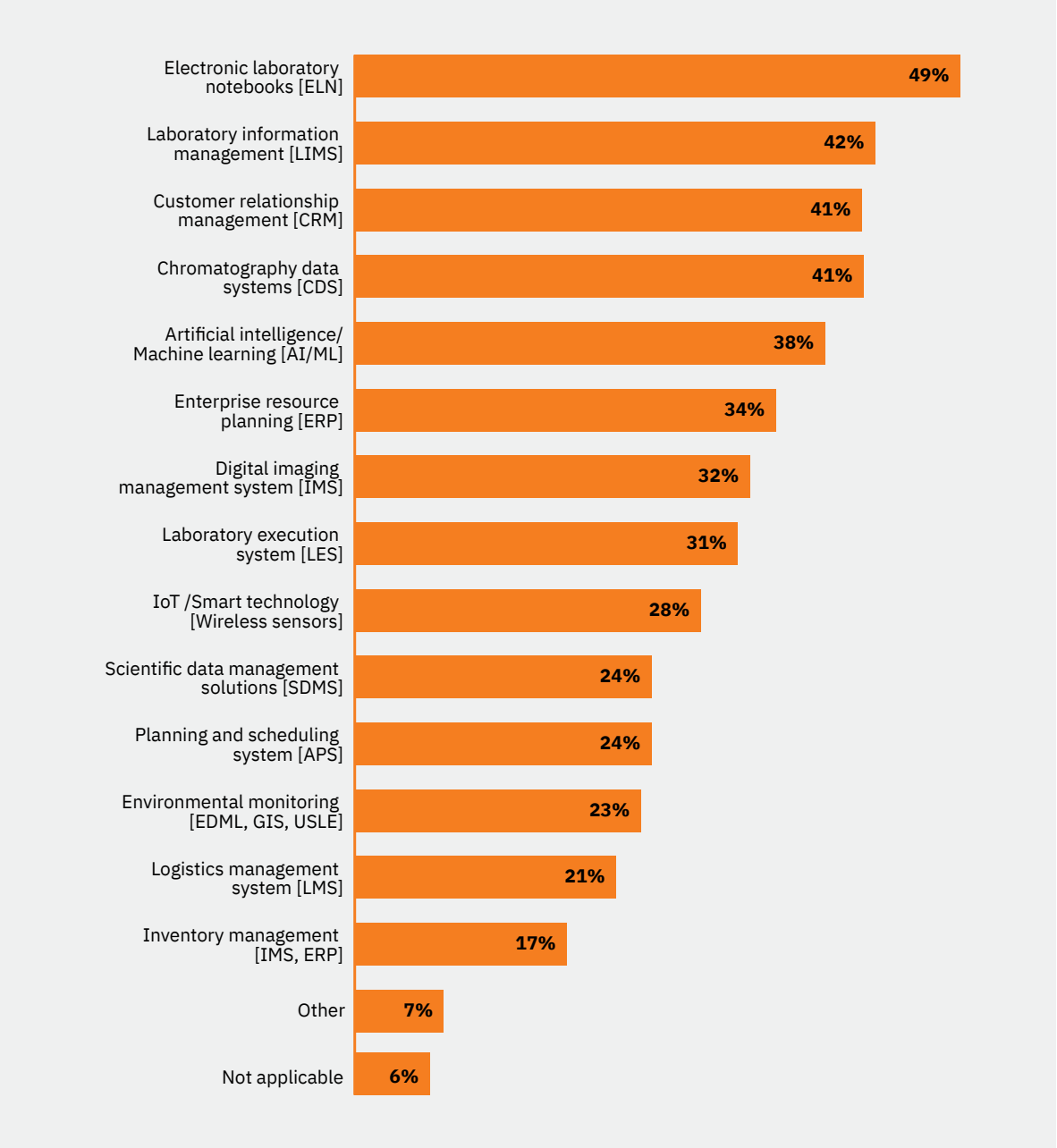
This is an exciting percentage and indicates that changes are well underway—with substantial progress having been made by over a third of our survey participants. Meanwhile, it appears that late adopters of modernization are likely to be highly specialized operations.



8 Systems planned for implementation or upgrade to better facilitate digital lab of the future initiatives (Checked all that applied)

Electronic laboratory notebooks (ELNs) are the top priority on the list of systems our survey participants report planning to implement or upgrade this year. Just under half of respondents (49%) plan to either upgrade or implement these systems.

Given that ELNs are an enabling platform for a burgeoning number of applications, it makes sense that these tools continue to lead the list of technologies (Fig. 2) in which laboratories are investing to modernize their processes and gain digital efficiency.



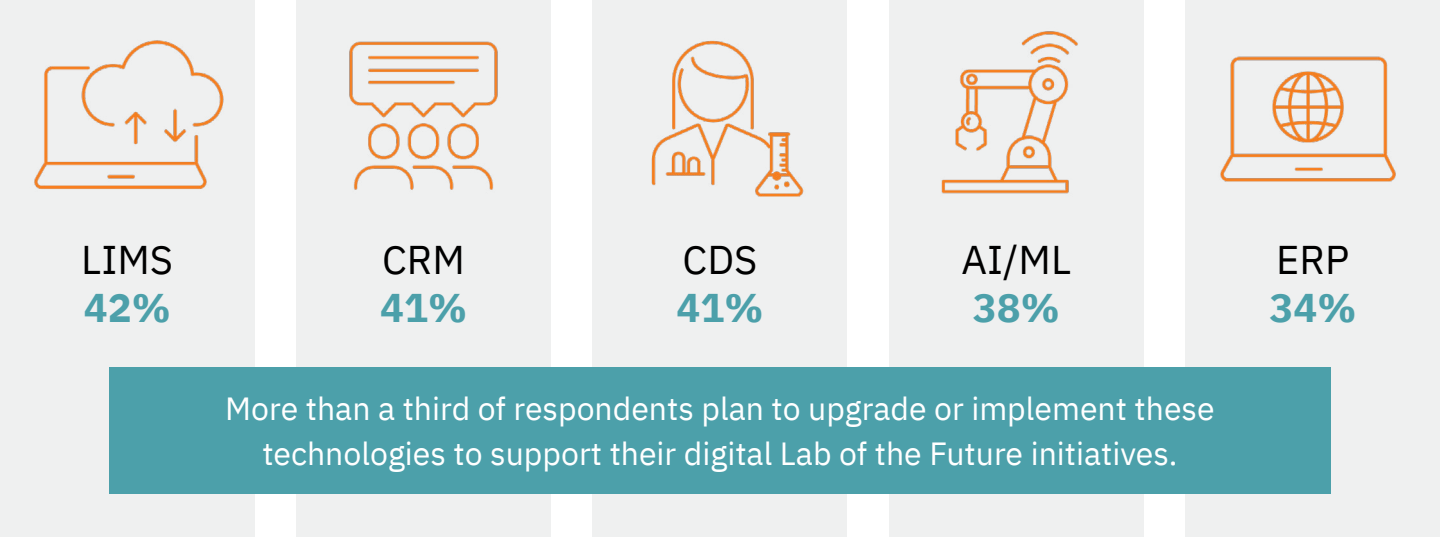


Fig. 2: The allocation of investments associated with specific technologies to support Lab of the Future initiatives.

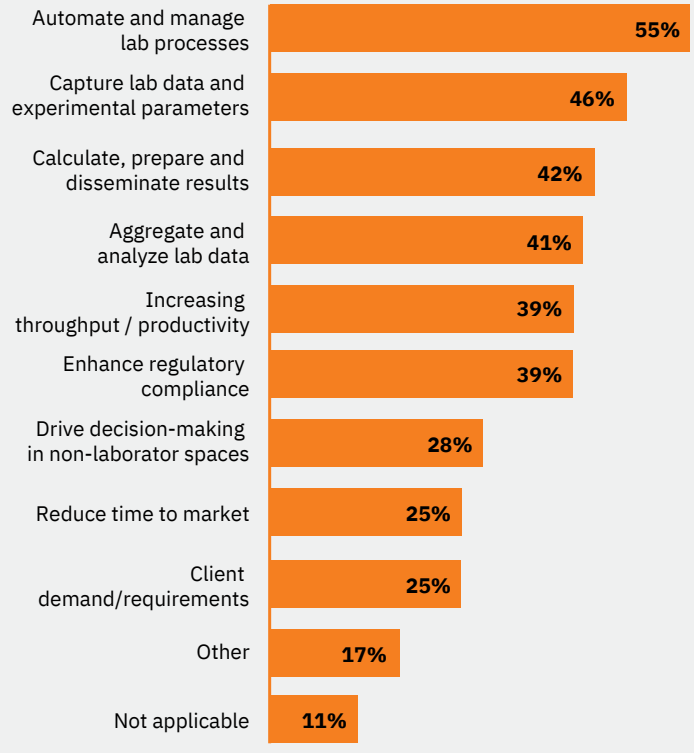
9 The priorities driving digital transformation initiatives

(Checked all that applied)

Among all priorities our clients have shared with us over the last year, which formed the basis of the survey presented to respondent lab professionals, 55% of the participants most often cited the need to automate and manage their lab processes as drivers of their digital transformation.

Second in prevalance to that priority, the need to capture both lab data and experimental parameters were drivers for 46% of survey participants.

In the second statistical grouping of organizational priorities driving investments in digital transformation, Calculation, preparation, and dissemination of lab results were selected by 42%; Aggregation and analysis of lab data were cited by 41%; Increasing throughput and productivity and Regulatory Compliance were all identified by 39% of laboratory professionals.



The disparity in priority, among the two drivers with the highest incidence in reporting and those factors cited by the least number of participants, is noteworthy because the least popular factors are more closely associated with production rather that research:

- Driving decision-making in non-laboratory spaces (28%)
- Reducing time to market (25%)
- Client demand/requirements (25%)
- Other drivers not mentioned (17%)

Reducing time to market, cited by 25% of respondents as a driver of digital transformation initiatives, may be attributed to the representation of lab professionals specifically involved in either research or production of products originating in their labs.

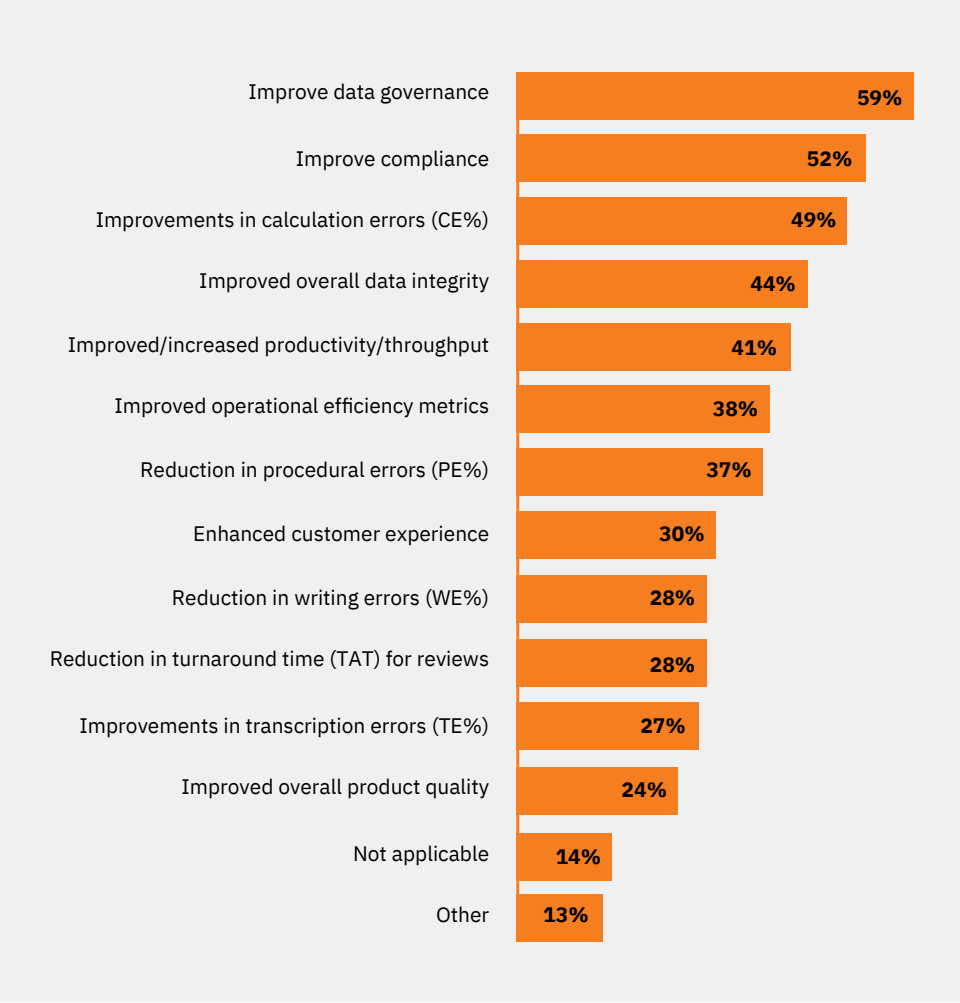
10 Outcomes targeted under current strategic plan

(Checked all that applied)

This question presumed the existence of a strategic plan for digital transformation in the laboratory, which many of our survey participants reported having in place. The top three outcomes identified by our survey participants were led by improvements in the following areas: data governance (59%), compliance (52%) and calculation error rates (49%).

These are the most prevalent goals among most life science lab professionals who shared their targets for modernization:

- Improving data integrity (44%)
- Improved/Increased productivity/throughput (41%)
- Improved operational efficiency metrics (38%) and
- Reduction in procedural errors (37%)



The stratified prioritization signals a secondary ranking in priorities that may not be fully addressed in calendar 2022 despite the possibility that newly installed digital platforms (or applications) may have capabilities that will be more fully integrated into lab processes once the more urgent functions have been normalized as Standard Operating Procedures (SOPs) among majorities of lab staff.

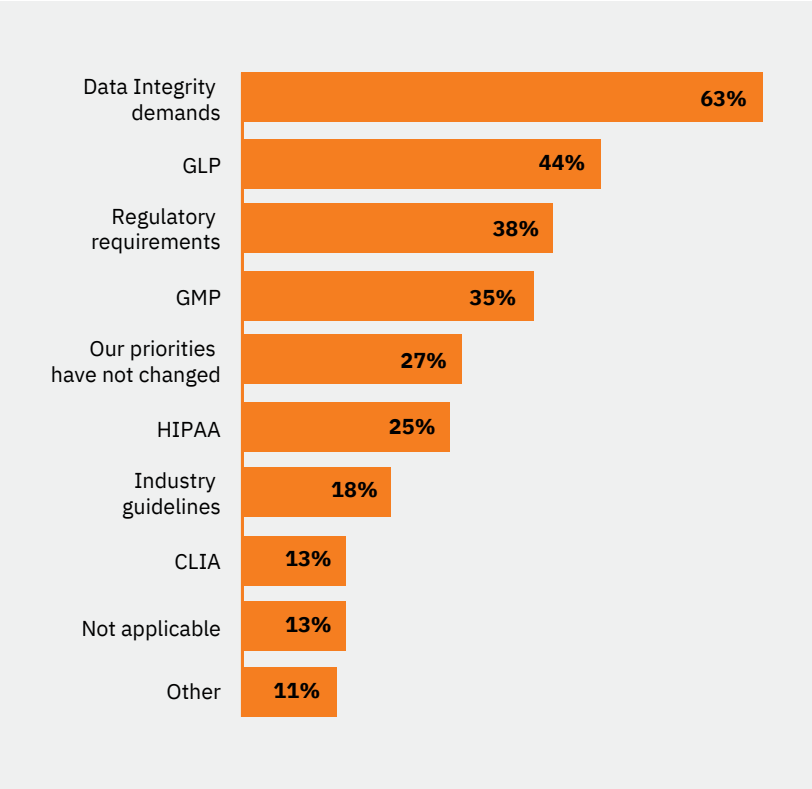
11 Organizational priorities that have changed, or requirements increased, for achieving or maintaining compliance

(Checked all that applied)

The driver most often cited across organizational types and missions, Data integrity (63%), reflects the need to initially obtain and record error-free, reliable data for use in automation and digitization of key functional and reporting processes.

Good Laboratory Practice (GLP) guidelines (44%), Regulatory requirements (38%), and Good Manufacturing Practice (GMP) guidelines (35%) represent the second tranche of organizational priorities—by prevalence—that survey participants report having changed.

Lab professionals with longstanding commitment to digitalization and automation—or at least those who have set down their priority-driven requirements in the prior years—are likeliest to be among the 27% of respondents whose priorities have not changed.



Health Insurance Portability and Accountability Act (HIPAA) requirements, impacting labs handling patient-identifiable data, are constant priorities for 25% of professionals participating in our survey while Clinical Laboratory Improvement Amendments (CLIA) requirements, impacting labs performing examinations of human specimens is a priority for 13% of our survey participants.

Industry guidelines, versus regulatory guidelines, represent priorities impacting decisions for lab modernization among 18% of the survey respondents. As with governmental requirements, industry guidelines continue to evolve in reaction to new standards, rules on quality, purity, and stability promulgated by public sector customers, partners, contractors, and competitors.

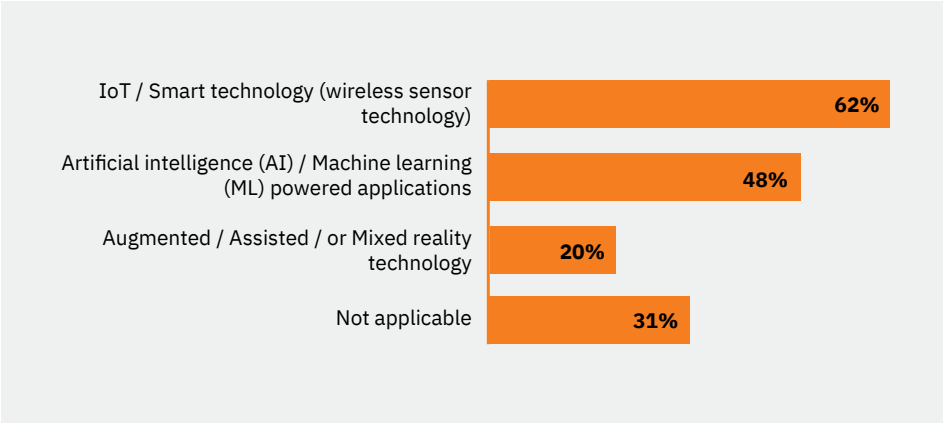
Regulatory Trends to Watch in 2022:

- Among **Biotech and Pharmaceutical companies with over 10,000 employees**, highest priorities reported are:
  - **Data aggregation**
  - **Automation**
  - **Data integrity**
- Among **Clinical Research Institutions with >10,000 employees**, highest priorities reported are:
  - Reduction in transcription errors (%TE)
  - Reduction in Procedural Errors (%PE)
  - Reduction in turnaround time (TAT)
  - CLIA compliance
  - Improved data integrity
  - Improved operational efficiency

12 Areas of investment associated with digital lab of the future initiatives

(Checked all that applied)

Specific to those lab professionals reporting Lab of the Future initiatives, which describes 76% of our survey participants, IoT/ Smart technology (characterized by wireless sensor-enabled) is the most popular area of investment among 62% of respondents.



Although 14% fewer survey participants report investment in Artificial Intelligence (AI) or Machine Learning (ML) (48%), than IoT/Smart Technology, it represents a rapidly growing field among lab professionals—especially in comparison to those 20% of respondents reporting investment by their organization in either Augmented or Mixed reality technologies.

In their recent report, **What Is Artificial Intelligence? Ignore the Hype; Here's Where to Start**, (March 15, 2022) Gartner analysts wrote,

> ***"Any AI strategy initiative must first focus on the organization's readiness. It must allow for learning and practical use, before embarking on a grand AI program. Engaging in an AI strategy without first experimenting with its component techniques is like putting the cart before the horse."***
>
> —"What is Artificial Intelligence", Gartner[6]

Among the majority of our survey participants, it is clear that the widespread adoption of wireless sensors (among other technologies enabling IoT and AI/ML) is well underway in Life Science labs—and likely in more operational, rather than experimental, deployments. As with so many sudden and formative changes in the workforce and workplace, the pandemic is seen as an engine of change over the last couple of years. In the same report, Gartner analyst observed that,

> ***"The COVID-19 crisis has accelerated a trend that we have been witnessing in the last few years. Organizations are combining different AI techniques to improve the efficiency of learning, to broaden the level of knowledge representations and, ultimately, to solve a wider range of business problems in a more efficient manner. We have dubbed this trend "composite AI."***
>
> —"What is Artificial Intelligence", Gartner[7]

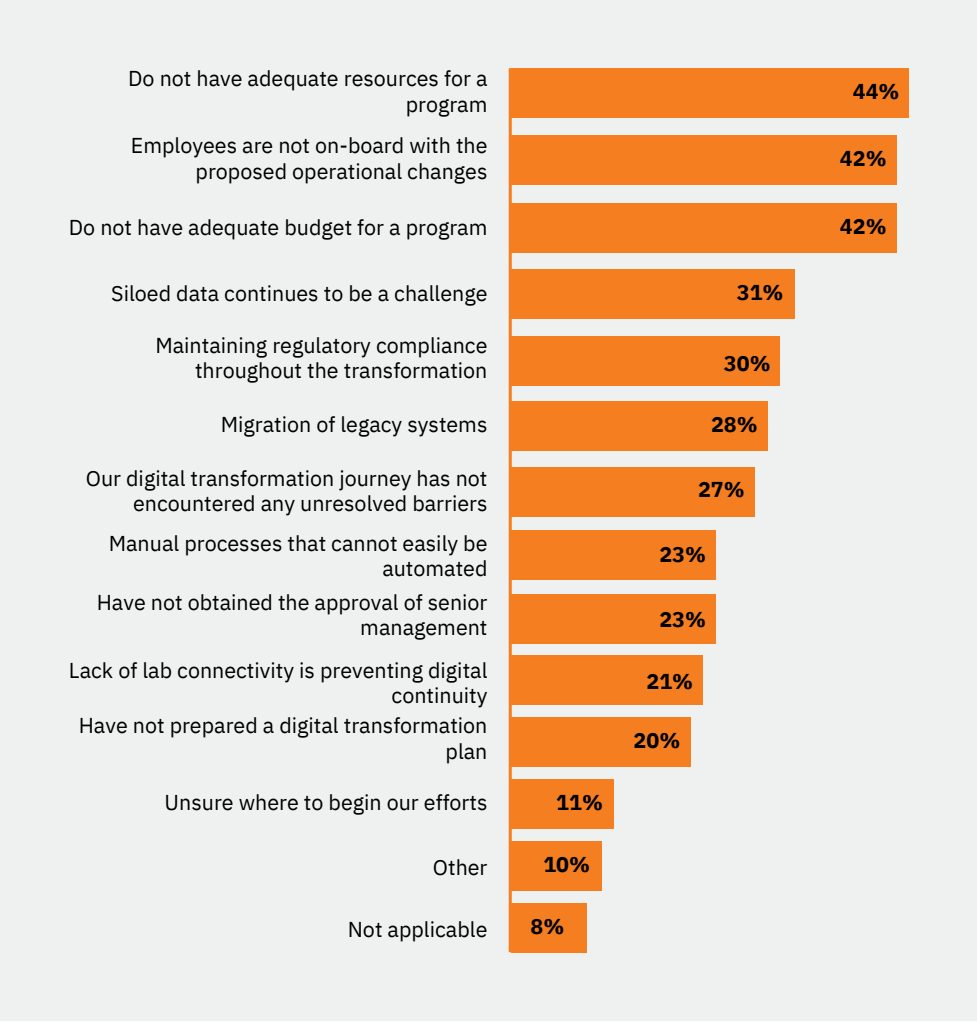
Digital Transformation Progress Assessment

13 Barriers to progress in implementing digital transformation plan

(Checked all that applied)

Lab professionals indicate a relatively wide variety of issues (typically in combination) which they consider to be impeding progress toward becoming a Lab of the Future. Less than a third of respondents (23%) believe that the nature of their work cannot be automated or digitalized. Nearly the same number (27%) report that they, in fact, have no unresolved barriers to progress with their digital transformation—which portends exciting progress for many of the lab professionals participating in our study.

In fact, only just over a fifth of respondents (21%) cite connectivity as a limiter to digital transformation planning. However, in terms of barriers either perceived or experienced by lab professionals, it is noteworthy that their planning and implementation are challenged by inadequate resources (44%), employee attitudes toward operational changes (42%), inadequate budget (42%), lack of senior management approval (23%), manual processes not easily be automated (23%) and the existence—and persistence—of data silos (31%).



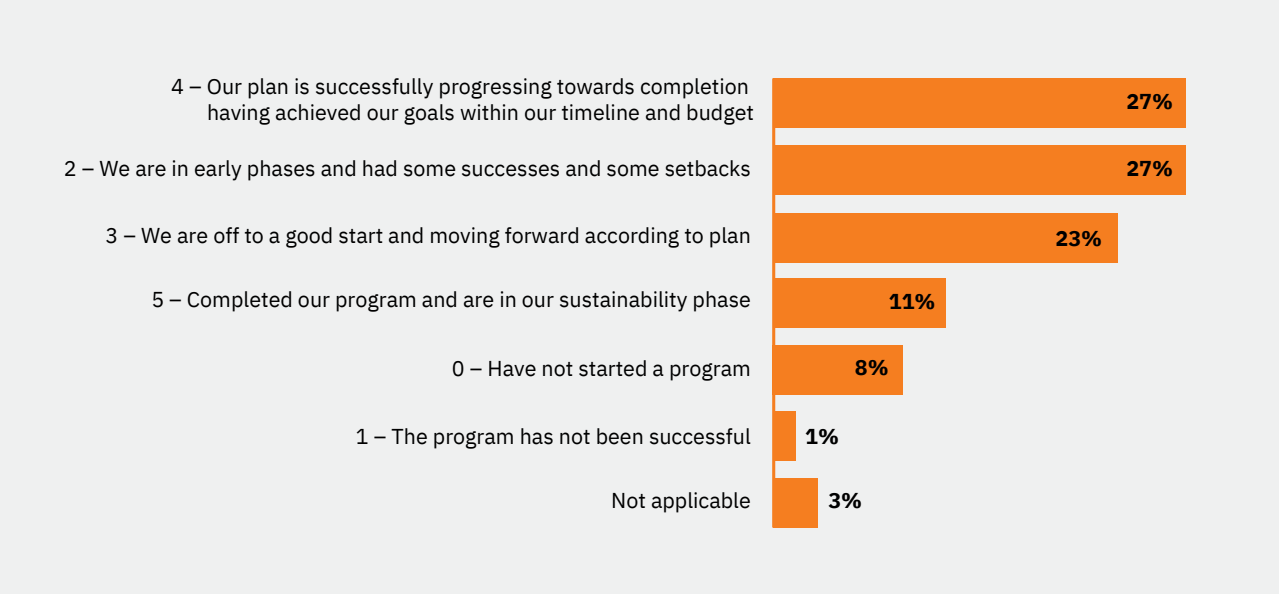
Migration of legacy systems is considered by a quarter of lab professionals in our survey to be one of—if not their largest—barrier to progress (28%). However, it is possible that this comprises several other issues associated with employee attitudes, management support (in the form of budget and approval), and the existence of siloed data in conditions that would make migration challenging for their organization—especially if (like 11% of study participants) they are unsure of where to begin their efforts at digital transformation.

Interestingly, while most respondent lab professionals do report initiatives underway, 20% report that they have not yet prepared a digital transformation plan. While budget, management commitment and employee cooperation may play substantial roles in preventing a plan from being started, there is evidence that some study participants (30%) believe that maintaining regulatory compliance is too important a status to risk damaging while undertaking a digital transformation.

14 Self-rating of organizational progress on digital transformation

Over two-thirds (88%) of the lab professionals participating in the survey report progress with their plans for digital transformation—although this spans a variety of sizes of initiatives. Some organizations represented among our participants have initiatives underway that are ambitious while others have described their initiatives as relatively limited in scope or focus—which may be the result of the various factors cited earlier in the survey (budget limitations, leadership support, time-based organizational priorities, and/or employee tolerance for change).

Half of the lab professionals reporting on their progress (50%) characterize their programs as successfully progressing (27%) or off to a good start and moving according to plan (23%). Virtually over a quarter of the respondents (27%) indicate they are in the early phases and had experienced some successes as well as setbacks.



Although it is true that a survey on digital transformation is likely to attract professionals engaged in their own organizational initiatives—or, at least, supportive of moves toward a Lab of the Future environment, data in third-party reports by firms such as Gartner support the findings of this survey that the majority of laboratories are actively engaged in some level of digital transformation.

Adoption of Cloud Technology

Cloud-native technologies will transcend all major technology domains, including:

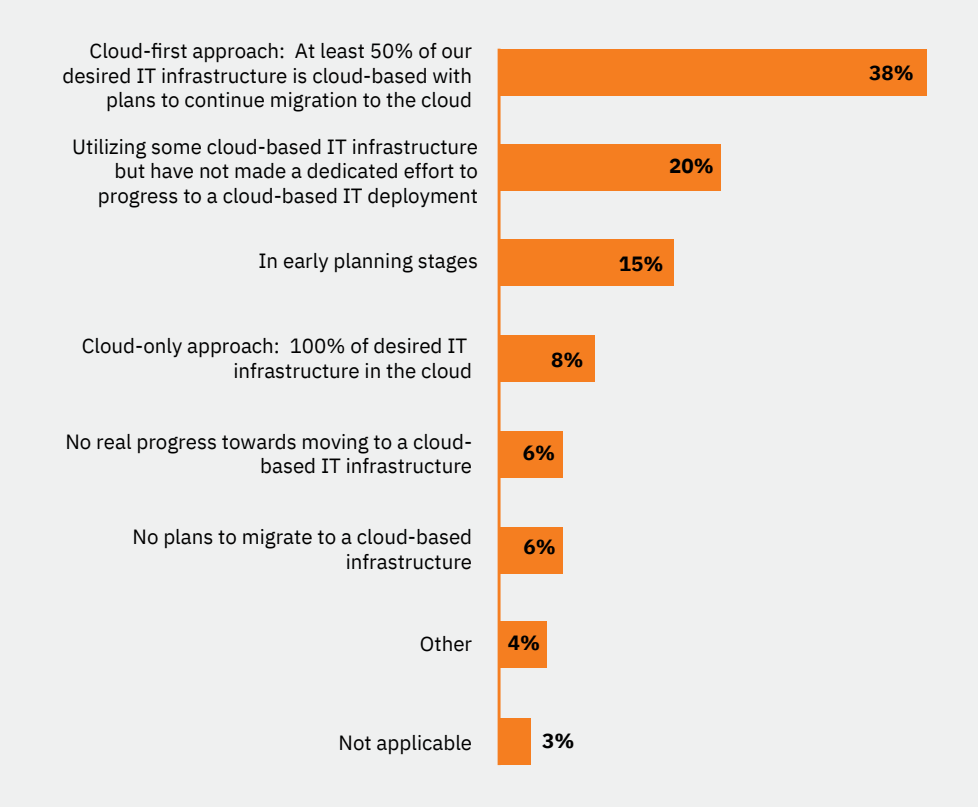
- **Big data** (distributed database, data lake, and Spark).
- **AI** (Kubeflow for ModelOps, Ray on K8s for distributed machine learning/reinforcement learning).
- **Internet of things** (EdgeX 2.0 refactoring toward microservices)

> ***"Rather than being supplementary or a nice-to-have, cloud-native will become the core of the cloud strategy in 2022 and moving forward."***
>
> —"Predictions 2022", Forrester Research[8]

15 Approaches toward adoption of cloud-based IT infrastructure

Over a third of the respondents (38%) report that they have migrated half—or more—of their desired IT infrastructure into the cloud. On the other end of the spectrum, 8% of Life Science lab professionals report that they have completed their migration to a cloud-only IT program.

Only 6% of the respondents have indicated they have not made real progress, or have no plans to migrate their IT infrastructure to the cloud.

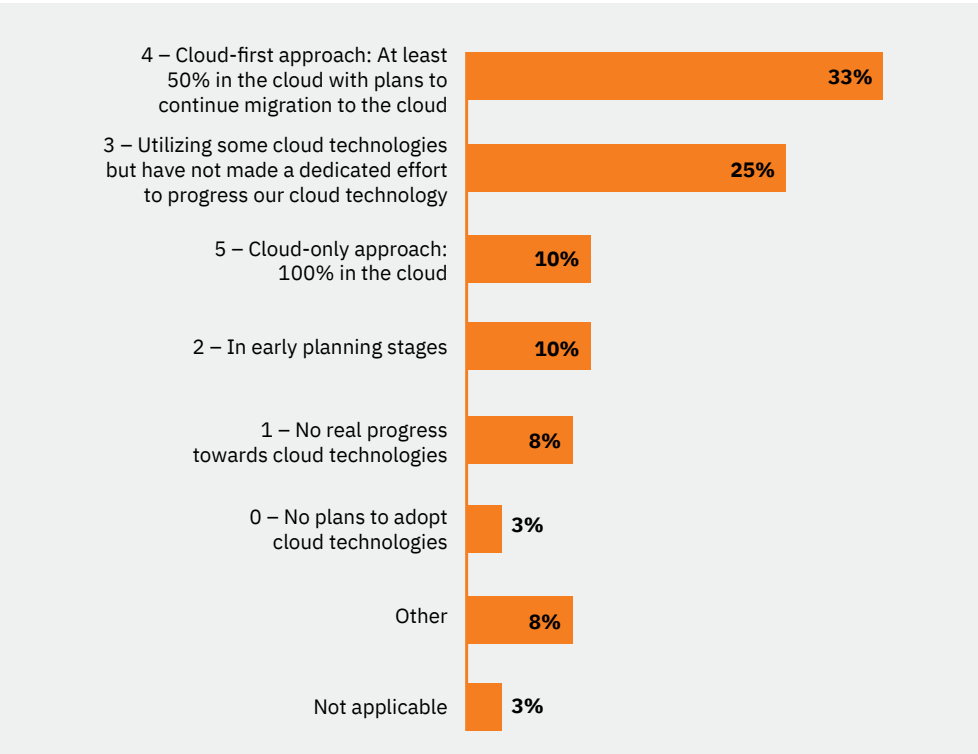


16 Organizational progress on adoption of cloud-based applications

Trends indicate that more than three-quarters of Life Science organizations surveyed (78%) are adopting or planning to utilize cloud-based applications.

A cloud-first or cloud-only approach is in place for 43% of the respondents.

Only 3% of respondents report having no plans to adopt cloud technologies.

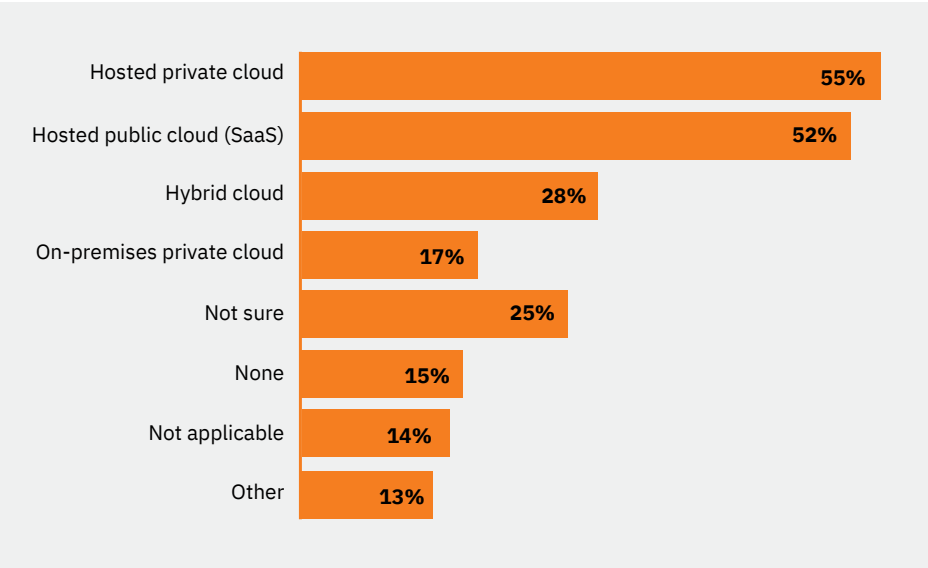


17 Types of cloud hosting models in use among cloud-based enterprises

(Checked all that applied)

Survey respondents report primarily using these four cloud hosting *models*:

- Hosted Private Cloud: 55%
- Hosted Public Cloud: 52%
- Hybrid Cloud Model: 28%
- On-premises Private Cloud: 17%



"Most organizations have fully operationalized at least one major public cloud infrastructure as a service (IaaS) or platform as a service (PaaS) provider. Now, many will look to add a second cloud provider for additional application use cases. Multi-cloud strategies improve flexibility,but they also increase complexity and cost."

—"Planning a Cloud Computing Strategy", Gartner[9]

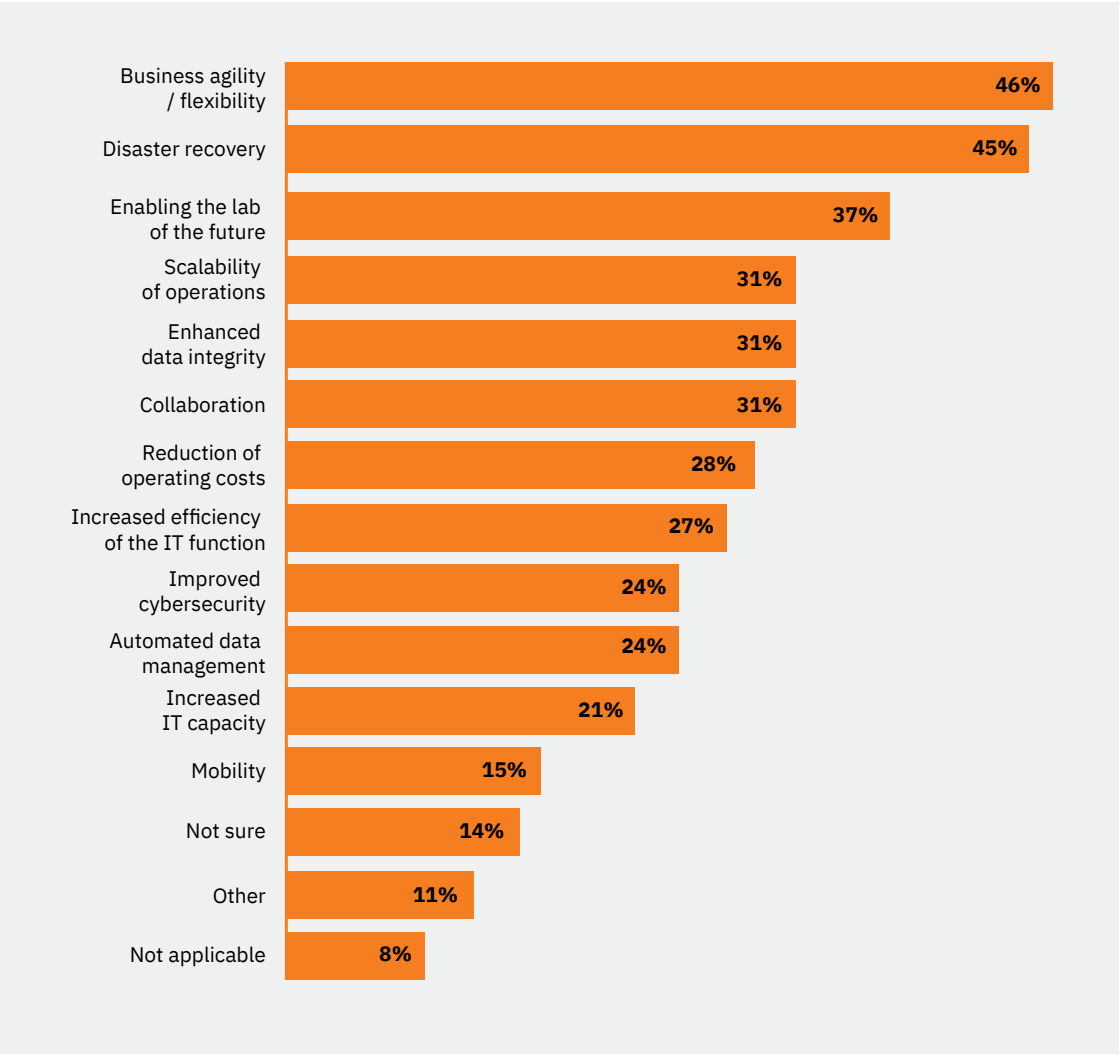
18 Benefits realized, or expected, upon migrating IT infrastructure to the cloud

(Checked all that applied)

Disaster recovery was the second most important driver for migrating IT infrastructure to the cloud (cited by 45% of respondents) but it was edged out as the leading reason by the flexibilty and business agility that cloud solutions offer as reported by 46% of survey participants.

Enabling the Lab of the Future was cited by 37% of respondents as a current or anticipated benefit of cloud migration. Increased collaboration amongst teams and enhanced data integrity also ranked high (31%) on the benefits offered through cloud-based models.

The multiple benefits of cloud migration are apparent in our survey but it is interesting to note that benefits of operating cost reduction, increased efficiency, increased IT capacity, and collaboration appeared to be lesser reported (as either a current or aniticpated benefit) than flexibility/agility and disaster recovery.



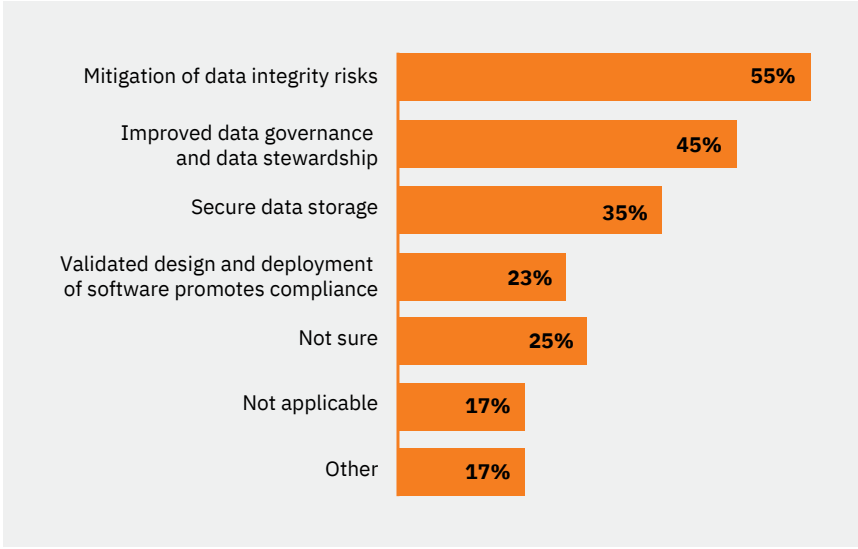
19 How cloud-based services have improved data integrity

(Checked all that applied)

The mitigation of data integrity risks, by moving to cloud-based services, is reportedly a primary benefit for over half (55%) of this year's survey respondents.

Data governance (45%) and secure data storage (35%) were also significant areas of improvement in data integrity through the use of cloud-based services.

Of particular interest is the quarter of survey participants who report being unsure of the benefits cloud-based services deliver to their operations.



20 Business operations that have been positively impacted by migration to the cloud (Checked all that applied)

Migration to the cloud had a significant impact on enabling remote operations for just over half (51%) of the respondents while also providing enhanced access to information (42%).

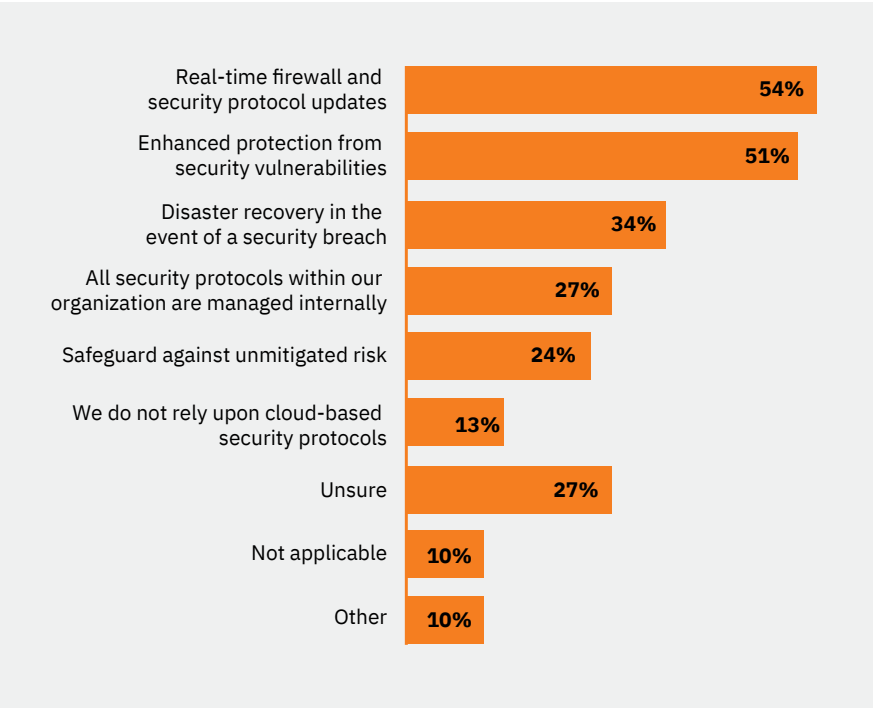
Despite the promise of increases in business process integration as well as collaboration amongst internal teams, customers and external partners, less than a third of laboratory professionals surveyed report benefits in these areas as a result of migrating business operations to the cloud.

21 Level of cybersecurity protection provided by the cloud for operations (Checked all that applied)

With cybersecurity a primary concern in most organizations, it is unsurprising that over half of surveyed lab professionals (54%) report cloud-based cybersecurity provided real-time firewall and security protocol updates.

Disaster recovery was an important concern for moving to the cloud for 34% of the respondents but this was significantly fewer than the 51% who report that enhanced protection from security vulnerabilities is more significant.

Interestingly, over a quarter of our surveyed lab professionals (27%) are unsure of the benefits of cloud based services on their level of cybersecurity. It appears that, for a substantial percentage of lab professionals, security is an issue more in the domain of IT managers (whom they likely rely upon for maintenance of data security).



Adoption of AI/ML Powered Applications

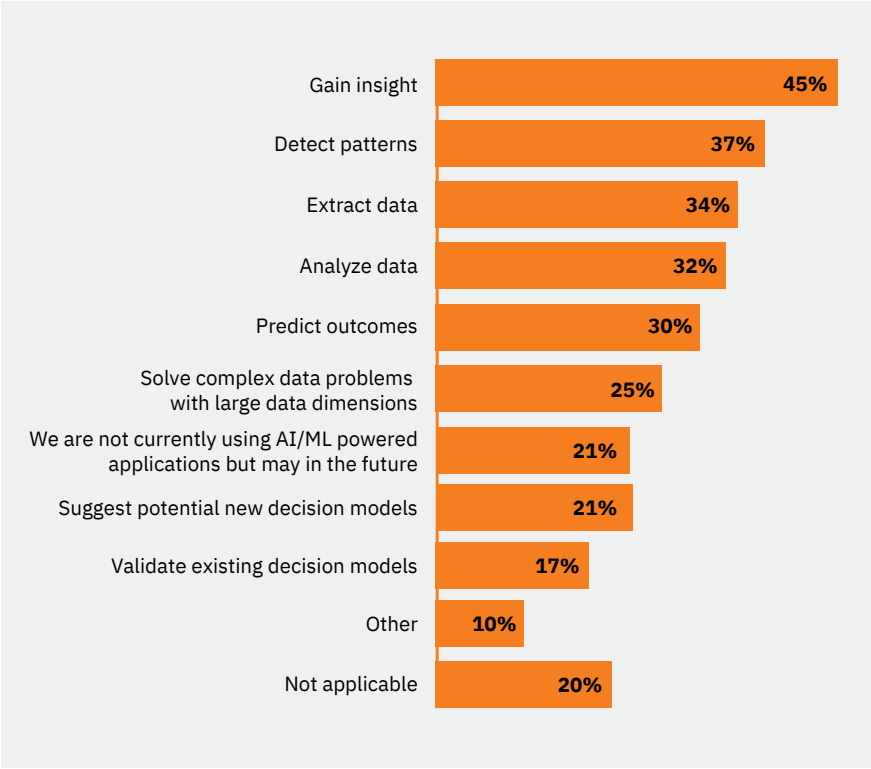
22 The role of AI/ML powered applications

(Checked all that applied)

AI/ML powered applications are enabling 45% of suveyed lab professionals to gain insights into their data.

Although a fifth of our survey participants report that they are not using articifial intelligence or machine learning in their lab operations, over a third (37%) are utilizing applications to detect patterns, (34%) extract data, and (32%) analyze data.

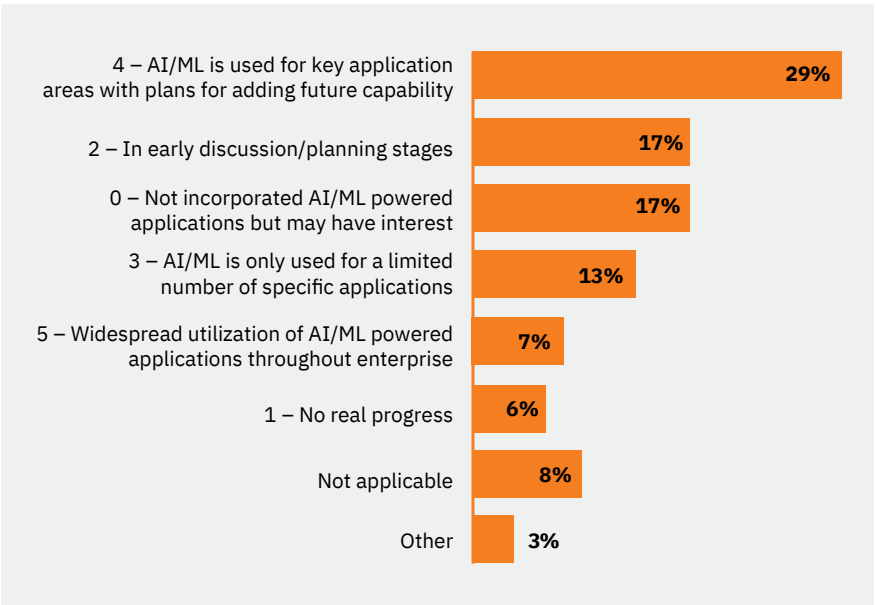
We would expect that, as use of these software applications proliferate among mid- and smaller-sized laboratories, the numbers of lab professionals realizing these benefits will increase corresponding to the prevalence of devices that will appear in their facilities (e.g., tablets and IoT connected devices for performing, and reporting on, processes and functions).



23 Utilization of AI/ML powered applications

AI/ML powered applications are being utilized for key applications, and throughout enterprises, with plans for adding more capabilities in the future among 29% of our surveyed lab professionals.

If we combine those laboratories in which there is reportedly limited use (13%) and possible interest, despite an absence of AI/ML applications (17%), we would expect to see 30% of our surveyed labs to be expanding their implementation and/or use of AI/ML powered applications in the coming year. This represents a significant rise in use, consistent with trends and predictions reported by other organizations conducting similar surveys of Life Science laboratories.

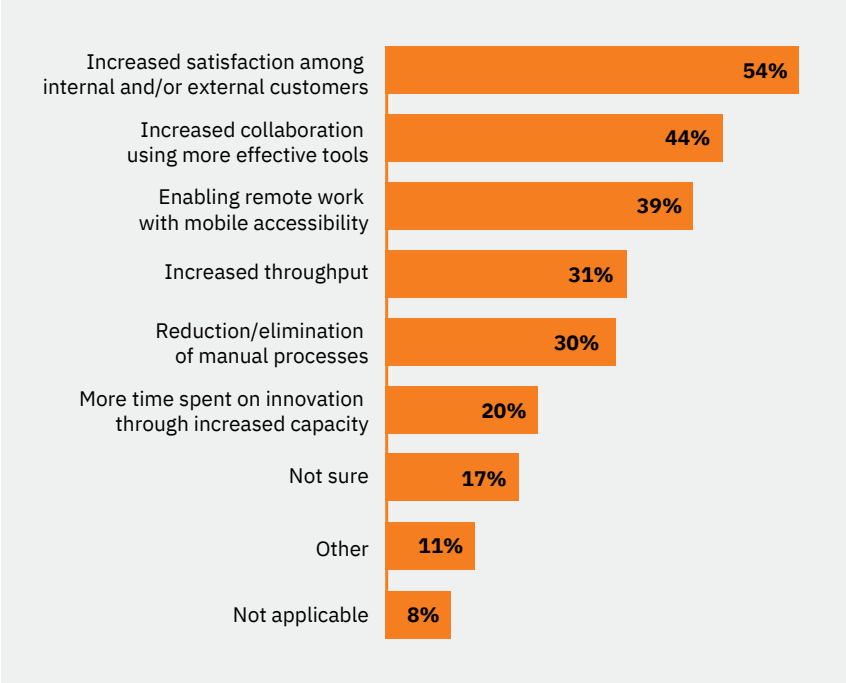


Benefits of Digital Transformation to Organizations

24 Improvements employees have realized from digital transformation

(Checked all that applied)

Despite a significant percentage of late-adopters in our participant pool reporting employee tolerance as a hurdle in digital transformation, it is noteworthy that over half (54%) reported increasing satisfaction among internal and/or external customers.



Once more, despite the reticence that some lab professionals have cited among their employees for adoption of digital tools, nearly half of respondents in our survey (44%) report that a significant improvement realized by their employees, via digital transformation, is increased collaboration using more effective tools.

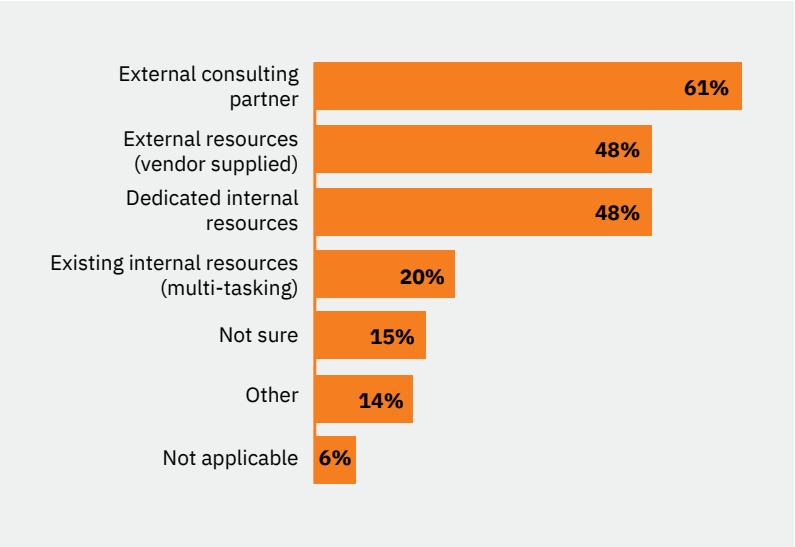
Significantly, less than half of Life Science respondents chose as benefits of their digitalization programs, factors associated with throughput (31%), reduction/elimination of manual processes (30%), or more time spent on innovation through increased capacity (20%)—three areas that might have been considered more popular drivers—or business case justifiers—of funding digital transformation initiatives.

Still, and in line with cautionary observations on rushing digitalization programs by such analysts as Gartner, 17% of lab professionals participating in this survey shared that they are not sure what improvements their employees have realized from digital transformation within their organizations.

25 Resources used to support digital transformation efforts

(Checked all that applied)

Increasing market demands and supply chain challenges are combining to generate urgency among some Life Science organizations. This is, in turn, fueling accelerated efforts to bring new informatics technologies and services into Life Science organizations.



Given the heavy lift for an organization to marshal employees, capital, and the wide diversity of legacy and emerging technologies, it is unsurprising that most Life Science lab professionals (61%) bring in *external consulting partners* to assist in developing a robust digitalization strategy along with the program management expertise and resources to facilitate a successful digital transformation initiative.

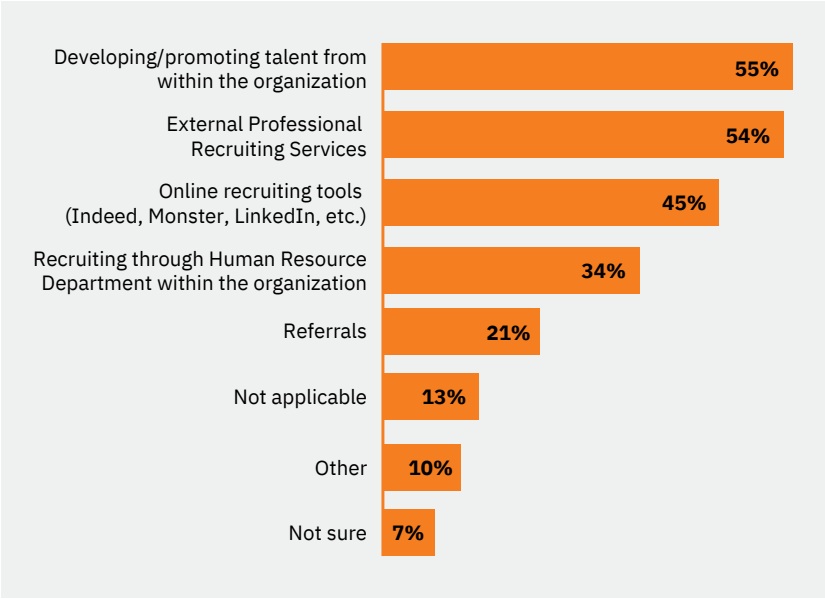
At both ends of the organizational size spectrum, for the very largest and smallest operations, it may make sense to have dedicated internal resources managing digital transformation programs. Nearly half of our survey participants (48%) report that dedicated internal resources are tasked with supporting these efforts. However, the same percentage (48%) responded that they are using external (vendor) resources to support their digital enablement programs.

It is plausible that, among those lab professionals who report their organizations' efforts at digital transformation are underperforming against their goals, a contributing factor is their having to divide their attention among daily responsibilities and the additional efforts needed for modernizing equipment, processes, and conducting training among their staff.

It is noteworthy that 15% of respondents are *not sure* what resources are being used to support their organizations' digital transformation but this likely reflects the population that has yet to fully engage on their programs as planning has started but implementation has yet to move into high gear.

26 Tactics currently employing in hiring and developing highly specialized resources for organizational informatics needs (Checked all that applied)

With a national talent shortage afflicting sectors across the industry spectrum, it is not surprising that over half of the professionals participating in our survey (54%) report turning to *external professional recruting services* to fill staff positions in their laboratory.



Another popular tactic for sourcing talent is online recruitment via third-party services, which is used by 45% of our survey participants. Developing and promoting talent from within the organization is more prevalent (55%) than online tools, recruiting through the organization's HR department (34%), and referral generation (21%).

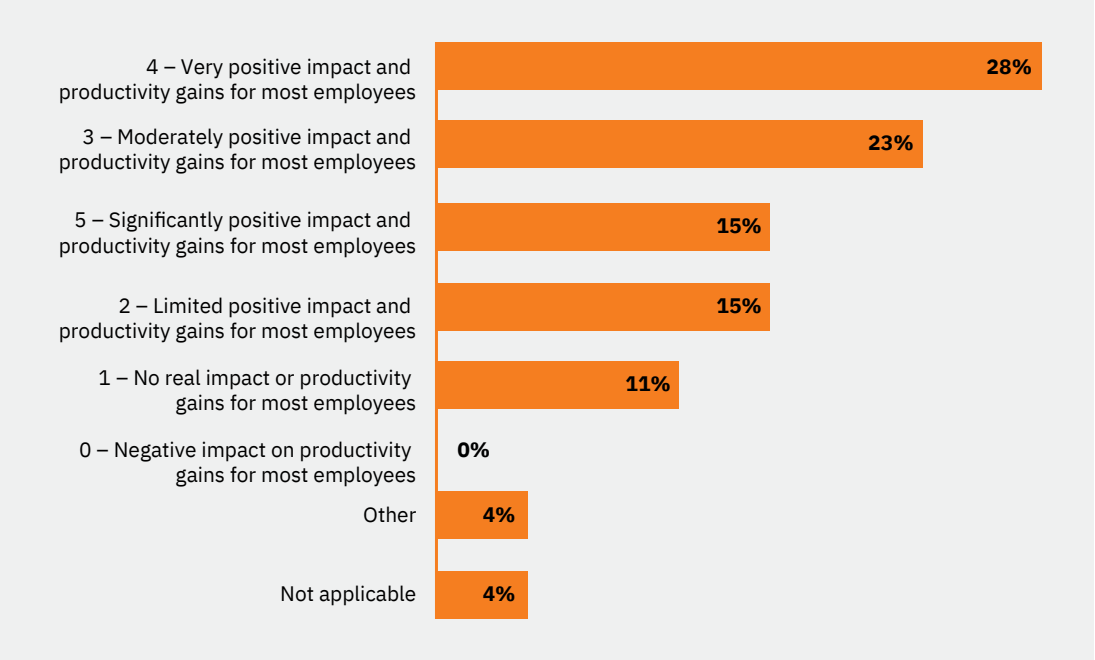
It is interesting to note that there are 17% of respondents who either are unsure (7%) or using other means (10%) to identify highly specialized staff to their organizations. It is possible that these professionals are not engaged in staff hiring or that they are unaware of how candidates are sourced for employment by their organization.

27 The impact of digital transformation on employees

Like question #24, in which we asked survey participants to identify what improvements employees have realized from digital transformation, we focused on a combination of objective and subjective measures to assess the rates and factors describing the impact of digitalization on the workforce —versus technology function.

Half of the Life Science respondents report moderate (23%) to very positive (28%) impact on employee productivity through their Lab of the Future initiatives. And, as with other responses, the same percentage of respondents report significantly positive impact on employee productivity (15%) as do respondents who report limited positive gains in employee productivity (15%).

Only 11% report that there have been no discernable impact or productivity gains for most employees and none of our respondents report a negative impact on employee productivity resulting from digital transformation initiatives.



Conclusions

Current State

- The Early Adopters of LoF technology are likely to be driven by factors and forces that, recently or presently, have limited their success. These enterprises consider LoF technologies as essential to their competitive advantage, through enabling/preserving the pace of their processes across large organizations and teams that may be separated by intra- as well as international borders.

> ***"The responses to our annual survey of laboratory professionals offers a snapshot of the ways in which innovation proliferates across laboratories among Life Science enterprises. We can view the state of modernization through the long-established lens known as the Diffusion of Innovation (DOI) Theory, developed by E.M. Rogers in 1962."***
>
> —"Diffusion of Innovations", Everett[10]

- In the second echelon of LoF technology adopters, the Fast Followers are likely bringing their wait-and-see perspective to each case study and journal article to determine—and justify—their incremental investments in new platforms (e.g., wireless tablets), software (i.e., LIMS), and IoT/Smart lab productivity and safety tools (e.g., augmented reality and voice-enabled technologies).
- Late Adopters of cloud-based and wireless technologies may be approaching (if not implementing) modernization with a sense of wariness born of skepticism about data security, for example, or the realities of economic constraints that inhibit their ability to purchase new technology and to train staff.

It may seem paradoxical—and even counter-intuitive—that some of the smallest operations are also among the fastest adopters of new technologies and processes, but the key to this mystery may be found in the ways in which multiple-site operations are like a chain, with the weakest link (in terms of legacy systems) having a disproportionately large impact on the entire system's ability to "go fully digital," for example.

Key Takeaways: By the Numbers

- 48% of Biotech/Pharma firms report having plans to add to their LIMS after 56% report already having implemented them to some extent.
- 52% of Biotech/Pharma firms report plans to add ELNs after 48% report already having acquired them.
- 50% of Clinical Research setting respondents report plans to acquire or upgrade their Chromatography, Digital Imaging, and Customer Relationship Management systems.

Barriers to Modernization

Our annual survey found that barriers to modernization, including the creation of a blueprint (a.k.a., a *digital transformation plan*), can be generalized into a relatively few topic areas that describe commonalities unsurprising to most managers:

- **Resources** - Adequate time and personnel dedicated to the project.
- **Budget** - Approved funds for equipment, staff, and training.
- **Planning** - A comprehensive, employee-centric, plan for digital transformation.

Additionally, the time it takes to become familiar with—and then to familiarize others with—the many options for workflow optimization, process modernization, and their enabling technologies can also be daunting to staff leadership teams and their timelines for modernization.

Roadblocks Hindering Lab of the Future Initiatives

- In terms of barriers either perceived or experienced by lab professionals, it is significant that planning and implementation *are* challenged by ***inadequate resources*** (44%). This insufficiency is, perhaps, a factor among 20% of the lab professionals who report that their organizations are ***multi-tasking internal personnel***, with simultaneous implementation of digital transformation initiatives. If this is the case, it may explain why their organizations' efforts are not producing the desired results at the anticipated pace of success.
- ***Data silos*** continue as an obstacle to progress for laboratory professionals (and business leaders) with just under a third (31%) reporting that they remain a persistent barrier to progress.
- Whether due to uncertain or competing priorities, or the lack of ***available budget***, 11% of study participants) say they are unsure of where to begin their efforts at digital transformation. Twenty percent of the survey respondents report that they have not yet prepared a ***digital transformation plan***.

Summary

This edition of our survey illustrates that some organizations have plans for their internal teams to push-through digital transformation initiatives while, simultaneously, coping with various levels of acceptance and adoption among their staff. Meanwhile, only a relatively small percentage of laboratories have decided to either wait, or suspend their digital transformation plans, due to challenges associated with their internal businesses processes, leadership, or employees.

Only a very small percentage of respondents in our survey cite insurmountable technology challenges as their barrier to starting or continuing a digital transformation.

An unforeseen accelerant of technology adoption

Possibly unique to the challenges—and interim coping tactics borne of the COVID19 pandemic—39% of lab professionals report that *enabling remote work with mobile accessibility* has been a benefit of their organizations' digital transformations.

Forecasting based on Survey Results

- We would expect to see 30% of our surveyed labs expand their implementation and/or use of AI/ML powered applications in the coming year.
- IoT / Smart technology (characterized by wireless sensors) is the most popular area of investment among 62% of respondents.
- Given the imperative for enhanced integration of data sources to realize the benefits of modernization, we expect to see increasing investments to replace legacy systems with modern enabling technologies to reduce or eliminate data silos.

Assessing Readiness for Planning and Implementing Digitalization

The steps toward a Laboratory of the Future can be halting at first and at several points along the path. It's useful to recognize that bottlenecks and speedbumps are common to the process of modernization. To avoid mistakes that have caused many other organizations millions of dollars and thousands of hours, leaders and managers of modernization projects need only devote some time at the start, and throughout, to address the realities of introducing new processes and technologies. While imperatives—as well as goals—driving modernization are clearly understood by leaders, it is also imperative to factor into planning that adoption of innovation is acutely impacted by the people whose work lives will be most directly impacted.

> ***"Tragically, research tells us that 70% of these initiatives will not reach their stated goals. That equates to over $900 billion worth of spend that will miss the mark. This is mismanagement on a colossal scale."***
>
> —"Why Digital Transformations Fail", Forbes[11]

According to 20% of the lab professionals participating in the 2022 survey, their efforts have been frustrated by at least several issues associated with organizational readiness and preparedness.

Organizational Preparedness Assessment

The following assessment questions are offered to assist in surfacing, and preparing for, challenges endemic to organizations engaged in laboratory modernization.

1. To what extent are executive leaders demonstrably receptive to digitalization?

a. Resistant **b.** Skeptical **c.** Neutral **d.** Optimistic **e.** Enthusiastic

2. To what extent do executive leaders feel digitalization poses unacceptable risks?

a. Greatly **b.** Somewhat **c.** Unsure **d.** Minimally **e.** Unafraid

3. To what extent do lab staff demonstrate receptiveness to digitalization?

a. Resistant **b.** Skeptical **c.** Neutral **d.** Optimistic **e.** Enthusiastic

4. To what extent has your organization demystified the reasons for digitalization by communicating the benefits envisioned for the employees as well as the organization?

a. Not planning an inifiative **b.** Considering a plan **c.** Planning an inititive **d.** A program is underway **e.** Completed the program

5. To what extent do lab staff express that they feel digitalization poses unacceptable risks?

a. Greatly **b.** Somewhat **c.** Unsure **d.** Minimally **e.** Not at all

6. **To what extent has the organization planned or undertaken a program to address concerns about digitalization of laboratory processes among stakeholders?**

a. Not a concern **b.** Unaware of need **c.** Aware of need **d.** Some action **e.** Actively addressing

7. **To what extent is the organization measuring the impact of current or planned digitalization?**

a. Not interested **b.** Interested but unable **c.** Unsure **d.** Planning measurements **e.** Actively measuring

8. **To what extent is digitalization being planned, or implemented, to eliminate data silos?**

a. Not interested **b.** Interested but unable **c.** Unsure **d.** Planning solutions **e.** Solutions implemented

9. **To what extent has the organization assessed the potential benefits of expanding their implementation and/or use of AI/ML powered applications?**

a. Not interested **b.** Interested in assessing **c.** Actively assessing **d.** Planning implementation **e.** Planning expansion

10. **To what extent has the organization assessed the risks and benefits of migrating its business operations to the cloud?**

a. Against migration **b.** Unsure of benefits **c.** Planning to assess **d.** Assessing risks and benefits **e.** Completed assessment

11. **To what extent has the organization evaluated specific cloud-based applications?**

a. Planning to start **b.** Starting **c.** Identified canidate apps **d.** Evaluating canidate apps **e.** Completed section

12. **To what extent has the organization dedicated resources, either among internal staff or through the services of a third-party, to identify barriers to progress in assessing, planning, and implementing digital transformation?**

a. No special allocations planned now **b.** Intend to dedicate resources in the future **c.** Planning the scope of resources **d.** Committed resources for internal staff only **e.** Committed resources for internal and external staff

13. **Where is the organization in the process of forming, or tasking, a specific team to identify and prioritize areas of operation that would benefit from Laboratory of the Future technologies?**

a. Not planned **b.** Planning to form or task a team **c.** Have assembled the team **d.** Team is working **e.** Team has produced the plan

14. **To what extent has the organization established budgets earmarked for modernization that include staff time, acquisition, and staff training on Laboratory of the Future technologies?**

a. Team has yet to create budget **b.** Budget being compiled **c.** Budget being reviewed **d.** Funds approved **e.** Funds allocated

Conclusion

Enterprise leaders and facility managers need to focus on changing the *mindset* of employees as an integral part of an updating both their organizational culture and its daily practices. Preparing a strategy for introducing this new mindset, in advance, will help guide leaders in choosing the digital tools best suited to their culture, workforce, and processes. Most importantly, to succeed at driving digital transformation, enterprise leaders are well advised to be energetic in designing and taking steps to achieve an inclusive culture that encourages its members to share a forward-looking view of their digitally enabled laboratory and its potential to make a positive impact on life within—and beyond—the organization.

> ***"Accelerating digital transformation will succeed when leaders focus on the changing mindset of the employees alongside the organizational culture and practices. The right strategy in advance will help leaders to choose a suitable digital tool. And most importantly, inclusive culture with all members looking at the same direction will drive digital transformation and not vice versa."***
>
> —"Why do employees resist digital transformation", Be Informed[12]

Next Steps on the Path of Realizing the Promises of a Lab of the Future

One enabler of success reported by lab professionals is the availability of external resources who focus on understanding actual—versus presumed—needs. Experts, adept at understanding the range of factors associated with organizational change, offer both a holistic and perceptive approach to modernizing operations that can actually maximize impact while minimizing disruption. More than acquiring new technologies and equipment, it is essential that employees acquire the confident mindsets and positive expectations essential to optimizing returns on investments in Lab of the Future initiatives. The key to success is, apparently, establishing a balance of effort that preserves managers' focus on enterprise standards and goals (including staff productivity) while—simultaneously—devoting appropriate time and energy to modernizing operations.

> ***"In today's uncertain business environment, organizations must be able to move quickly to seize opportunities ahead of the competition. Cloud services have an important role to play in making the business they serve more agile and, therefore, more likely to succeed."***
>
> —"Planning a Cloud Computing Strategy", Gartner[13]

About Astrix

For over 25 years, Astrix has been a market-leader in delivering innovative solutions through world class people, process, and technology that fundamentally improves scientific outcomes and quality of life everywhere. Founded by scientists to solve the unique challenges life sciences and other science-based business face. Astrix offers a growing array of strategic, technical, and staffing services designed to deliver value to clients across their organizations. To learn the latest about how Astrix is transforming the way science-based business succeed today, visit www.astrixinc.com.

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Appendices

2020 Astrix LIMS Market Research Report

White Paper - Moving your Laboratory Software to the Cloud - Astrix (astrixinc.com)

eBook - Digital Transformation of Quality in the Life Science Industry - Astrix (astrixinc.com)

Data Integrity White Paper - Astrix (astrixinc.com)

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