Hype Cycle for Life Science Discovery Research, 2023

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Initiatives: Healthcare and Life Science Digital Optimization and Modernization; Healthcare and Life Science Digital Transformation and Innovation

Life science companies continue to build new capabilities in digital research and early stage drug discovery capabilities. CIOs can use this Hype Cycle to identify innovative technologies reshaping their industry and to prioritize their investments accordingly.

More on This Topic

This is part of an in-depth collection of research. See the collection:

- 2023 Hype Cycles: Deglobalization, AI at the Cusp and Operational Sustainability

Analysis

What You Need to Know

The advancement of technology, such as the rise of artificial intelligence (AI) and machine learning (ML), data and analytics, cloud, and automation, is changing the way that drugs are discovered, developed and delivered. AI-native technology service providers and biotechnology companies have overturned the status quo on drug discovery and are accelerating drug candidates into preclinical and clinical trials at an unprecedented rate. The advent of in silico research has arrived. In addition, increasing focus on personalized medicine is driving the need for new and innovative approaches to drug development.

CIOs of life science companies are facing new challenges on the journey to integrating and leveraging new technologies and digital approaches. They need to find more efficient and effective ways to integrate new technologies into their research processes, while also ensuring that their systems are secure and compliant with regulations. By understanding these trends, life science CIOs can position themselves to succeed in this rapidly changing field.

The Hype Cycle

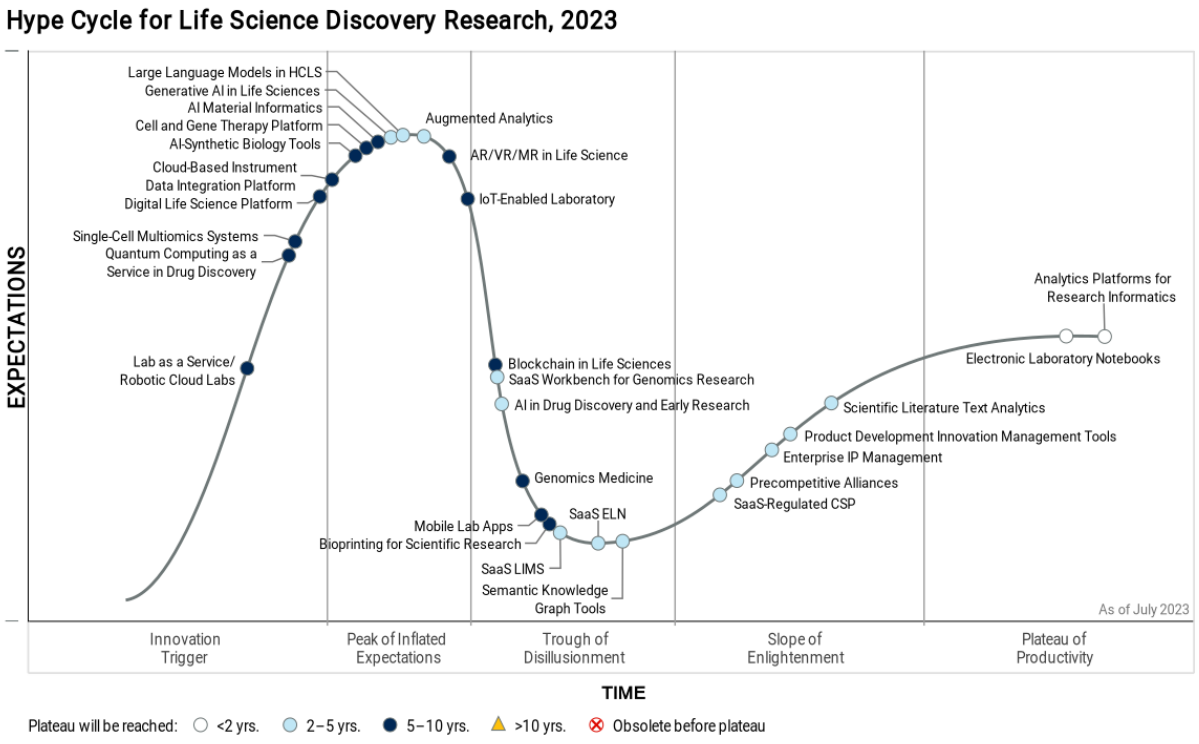
The convergence of science and technology has ushered in a transformative era. Life science discovery research has become a leading use case of cutting-edge technology, including AI, ML and quantum computing. As scientific advancements intertwine with technological innovations, new possibilities emerge for unraveling complex biological mechanisms and accelerating novel target and drug discovery.

To remain competitive, research teams need — and are selecting — technologies that enable new scientific discovery approaches, seamless collaboration, knowledge exchange and enhanced productivity. As a result, several innovations on the Hype Cycle have been introduced or accelerated:

- Cloud-based instrument data integration platform, AR/VR/MR in life science and quantum computing as a service in drug discovery have moved furthest through the Hype Cycle since last year. This represents a focus on streamlining data integration and analysis — and progress in the use of advanced technology.
- Generative AI in life sciences and large language models in HCLS debut at the Peak of Inflated Expectations for 2023. This represents a focus on accelerating the drug discovery process through aggregating research intelligence, creating research article drafts, identifying novel targets, and predicting novel drug-like molecular structures and generating validation reports.

This Hype Cycle is part of a family of life science industry Hype Cycles, including Hype Cycle for Life Science Clinical Development, 2023, Hype Cycle for Life Science Manufacturing, Quality and Supply Chain, 2023 and Hype Cycle for Life Science Commercial Operations, 2023. The combination helps CIOs apply a comprehensive view on emerging technologies across the entire life science value chain. The innovations we cover in this research span all phases of the Hype Cycle (see Understanding Gartner's Hype Cycles).

Figure 1: Hype Cycle for Life Science Discovery Research, 2023



The Priority Matrix

CIOs must look at each of the technologies in the portfolio and consider how they support the organization's ambitions to digitalize. CIOs should prepare for high and transformational innovations that will become mainstream in the next two to five years. The impacts of innovations, such as generative AI and analytics platforms for research informatics, should inform decisions about when and how to adopt these technologies, mitigating risks and maximizing the potential benefits for the organization.

Using data from the benefit rating and Time to Plateau values for each technology, it plots the answers to two key questions:

- How much value could an organization expect to realize from the effective implementation of a particular technology?
- When will the technology be mature enough to help deliver that value?

Quickly maturing, high-importance transformational technologies are up and to the left of the Priority Matrix. Below them are technologies that are still important, but with a lesser scope of potential impact. To the right are emerging technologies with great potential that are further away from their full maturity. Technologies with lower benefit ratings and longer times to value are listed in the Priority Matrix's lower-right sections.

Table 1: Priority Matrix for Life Science Discovery Research, 2023

(Enlarged table in Appendix)

Benefit	*Years to Mainstream Adoption*			
↓	*Less Than 2 Years* ↓	*2 - 5 Years* ↓	*5 - 10 Years* ↓	*More Than 10 Years* ↓
Transformational		Generative AI in Life Sciences Large Language Models in HCLS	Blockchain in Life Sciences Digital Life Science Platform Genomics Medicine	
High	Analytics Platforms for Research Informatics	AI in Drug Discovery and Early Research Augmented Analytics Product Development Innovation Management Tools SaaS ELN SaaS-Regulated CSP SaaS Workbench for Genomics Research Scientific Literature Text Analytics Semantic Knowledge Graph Tools	AI-Synthetic Biology Tools Bioprinting for Scientific Research Cell and Gene Therapy Platform IoT-Enabled Laboratory Quantum Computing as a Service in Drug Discovery Single-Cell Multiomics Systems	
Moderate	Electronic Laboratory Notebooks	Enterprise IP Management Precompetitive Alliances SaaS LIMS	AI Material Informatics AR/VR/MR in Life Science Cloud-Based Instrument Data Integration Platform Lab as a Service/Robotic Cloud Labs Mobile Lab Apps	
Low				

Source: Gartner (July 2023)

Off the Hype Cycle

Some profiles have new names, reflecting refinement of the scope or technology positioning. These name changes include:

- Innovation management tools for product development is now product development innovation management tools.

- Quantum computing as a service is now quantum computing as a service in drug discovery.
- Analytics platforms for informatics is now analytics platforms for research informatics.

On the Rise

Lab as a Service/Robotic Cloud Labs

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Definition:

Lab as a service (LaaS) or “robotic cloud labs” are automated, scientific wet labs that are hosted in the cloud and can be accessed remotely. The labs can be managed by contract research organizations as well as internal teams. The cloud lab enables remote access, facilitated design, protocol transfers, live instrument monitoring and dynamic scheduling.

Why This Is Important

Laboratories represent a cost-related barrier to performing high-velocity scientific experimentation. Startup costs for assets begin from $5 million to $10 million. LaaS represents an opportunity for clients to externalize some of the work into a contract research organization (CRO) to perform complex laboratory-based activities with clusters of instruments, analyzers and robotics. Some providers can extend the same cloud-lab platform back to sponsors to internally duplicate the model.

Business Impact

LaaS enables life science organizations to rapidly deploy automation and testing capabilities without having to pay for and maintain expensive laboratory automation infrastructure. By centralizing the activities in the cloud, organizations can better share assets and harmonize approaches for science, experimentation and quality testing. Thus, LaaS reduces the barrier to entry for laboratory activities.

Drivers

- ROI for R&D investment continues to decline, which causes executive leadership to look for ways to improve productivity and evolve the science using any means possible. This includes shifting from internal R&D models toward external relationships with partners, as well as more open innovation models where information is collaborated with groups of partners, consortia members and academic researchers. These newer innovation models require new infrastructure for real-time collaboration across multiple time zones and locations. In most cases, researchers are pursuing similar models for both wet bench work as well as in-silico methodologies.

- Cloud technology is on the rise for standing up lab infrastructure and instrumentation software. Most new product launches in the lab-automation space have cloud and SaaS models.

- New biotech and upstart labs need quick entry into the lab automation space. As-a-service delivery models lower barriers to entry for these organizations and can reduce costs and accelerate scientific and lab-testing initiatives.

- Work-from-home policies and a push to enable remote access to systems in laboratories have pushed organizations to investigate quicker and easier ways to deploy solutions for lab automation and assays.

- Live event streaming technology and Internet of Lab Things (IoLT) are driving instrument connectivity.

- AI, ML and data science technologies to enable “insight engines” for lab processes are on the rise.

- Physical automation of robotics (such as lab instruments, analyzers, liquid handlers and peripherals) as well as automation of data (such as data processing, pipelining and workflow automation) are becoming less expensive and easier to deploy.

- Since LaaS product launches are fairly recent, and the reasons listed above are drivers, this technology is located in the Innovation Trigger phase.

Obstacles

- **Cultural:** Some organizations have a distrust for CRO-based staff when it comes to evolving science. Also, the domain expertise of partners may not be viewed as “equivalent” to sponsor companies within a certain scientific space or therapeutic domain.

- **Unclear financial implications:** Many organizations have existing internal assets that are still being depreciated, as well as staff who are dedicated to running laboratory and scientific operations. The movement toward cloud labs often means writing off or accelerating depreciation of those assets.
- **Risk of IP theft:** Intellectual property can potentially be exposed to third parties. Risk-averse organizations often view cloud or externalized resources as a potential for loss or theft.
- **Validation:** Good lab practice (GLP) studies require a higher level of validation than non-GLP studies. Many organizations are not set up with validation principles to support SaaS-based work.

User Recommendations

Start by evaluating how a LaaS strategy can either accelerate the science and/or improve the quality of the scientific method. To do this:

- Address projects that are good candidates for cloud-based labs. Consider externalizing this work to get experience with these types of vendors.
- Model the central lab infrastructure that can be deployed via cloud-lab approaches. Identify the laboratory assets and projects in your own organization to discover where it can make sense to centralize the control and deploy an internal cloud lab using either LaaS software or the vendors in your existing portfolio. Many vendors now have SaaS offerings for instrument control, drivers, instrument data lakes and dynamic scheduling, and can integrate into lab informatics solutions such as an electronic laboratory notebook (ELN), scientific data management system (SDMS) or laboratory information management system (LIMS).
- Evaluate the four major obstacles listed above and develop a plan to conquer these risks by talking to stakeholders in the scientific, laboratory, regulatory and governance, risk and compliance (GRC) groups.

Sample Vendors

Automata; Emerald Cloud Lab; Strateos

Gartner Recommended Reading

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You’re Building a Truly Digital Life Science Lab of the Future?

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Quick Answer: What Are the Advantages of Leveraging Cloud Technologies in Life Science Omics R&D?

Life Science Manufacturer CIO Top Actions for 2023

Quantum Computing as a Service in Drug Discovery

Analysis By: Michael Shanler, Reuben Harwood

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Definition:

Quantum computing as a service (QCaaS) in drug discovery provides enterprises with access to quantum computing systems and associated services that enable them to explore use cases (such as molecular generation) and devise quantum algorithms for highly specialized sets of problems. QCaaS provides vendors with access to their own technologies, and some cloud service providers offer QCaaS that supports access to various quantum computing implementations, vendors and solution approaches.

Why This Is Important

QCaaS is a type of nonclassical computing that operates on the quantum state of subatomic particles. The particles represent information as elements denoted as quantum bits (qubits). A qubit can represent all possible values of its two dimensions (superposition) until read. Quantum algorithms manipulate linked qubits in their entangled state, and quickly address vast combinatorial complexity — especially in the drug discovery space because creating and managing QC hardware itself is still a significant cost and technical barrier.

Business Impact

Today, QCaaS has an impact on biomolecular optimization, genomics analysis, machine learning for pathway analysis, drug discovery, and organic chemistry and synthesis. QCaaS is accelerating in-silico activities and reducing timelines in drug discovery. R&D leaders will be able to augment and potentially replace screening efforts and work at the lab bench, especially as more QCaaS hits the market. This impacts key drug research partnerships and helps augment drug pipelines.

Drivers

- R&D teams are under immense pressure to deliver new molecular leads and refine offerings in their portfolios. Only recently has QCaaS for drug discovery become available through new software vendors, consultants and biotechnology companies. Once the technology has evolved and stabilized, Gartner expects QC to provide a high-value tool, handling the more complex computational challenges in drug discovery.
- Scientists' expectations of QC capabilities will rapidly increase as new vendors get involved in drug discovery. Conventional silicon computation speed has been handicapped over the past 10 years as silicon chip engineers have reached the upper limit. QCaaS provides a tantalizing alternative, boosting certain types of computational operations that are much faster than conventional designs.
- We see an increase in QC staff training. Initial QC-knowledgeable personnel are already becoming managers attempting to drive competitive differentiation through the application of this technology.
- Sponsor clients running discovery programs are increasingly engaging science-as-a-service companies and in-silico contract research organizations (CROs).
- The promise of QCaaS for drug discovery continues to drive proofs of concept (POCs) and collaborations with pharma and technology companies, such as Bayer's investment with Google and Moderna's collaboration with IBM.
- While we do not expect QC hardware in life science to reach the mainstream for well over 10 years, QCaaS and specifically its usage in drug discovery are accelerating. Life science companies will adopt this technology faster than most other industries. Although the technology is still in the Innovation Trigger phase, it is ascending to peak hype in the next few years.

Obstacles

- While QC itself is near peak hype, it is poorly understood and supported in the market. While we see advancements in quantum algorithmic development on the horizon, adoption will take time.
- QCaaS adoption within the life science industry is outpacing most other industries, but clients are moving quickly with POCs and have unrealistic expectations about exactly how much can be delivered via QCaaS partners.
- While many clients report successful pilots for QCaaS projects, the ones with less technical teams and staff are less confident in the ability to sustain financial justifications and move POCs into production with the proper POC gates (scientific, technologic, economic).
- While a handful of large pharmaceutical companies have sponsored quantum projects (e.g., Biogen worked with 1QBit and Accenture for quantum-enabled molecular comparisons in 2017), results remain unproven for more than a handful of molecular leads.
- Organizations do not yet have dedicated scientific informatics disciplines nor prepackaged workflows, upping the sticker price for investments due to extensive consultancy and partnering fees.

User Recommendations

- Start limited pilots today for QCaaS in drug discovery to develop the skills and refine the strategy required for a longer-term program.
- Evaluate if QCaaS is a good fit for these application areas: binding site prediction, high-content imaging, antibody design and research, catalyst research, molecular generation, affinity calculations, quantitative structure-activity relationship (QSAR), screening, docking programs, predictive spectra, quantum mechanics, molecular dynamics, protein structure design and predictions, molecular-molecule interactions, large molecule dynamics, and material and formulation design.
- Evaluate the benefits of using a general QCaaS provider that will require extra consulting and services to implement (such as those provided by D-Wave, Honeywell, IBM, IonQ, Microsoft, QCI and Rigetti Computing) versus the more focused QCaaS companies that have life science domain expertise and applications.

- Follow existing consortiums and projects for inspiration, such as the Novo Nordisk Foundation's $200M investment.

Sample Vendors

ApexQubit; ChemAlive; Cloud Pharmaceuticals; PharmCADD; POLARISqb; ProteinQure; Riverlane; Silicon Therapeutics; Xanadu; XtalPi

Gartner Recommended Reading

Emerging Tech: Top Use Cases for Quantum Computing

Infographic: How Use Cases Are Developed and Executed on a Quantum Computer

Quick Answer: How Is AI Being Used in Preclinical Drug Development?

Single-Cell Multiomics Systems

Analysis By: Reuben Harwood

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition:

Multiomics is the combination and analysis of datasets generated by two or more omics approaches. This includes genomics, proteomics, transcriptomics, epigenomics, metabolomics and/or microbiomics. Recent technological advancements allow researchers to perform multiomics analysis at the level of a single cell, providing an extraordinarily detailed analysis of cell activity that advances the understanding of disease pathophysiology.

Why This Is Important

Multiomics enables scientists to explore beyond the genetic blueprint of a specimen and investigate regulation, transcription and translation of genes, as well as molecular mechanisms of a phenotype. Single-cell technology supports analysis of cellular heterogeneity with applications in cancer, rare disease, cell and synthetic biology and more. This technology — a natural evolution of individual omics methodologies, combined with the single-cell approach — will accelerate precision medicine.

Business Impact

Single-cell multiomics systems will impact the following areas:

- Exposure of complex relationships between the different layers of biological information and the connections between structural and functional information, giving insight into disease pathophysiology.
- The accelerated development and production time of cell and gene therapy programs.
- The development of preventative (not just responsive) treatments for disease, a core tenet of personalized health.

Drivers

- Correlating the data from different omics experiments and techniques into valid datasets presents an exciting frontier in molecular biology. Such a goal is embodied in large-scale initiatives, such as the Human Cell Atlas, the National Institute of Mental Health's BRAIN Initiative, as well as precision medicine.

- Multiomics instrumentation is advancing every one to two years. Advances in biochemistry, cell culture, microfluidics, automation and bioinformatics have already gone a long way toward the goal of studying every molecule in every cell simultaneously. Scientists can now sequence DNA and messenger ribonucleic acid (mRNA), catalog proteins or classify chromatin structures in single cells, repeating the process thousands of times in an experiment, producing detailed pictures of both individual and collective cell activity.

- The reagents, instruments (such as flow cytometry, microfluidics and imaging systems) and consumables associated with single-cell analysis are becoming more widely available. The entry costs for performing high-throughput experiments have lowered, and the speed and sensitivity has improved. Additionally, more contract research organizations (CROs) offer single-cell multiomics as a service.

- Some omics vendors are developing new solutions for multiomics to help researchers navigate the challenges of running multiplex experiments. These include overcoming extremely large datasets, advanced tools, and new techniques for handling advanced analysis capabilities, e.g., comparing and cross-referencing data from the different streams of output.

- Today, single-cell multiomics systems exist largely as an expansion of genomics platforms to incorporate other omics data and the latest single-cell technology and methods. We expect there will be substantial optimization of multiplex omics systems and end-to-end vendor platform solutions in the next three years. Mainstream adoption is likely to be on the later side of the five- to ten-year range.

Obstacles

- A current lack of vendors offering end-to-end technology, reagents and software solutions for multiomics research means organizations often assemble their systems from multiple vendors. This can complicate experimental processes, hinder collaboration and pose significant barriers to scalability.
- While the technology is maturing fast, there are currently few approaches that enable multiomics measurements of the same cell. Some omics methodologies require intact cells (e.g., transcriptome or proteome analysis), while others destroy the cell during the process (e.g., DNA sequencing). Configuring the right sequence of analyses is challenging, and some omics analyses are less easy to "pair" than others.
- Researchers can become overwhelmed by rapidly growing, large datasets and the lack of tools to enable them to perform detailed analysis on such datasets. In addition, the limitations and complexities of each omics technology are further exacerbated by combining them into a multimodal analysis.

User Recommendations

- Keep track of the latest developments in single-cell multiomics. Speak with science and research leaders to understand how multiomics is likely to support your organization's strategic vision, how to leverage new or existing strategic partnerships, and determine which capabilities to build internally or outsource.
- Explore current- and future-planned offerings of your existing omics vendors and contract research organization (CRO) partners to identify whether they are best suited to provide necessary capabilities for your single-cell multiomics system.
- Work with scientific informatics and research IT leaders on how the information generated from the different streams of omics workflow can be processed, integrated and analyzed most effectively.

Sample Vendors

10x Genomics; BD; Bio-Rad; Mission Bio; My Intelligent Machines; NanoString; OmniTier; Takara Bio; Thermo Fisher Scientific; Watershed

Gartner Recommended Reading

Quick Answer: What Are the Advantages of Leveraging Cloud Technologies in Life Science Omics R&D?

Healthcare and Life Science CIO's Genomics Series: Part 1 — Understanding the Business Value of Omics Data

Healthcare and Life Science CIO's Genomics Series: Part 2 — Formulating an Omics Vision

Healthcare and Life Science CIO's Genomics Series: Part 3 — Prioritizing Omics Investments

Digital Life Science Platform

Analysis By: Michael Shanler

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Definition:

A digital life science platform (DLSP) is an architectural approach that enables companies to nimbly adapt their business and operating model, in response to external disruption and change in business strategy. The DLSP sources and integrates functionality from internal and ecosystem partners to create packaged business capabilities (PBCs). Nontechnical and IT staff can use PBCs to compose new experiences.

Why This Is Important

Life science (LS) organizations realize the limitations of monolithic ERP-centric or heavily customized or niche business application portfolios. The siloed nature of current architectures has stifled innovation and slowed digital transformation. Business users are exhausted by feeble attempts at interoperability by vendors, resulting in an excessive total cost of ownership (TCO) and fragmented user experiences.

Business Impact

The DLSP supports the following capabilities:

- Digital consumer and patient engagement for personalized experiences for drug regimens, device usage and therapies, using plug-and-play capabilities from external ecosystem players.
- Decentralized, digital clinical trials.

- Advanced health analytics, using tools that leverage data sources from R&D, precision medicine and real-world evidence.
- Digital laboratory research connected across multiple scientific and experimental disciplines, like chemistry and biology.

Drivers

- Business users want to transform the business. They want to enable a "composable" life science enterprise that leverages technologies to solve increasingly complex therapeutic issues. The composed experience will be realized through business-user-focused application experiences that are independent of the underlying set of commercial off-the-shelf (COTS) or legacy monolithic applications.
- Clients want a more effective means of bringing together different domains (e.g., clinical and AI subject matter experts [SMEs]) to provide a focus for democratized innovation among a range of stakeholders (see Fusion Teams: A Proven Model for Digital Delivery).
- The DLSP approaches are removing critical technological barriers to digital innovation and transformation (see Best Practices for Reimagining Your Life Science Company as a Digital Business Technology Platform).
- Organizations are starting to deliver business outcomes by delivering PBCs. These are application building blocks that have been purchased or developed internally or with third parties.
- Many clients and vendors are adopting a platform strategy as the primary vehicle for digital business transformation.
- As this is a relatively new concept, it is still in the Innovation Trigger phase of the Hype Cycle.

Obstacles

- This is an architectural approach that ultimately needs to be enabled by the end user. However, many end users want “holistic solutions” provided by vendors, which do not exist yet.
- Vendors often posture as having a platform. However, they think more in terms of software, and not architectural approaches, which creates confusion. End users, working with vendors, will need to provide a means of rapidly producing composable digital products and services from different sources (not just their marketplace or product offerings).
- DLSP requires vision and alignment with the business and IT, and may involve functional leads to help drive requirements. Since this is a big departure from application-centric thinking, we expect delays in design and essential partner selections.
- As the approach reaches peak hype, clients will inevitably be underwhelmed by either the vendor’s capabilities or their aspirations not meeting reality.

User Recommendations

- Align digital and IT strategy with existing business strategy through the power of people from business and IT backgrounds in the form of digital fusion teams (see IT-Business “Fusion” Teams and How They Can Deliver Innovation).
- Evaluate vendor solutions on their compatibility with the composable architecture that is emerging. Take appropriate actions on vendor and key technology sourcing across the current and future enterprise application portfolio (see Healthcare and Life Science Business Driver: Medical Technology Innovation).
- Drive technology and data architecture decisions, and organizational models that redefine the relationship between the business and IT. Plan to modernize legacy applications toward the PBC model.
- Verify the attributes of “composability” when assessing new vendor capabilities or solution offerings, and when renewing contracts with incumbent vendors. Explore strategic relations with hyperscale solution providers and channel partners.

Sample Vendors

Amazon; Google; IBM; Microsoft; Oracle, Salesforce; SAP; Veeva Systems

Gartner Recommended Reading

Innovation Insight for Digital Life Science Platforms

Democratizing Digital Delivery in Healthcare and Life Sciences

Healthcare and Life Science Business Driver: Strategic Technology Change

Quick Answer: What Should Life Science CIOs Know About Data Fabrics?

Quick Answer: What Are Packaged Business Capabilities in Healthcare and Life Sciences?

At the Peak

Cloud-Based Instrument Data Integration Platform

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition:

A cloud-based instrument data integration platform is a way to move laboratory instrument connections, drivers and data to the cloud. It may also include a data lake designed to capture lab instrument data, methods, protocols, analysis and workflow information. These systems can be used for wet laboratories and can interrogate historical instrument data.

Why This Is Important

Connecting laboratory instrument data usually requires point-to-point integrations and constant vigilance with instrument drivers. In most cases, instrument connectivity is possible through proprietary vendor-provided solutions. When lab systems are upgraded, the instrument drivers often need to be revalidated, which is time-consuming and costly. This new method for connecting instruments enables the lab informatics systems to be decoupled from instrument data capture, thus improving agility.

Business Impact

This technology enables the fast and efficient transfer of laboratory and scientific data, methods and results, which can then be shared across the laboratory and into different informatics systems. It decreases the amount of time it takes to connect complex laboratory data streams and realize value. Further, it allows companies to separate lab connectivity from specific lab informatics solutions, creating more flexibility for new workflows, analysis software and scientific informatics systems.

Drivers

While vendors in this space have only recently launched products, the technology is rapidly moving through The Peak of Inflated Expectations and will likely drop into the Trough next year. This is due to:

- Lab-of-the-future (LoF) or digital lab strategies where data is viewed as an asset.
- The availability of low-cost cloud infrastructure and SaaS software, minimizing on-premises assets in the laboratory.
- The desire for instrument companies to have flexible plug-ins to any virtual laboratory environment.
- The costs and staffing efforts associated with the shortcomings of proprietary instrument connections centered around electronic laboratory notebook (ELN) and laboratory information management system (LIMS).
- New tools and techniques for data mapping, live event streaming and data management.
- Rising costs of R&D and infrastructure.
- The drive for organizations to support connectivity and work-from-home policies.

Obstacles

- **IT complexity:** Most manufacturers do not want to add additional vendors into the lab toolkit.
- **Unclear validation:** Many clients and vendors are confused about how to best execute a GxP validation for lab data in the cloud. Today, most solutions are used for research, not for downstream manufacturing development or operations.
- **Total cost of ownership (TCO):** Without careful planning, the pricing models of the providers may escalate lab-related expenses.
- **Consulting conflicts of interest:** Lab IT consulting vendors often market their own capabilities for creating instrument connection modules, which may compete with the vendors in the space.
- **Limited regional footprint:** Many companies operate with global facilities. Yet, most of the vendors still only have spotty regional influence in the U.S. and parts of Europe.
- **Domain experience:** Most of the vendors have experience with pharma or biotech research labs. There are fewer references for successful implementations outside of the vertical industry.

User Recommendations

Evaluate the strategy for next-generation laboratory instrument connectivity and data processing with a digital LoF platform approach. In this new digital LoF platform approach, laboratory data is used more broadly as an asset. Consider implementing it if your current vendors cannot provide this capability.

Before running a POC with the vendors, think about and investigate:

- Integration points into other core systems such as inventory, ELN, LIMS, ERP and safety systems.
- The number of instruments and the instrument driver types.
- Requirements for the data life cycle.
- Life science or healthcare domain expertise of vendors, service providers and consultants.
- Requirements for the enrichment of the data.
- Requirements for archiving data.
- The ability of your group, outsourced consulting and software partners to support the approach.

Sample Vendors

Dotmatics; Ganymede Bio; Labforward; Scitara; TetraScience

Gartner Recommended Reading

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You’re Building a Truly Digital Life Science Lab of the Future?

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Innovation Insight for Digital Life Science Platforms

Market Guide for Laboratory Informatics

AI-Synthetic Biology Tools

Analysis By: Reuben Harwood, Michael Shanler

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition:

Synthetic biology is a multidisciplinary area of research that seeks to create new biological parts, devices and systems, or to redesign systems that are already found in nature. AI-enabled techniques and computational analysis are powering decisions to improve the designs, the modeling and the simulations for new biomolecules.

Why This Is Important

Synthetic biology represents a growth area for therapeutics pipelines, personalized medicines and materials innovation. Until recently, synthetic biology research was difficult to perform due to the intensive informatics process requirements, the lack of dedicated software and the deep scientific domain knowledge required to be effective. With the rise of AI, this discipline is poised to accelerate, enabling organizations to develop brand new molecules that can be synthesized on demand.

Business Impact

These tools will drive portfolio innovation across a range of areas — genetic engineering, sequencing, gene synthesis, molecular biology, biophysics, biosensors, multiomics research and sustainability efforts. These tools enable predictive design, development and modeling of new materials, which will ultimately be bioprocessed or biofabricated. Organizations building AI synbio capabilities will require large volumes of labeled, curated, high-quality and contextually rich data from experiments.

Drivers

- Portfolio innovation — Many organizations are looking to create brand new organisms and materials that are fit-for-purpose for specific diseases, diagnostics and materials in products.
- Scientific advancements — An explosion of scientific innovation and collaboration across multiple disciplines makes vetting synthetic biologies more amenable for more organizations.
- Materials advancements — Automation and technology have enabled materials advancements to evolve at faster rates using modeling software.
- Low-cost cloud infrastructure — It is easier than ever to deploy new tools and share those with more scientists.
- The rise in compute power — High-performance computing, quantum computing and quantum computing simulation costs are decreasing, which enables more research groups to actively pursue new synthetic leads.
- Intelligence solutions going mainstream — AI- and ML-based approaches are well-deployed in R&D organizations. These new tools enable scientists to make more predictive decisions across a range of applications (e.g., materials design, solubility and binding affinity).
- In silico innovation — In silico modeling tools are increasingly being used earlier in product discovery and development processes.
- Given the fast-paced development of AI and ML tools for synbio and adjacent fields, such as in silico research, we place this innovation just before the Peak of Inflated Expectations.

Obstacles

- Synthetic biology has a broad and confusing landscape. The inability to easily verify test data and results due to the scientific complexity creates a challenge for vetting lead candidates and designs.
- Synthetic biology data is complicated. This means ancillary systems and integration points will need to be upgraded to scale the tools into industrialized production systems.
- Organizations currently lack digital solutions capable of managing synbio data requirements.
- Know-how of consultants is somewhat low. As with any new area, synthetic biology is not well-understood by global consultancies, which makes piloting and scaling a technology difficult.

User Recommendations

- Explore with scientific and research stakeholders, if expanding enterprise synthetic biology capabilities makes the most sense. Many organizations may outsource the in silico and modeling work; however, if this is a desired core capability, explore bringing SaaS-based platforms into your R&D community.
- Determine the level of integration required by performing an analysis of common R&D or product development processes. Common integration points include biomolecular registration, assay request tools, laboratory informatics software, lab automation integration and assay databases.
- Determine the level of validation required and the platform requirements before committing to certain software packages. While there are many open-source, off-the-shelf tools available from GitHub and other research-oriented and scientific software repositories, such as SynBiopython and Synthetic Biology Open Language (SBOL), many of these scripts are hard to document and validate.

Sample Vendors

Absci; Amyris; Arzeda; ATUM; Conagen; DeepMind; Ginkgo Bioworks; LanzaTech; Telesis Bio; Twist Bioscience

Gartner Recommended Reading

Innovation Insight: Synthetic Biology in Medical Sciences

Infographic: Artificial Intelligence Use-Case Prism for Life Science Manufacturers

Quick Answer: How Is AI Being Used in Preclinical Drug Development?

Predicts 2023: Digital Transformation of Healthcare Beckons New Era for Life Sciences

Cell and Gene Therapy Platform

Analysis By: Reuben Harwood, Maria Nieradka, Michael Shanler

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition:

Cell and gene therapy (CGT) platforms are systems designed to help collect, analyze and prepare biological samples as therapies for patients. The American Society of Gene & Cell Therapy defines gene therapy as the use of genetic material to manipulate a patient's cells for the treatment of an inherited or acquired disease. Cell therapy is defined as the infusion or transplantation of whole cells into a patient for the treatment of an inherited or acquired disease.

Why This Is Important

Spurred on by the successful approval of new CGT products, life science companies are investing heavily in new platforms that support R&D. While research organizations have put experimental cellular therapies into practice for decades, solutions managing the end-to-end process did not exist until recently. Most CGT is supported using heavily customized supply chain and logistics software. A handful of vendors have developed configurable solutions that simplify the support and delivery of CGT.

Business Impact

Currently, most CGT operations are fairly manual and have complex and inefficient process steps that threaten the quality of delivery. Business teams are searching for marketed solutions that can meet timing, logistics and quality requirements. CGT solutions can automate many of these steps from a process and delivery perspective. They can also facilitate clinical trials and logistics and patient/subject/physician and manufacturer communications.

Drivers

- CGT is becoming a more centralized strategy at many pharmaceutical companies, augmenting traditional drug portfolios. Personalized medicines, individualized therapeutics and more targeted approaches to therapies are trends that are driving new business models and creating this market.
- There are currently 28 FDA-approved cell and gene therapies. The number of regulatory approvals is likely to rise significantly in the near future as more than 1,500 clinical trials for CGTs are currently registered in ClinicalTrials.gov. These cover a wide range of disease categories, such as oncology, rare diseases, regenerative medicine and others.
- The approval of the first CRISPR gene-editing therapy (from Vertex and CRISPR Therapeutics) may occur in 2023. If commercially successful, it will bring added momentum to the field of gene editing.
- The demand for CGT clinical trials has accelerated, making CGT platforms that match the therapy area essential to streamlining trials and getting commercial products to the market.
- The data associated with CGT increasingly has broader uses across the business throughout the product life cycle, from R&D and commercial areas to specialized manufacturing and supply chain operations. Those requirements are becoming more acute for organizations supporting a “personalized medicine” approach, where markets consist of individuals. Once patient, manufacturing, operations and clinical data policies are updated, CGT systems will be even more scalable for supporting different kinds of CGT research and medicine programs.

Obstacles

- High inflation has slowed the development of cell and gene therapies, with reduced investment in R&D and higher production and transport costs.
- Life science companies and other research institutes can expect adoption challenges due to the complex nature of these therapies. Solutions must support several different types of models: allogeneic (the donor is different than the recipient), autologous (the donor and patient are the same) and variations of stem cell and T-cell therapies.
- In each of these cases, clients have unique needs and wildly different interventions and touchpoints they must orchestrate among R&D staff, healthcare professionals, lab technicians and supply chain personnel. This will cause complexity in vendor selection and system design, delaying adoption.
- Given its early stage of adoption, we position this technology in the Innovation Trigger phase with plateau achieved in five to 10 years.

User Recommendations

- Ascertain from leadership (such as the chief science officer) if CGT platforms will be necessary to support your business strategy. Focus on the touchpoints between CGT and major systems, such as ERP, manufacturing execution systems, electronic batch records, quality management systems and patient and healthcare-facing systems.
- Evaluate whether the newly established vendors can provide the capabilities you need versus building a custom solution.
- Work closely with product leaders to understand the commercial challenges (such as high price per therapeutics), including payer contracts that may affect architecture- and CGT-related information communication.
- Ensure extensive process, clinical and IT system validation is performed by the software provider's organizations and that those vendors properly support CGT processes. Work with quality teams to verify that governance and policies are in place to maintain vigilant compliance and that patient privacy is protected.

Sample Vendors

Autolomous; Be The Match BioTherapies; CellPort Software; Cytiva; FarmaTrust; Hypertrust Patient Data Care; IDBS; L7 Informatics; Tenthpin; TrakCel

Gartner Recommended Reading

How Technology Can Support the Next Phase of Commercial-Scale Cell and Gene Therapies

Life Science CIO's Strategy for Delivering Cell and Gene Therapy Capabilities

Prioritize Patients in Supply Chain Design for Cell and Gene Therapies

AI Material Informatics

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition:

AI material informatics solutions are software and services that apply advanced learning techniques to materials-related big data for better-predicting results by the characteristics of each material. Typically, life science organizations apply the resulting insights to the use, selection, discovery and development of materials in downstream engineering, product development and manufacturing.

Why This Is Important

This technology enables organizations to move beyond loosely packaged material databases with light search functionality. It allows life science organizations to simplify customized, proprietary in-house systems or outsourced work with contract research organizations (CROs) that perform material science; or modify their own drug-discovery-oriented cheminformatics applications or electronic laboratory notebooks (ELNs). Machine learning, advanced analytics, and quantum computing simulation-based approaches are on the rise.

Business Impact

AI in material informatics can impact business as follows:

- Reduces the amount of time it takes to drive materials through in silico design processes.

- Drives candidates for new materials that were previously undiscoverable using existing methodologies.
- Streamlines recipe formulation as well as modeling reductions for toxicity and carcinogenicity.

Drivers

- As investments in materials engineering and science increase, and software engineers begin to embrace data science and machine learning capabilities, the footprint of AI-enabled material informatics solutions will expand and become more prominent.
- The desired capability is now part of strategic plans at many small and large enterprises including medical devices, diagnostics equipment manufacturers, food and beverage, oil and gas, materials, chemicals, crop science, battery, electronics manufacturers, automotive, and aerospace and defense.
- Many organizations are looking to replace their current standard data-capture approach with electronic laboratory notebooks (ELNs) and Laboratory Information Management Systems (LIMSs) and move to newer and more advanced platform-based experimental solutions. They also want to better leverage the data streams for downstream engineering software, such as computer aided design (CAD), computer aided engineering (CAE) and product life cycle management (PLM).
- Process integration will further fuel innovations and inspire new startups to bring more capabilities to market. We also expect established engineering software companies to look toward these smaller materials and informatics companies as potential acquisition targets or areas where they build their own capabilities. This trend will continue because the synergies between materials informatics and R&D engineering enable a broader perspective on the overall product life cycle.
- This technology has rapidly reached peak hype. Most manufacturers with R&D programs have moved into production with AI-related solutions in the domain of materials development.

Obstacles

- Building out an AI strategy requires data to be machine-learning-readable, yet many organizations have not performed the data refinement needed.
- Clients often report that their own internal R&D datasets lack standards, governance and data principles, especially as it is transferred between ELN, LIMS, PLM, CAD and CAE systems.
- Most clients are still operating without a platform strategy to manage and govern scientific, laboratory, and formulation data, which is required to power and train the algorithms with proper datasets.
- CIOs report that they have multiple competing internal AI platforms, analytics software packages and custom-made software that is difficult to keep validated.
- Developing an AI-enabled materials strategy means addressing data and infrastructure fundamentals (such as data management, platform requirements and data resolution) while engaging shadow IT in the lab, which is often challenging to influence.

User Recommendations

- Collaborate with R&D and manufacturing business leads to understand which capabilities need to be augmented in the life cycle roadmap. Although advanced analytics applications represent a new space, the R&D staff required to operate these systems must be more scientifically oriented.
- Assess targeted pilots because it will take five to 10 years before these systems are fully simplified to mesh seamlessly into broad product development processes.
- Map the value of these systems to arrange data, especially if the system will learn based on existing datasets. Ensure stakeholders understand the fidelity and resolution of vendor-provided or public datasets.
- Align the materials informatics strategy to the product life cycle strategy before extending the application to the rest of the R&D enterprise. Most new instances of AI-enabled materials informatics will be targeted toward specific R&D functional areas and disciplines.

Sample Vendors

Ansatz AI; Atinary Technologies; Citrine Informatics; Kebotix; Mat3ra.com (previously Exabyte.io); Materials Zone; MatSci AI; Polymerize; Schrödinger; Uncountable

Gartner Recommended Reading

Tool: Build, Buy or Ally Decision Framework for Life Science R&D IT

2023 CIO and Technology Executive Survey: A Process Manufacturing Perspective

Applying AI in Industries

Applying AI — A Framework for the Enterprise

Generative AI in Life Sciences

Analysis By: Michael Shanler

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Definition:

Generative AI can generate new derived versions of content, strategies, designs and methods by learning from large repositories of original source content. Generative AI has profound business impacts, including on content discovery, creation, authenticity and regulations, automation of human work, and customer and employee experiences. In the life science industry, generative AI can be applied for a wide range of scientific, medical and commercial purposes.

Why This Is Important

Generative AI exploration is accelerating, thanks to the popularity of Stability AI (Stable Diffusion), Midjourney, ChatGPT and other applications leveraging large language models (LLMs). Today, life science organizations are aggressively experimenting with generative AI to help tune AI for images, videos, audio, molecular- and engineering-based formats. Use cases include identifying new drug targets, improving clinical site selection, monitoring drug reactions and accelerating marketing content development.

Business Impact

Most technology products and services will incorporate some form of generative AI capabilities in the next 12 months, in turn, leading to their democratization. Generative AI will progress rapidly, especially in the area of scientific discovery and technology commercialization. The technology will have broad impacts for the entire organization, including education and training for appropriate use; updates to security and governance; and skills investments.

Drivers

- ChatGPT is a very hyped technology and the number of technology proofs of concept have escalated.
- Life science industry's interest in generative AI is rapidly growing. Engagements with analysts are significantly up to explore capabilities and vendors. Enterprises are examining generative AI as employee-facing tools for assembling information and creating reports that aggregate information from financial, HR, learning management and project management functions.
- In life science commercial operations, the technology is being explored for publication summarization in medical affairs as well as generating market performance insights for sales and marketing business users.
- Generative AI is already speeding up the drug discovery process. This includes creating research article drafts, aggregating research intelligence, identifying novel targets and predicting novel drug-like chemical structures, and generating validation reports,
- Generative pretrained transformer (GPT) enables non-native English speakers to be included in collaborations across the scientific community.
- Clinical and regulatory leaders are exploring the technology to improve site selection, develop enrollment, recruitment and retention reports, aggregate clinical intelligence findings, and create clinical summaries.
- Manufacturing, quality and supply chain staff are using the technology for creating SOPs for recipe and formulation, developing procedures for laboratory workflows, and assembling regulatory information.
- Generative AI will disrupt "low code" and "no code" software programming. Combined with development automation techniques, it can automate 30% to 40% of programmers' work. This is highly attractive across the life science value chain, especially with informatics and analytics applications teams due to prevalence of "high code" technology and heavily customized legacy systems.
- We are introducing this technology at the peak, and expect it to reach a plateau in two to five years.

Obstacles

- A wide range of new regulations on generative AI are emerging globally. For instance, in 2023, a call to pause giant AI experiments (Future of Life Institute) for six months was signed by many AI and technology dignitaries.
- The risk of generative AI creating incorrect scientific assumptions or recommendations that put patients at risk is causing pause at many organizations.
- Corporate policy on use of generative AI, especially those leveraging public models and applications, is driving “fit for purpose” rubrics while updating and educating staff on intellectual property, trust and privacy issues.
- The black-box nature and a lack of experience with a full AI life cycle for proprietary systems might preclude the use of generative AI for critical use cases where there are high barriers to explainability or validation.
- The validation requirements, such as GxP can challenge use of the tool in operations and decision making, as regulatory guidance on AI validation remains unclear.
- Some vendors will use generative AI terminology for trying to sell subpar “generative AI” solutions.

User Recommendations

- Accelerate clear and effective internal communications by ensuring business, clinical and technology leaders have a common set of definitions for key terms in generative AI and a foundational understanding of how LLMs, such as GPT, work.
- Establish a technology leader as the enterprise subject matter expert on generative AI technology by allocating time for this individual to digest industry updates as they unfold, create guidance and communications for leadership, and oversee experimentation and learning across the broader organization.
- Identify initial use cases where you can improve your solutions with generative AI by relying on purchased capabilities or partnering with specialists. Consult vendor roadmaps to avoid developing similar solutions in-house.
- Ensure your vendor partnerships are positioning their products and services to maximize the value and manage the risk by making generative AI a regular point of discussion.

Sample Vendors

Amazon; Atomwise; Google; Huma.AI; insitro; Microsoft; OpenAI; Schrödinger; Stability AI; Tencent

Gartner Recommended Reading

Innovation Insight for Generative AI

Emerging Tech Roundup: ChatGPT Hype Fuels Urgency for Advancing Conversational AI and Generative AI

Emerging Tech: Generative AI Needs Focus on Accuracy and Veracity to Ensure Widespread B2B Adoption

Glossary of Terms for Generative AI and Large Language Models

Large Language Models in HCLS

Analysis By: Jeff Cribbs, Sharon Hakkennes, Michael Shanler

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition:

Large language models (LLMs) in healthcare and life sciences (HCLS) are a type of foundation model trained on large volumes of unlabeled textual data. Applications can use LLMs to accomplish a wide range of tasks such as content generation, content summarization, search, code generation, language translation and conversational chat for HCLS industry applications.

Why This Is Important

LLMs have demonstrated surprising and significant capabilities across industries and are likely to be a standard feature of both personal and enterprise technology experiences in just a few years. Within HCLS, LLMs' achievements in demonstrating medical knowledge, engaging patient questions with empathy and insight, and parsing complex administrative scenarios have been remarkable. HCLS technology leaders have been tasked with planning a strategic response.

Business Impact

LLMs will first impact areas where they can be deployed with simple design patterns and areas with higher tolerance for error and correction. Early pilot examples include autogeneration of clinical trial intelligence reports, natural language interaction with business intelligence, ambient digital scribes and scientific literature search. Long term, LLMs have the potential to disrupt many critical functions — from research agents and office visit discharge notes to interoperability protocols.

Drivers

- The general release, explosive adoption and media attention given to ChatGPT — just one of many applications leveraging LLMs — has captured enormous mind share of healthcare business, clinical, and technology leaders alike. This has drawn significant strategic planning attention in 2023, though the real investment result is still to be seen.
- A steady cadence of healthcare technology vendors are announcing integration with LLMs.
- Large technology companies are making enormous investments in developing new LLMs and applying them to new application areas, demonstrating and broadcasting their achievements in a race to achieve a strong position in the LLM space. For example, Microsoft Health Bot is being integrated with Azure OpenAI services.
- Medical and healthcare policy research will drive deeper understanding of the risks and virtues of LLMs in healthcare use cases. As this emerges, HCLS organizations will gain comfort in embarking on more ambitious use cases.
- A pressing need to reduce the contribution of healthcare technology to worker (especially clinician) burn-out will drive investment in use cases like digital scribing and patient message responses.
- A tightening fiscal environment combined with structural changes in patient populations drive the need for increased efficiency of the workforce. This will drive long-term use cases like chat-based self-triage and navigation, and automated back-office functions.
- Initiatives focused on improving data literacy, analytics self-service and data-driven decision making will drive interest and investment in chat-based interfaces with business intelligence and analytics platforms, whether those are deployed within functional applications (EHR, ERP, claims processing) or enterprise analytics.

Obstacles

- Software vendors and consultants often use the GPT, LLM and generative AI terms interchangeably. This creates confusion about what the technologies actually are, the relationships between them, and what is realistically achievable with investments.
- There is widespread misunderstanding of the technology. This results in unproductive strategic discussions and reflexive governance decisions to restrict or prohibit use of LLM tools.
- Truly transformative use cases will require higher degrees of proven accuracy and safety than the 80% to 90% general performance LLMs demonstrate today. This last decile of improvement often reveals complicated fringe scenarios and engineering challenges that take many years to resolve.
- LLM outputs are not currently explainable — at least, not in the sense we are accustomed to in healthcare when we validate rule-based software, clinical protocols or efficacy studies. LLM use case adoption will be constrained by the need for transparency about decision making.
- There is significant uncertainty about the future regulatory environment for LLMs. Issues include intellectual property in LLM training datasets, privacy and confidentiality of enterprise data, and legal liability for content generated by the LLM.

Analysts' Notes: It is difficult to position a technology moving as quickly as LLMs in an annual publication. We take enterprise deployments of LLMs (largely via cloud APIs) as our numerator to arrive at the low end of 1% to 5% of HCLS organizations. We place LLMs at the peak of hype and predict a year of vendor integration announcements, regulatory starts and stops, and reality checks for the near-term value of today's LLMs. Next year, we are likely to see new, specific use cases emerging across the HCLS Hype Cycles.

User Recommendations

- Accelerate clear and effective internal communications by ensuring business, clinical and technology leadership teams have a common set of definitions for key terms in generative AI and a foundational understanding of how LLMs work, along with their risks.
- Establish a technology leader as the enterprise subject matter expert on generative AI by allocating time for this individual to digest industry updates as they unfold, create guidance and communications for leadership and governing experimentation and learning across the organization.
- Engage your patient populations directly by convening sessions with patient advisory groups to understand current utilization of ChatGPT, ascertain perceptions of the technology, observe first usage where possible and trial messaging for safe patient usage.
- Ensure your vendor partnerships are positioning their products and services to maximize the value and manage the risk presented by LLMs by making generative AI a regular point of discussion.

Innovation in Practice:

- Three health systems (UC San Diego Health, UW Health in Madison, Wisconsin, and Stanford Health Care) are piloting the use of GPT-4 to autogenerate responses to patient messages in the EHR. These draft responses are reviewed and revised as necessary by the clinician prior to sending.

Sample Vendors

Facebook; Google; Microsoft; NVIDIA; OpenAI; Palantir

Gartner Recommended Reading

GPT-4 Impacts and Actions in Healthcare and Life Science

Board Briefing: Understanding ChatGPT, Other Large Language Models and Their Risks

Quick Answer: What Healthcare Provider CIOs Need to Know About LLM Applications Such as ChatGPT

AI Design Patterns for Large Language Models

Augmented Analytics

Analysis By: David Pidsley, Anirudh Ganeshan

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition:

Augmented analytics uses AI to automate analytics workflows in platforms, contextualizing user interfaces with automated insights, generative storytelling explanations and collaborative exploration. Driven by ML and generative AI, it enables natural language queries and personalized analytics catalogs. It democratizes advanced analytics with augmented data ingestion, preparation, analytics content and DSML model development. It also curbs human biases and accelerates insights for diverse users.

Why This Is Important

Many activities associated with data, including preparation, pattern identification, transformation, model development and insight sharing, remain highly manual. This friction limits the user adoption and business impact of analytics. Enhancing these capabilities with generative AI democratizes analytics and reduces barriers to entry by allowing users to perform complex analytics tasks with low/no code.

Business Impact

Augmented analytics is transforming how users interact with analytics content. Features like conversational interfaces are making analytics more accessible, explainable and expedient. Generative AI is changing how people interact with augmented analytics, enabling access to deeper insights from data. Once confined to experts only, insights from advanced analytics are now in the hands of business analysts, decision makers and operational workers across the enterprise. These augmented consumers are driving new sources of business value.

Drivers

- Organizations increasingly want to analyze more complex datasets combining diverse data from both internal and external sources. With an increasing number of variables to explore in such harmonized data, it is practically impossible for users to explore every pattern combination. It is even more difficult for users to determine whether their findings are the most relevant, significant and actionable. Expanding the use of augmented analytics will reduce the time users spend on exploring data, while giving them more time to act on the most relevant insights.
- Generative AI has accelerated market interest in dynamic data stories and other combinations of augmented analytics features that automate insights. Generative AI combines augmented analytics with natural language query, natural language generation, and anomaly detection to dynamically generate data stories for users in their contexts. This type of multiexperience UI will reduce the use of predefined dashboards for monitoring and analysis, and increase the use of augmented analytics.
- Vendor technology innovation is pushing augmented analytics forward. With the explosion of generative AI, augmented analytics is receiving heightened attention. ABI platforms are now integrating large language models like GPT-4, allowing users to generate, debug and convert code, create data stories, and aid in data preparation. This integration has also enabled newer users to emerge, fueling analytics adoption. In a next wave of generative analytics experiences, users may see the entire workflow become AI-driven.
- Most organizations leverage multiple ABI platforms, causing exponential proliferation of analytics content. Coupled with a lack of governance, this proliferation often leads to inconsistencies in metrics and insights, duplication of reports and dashboards, and an overall decline of trust in data. Hence, analytics catalogs, powered by augmented analytics capabilities with generative AI, are becoming key in allowing users to find and recommend analytics content.
- By integrating with digital workplace applications (e.g., Microsoft Teams and Slack), augmented analytics features allow users to share and collaborate on insights.

Obstacles

- **Lack of trust in autogenerated models and insights:** Organizations must ensure that the augmented approach is transparent and auditable for accuracy and bias. They must establish a process to review and certify analyses created. These guardrails are especially important with generative AI being included within ABI platforms.
- **Training and rapidly evolving skills needs:** Obtaining desired skill sets and data literacy standards is a never-ending challenge, and leaders need broad and diverse training for multiple personas.
- **Ecosystem requirements:** It will be critical to build an ecosystem that includes not only tools, but also data assets, people and processes to support the use of augmented analytics.
- **Cultural barriers:** Analytics developers writing analytics-as-code and business analysts accustomed to visual self-service analytics may regard augmented analytics as a "nice to have" feature. However, they neither utilize nor rely on it in their analytics content production workflows.

User Recommendations

- Identify the personas and use cases that will benefit most from augmented analytics capabilities.
- Ensure that users can get value from new augmented analytics features by providing targeted and context-specific training. Invest in data literacy to ensure responsible adoption.
- Focus on explainability as a key feature to build trust in autogenerated models. Create learning opportunities for those who wish to know more about the theory and inner workings of augmented analytics solutions.
- Assess the augmented analytics capabilities and roadmaps of ABI platforms, data science platforms, data preparation platforms and startups as they mature. Look into the upfront setup and data preparation required, the range of data types and algorithms supported, the integration with existing tools, the explainability of the models, and the accuracy of the findings.
- Provide incentives for citizen data scientists to collaborate with, and be coached by, specialist data scientists who still need to validate models, findings and applications.

Sample Vendors

AnswerRocket; iGenius; Microsoft; Oracle; Pyramid Analytics; Qlik; Sisense; Tableau; Tellius; ThoughtSpot

Gartner Recommended Reading

Market Guide for Augmented Analytics

Magic Quadrant for Analytics and Business Intelligence Platforms

Critical Capabilities for Analytics and Business Intelligence Platforms

Is Your Business Intelligence Enabling Intelligent Business?

Top Trends in Data and Analytics, 2023

AR/VR/MR in Life Science

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Definition:

Augmented reality (AR), virtual reality (VR) and mixed reality (MR) in life science are technologies that create immersive experiences for consumers, patients and employees. Within life science organizations, these applications span a range of business functions, including R&D, quality, manufacturing, therapy, field service and commercial.

Why This Is Important

AR/VR/MR technologies are rising in prominence as life science business users look to create more immersive experiences, improve collaboration and digitalize operations. These technologies allow for new ways to engage individuals, assets and information. Gartner expects increased applications and sophistication in a range of application areas that can help design and deliver better products, improve compliance in regulated processes, and assist with the creation of better user experiences.

Business Impact

AR/VR/MR will have the following business impacts:

- AR increases throughput, collaboration, quality, compliance and insights in the areas of labs, inventory, storeroom, diagnostics, and stockroom logistics and planning.
- VR is commonly used for molecular design, physician education, and manufacturing and facility design.
- While AR and VR are more mature technologies, MR is still evolving. It doesn't have as many clear business benefits beyond the current, more narrow applications — like logistics, robotic surgery, field service and sales enablement.

Drivers

- As health models evolve and new devices are coming online, organizations are funding more proof of concepts (POCs) for remote, digital and clinical experiences. This is driving adoption of AR, VR and MR.
- The popularity of immersive experiences as digital work tools has increased due to the effects of work-at-home policies. Most organizations have continued these staff engagement strategies now that digital workplace strategies have become the norm in many organizations.
- Consumer technologies have advanced to the point where AR and VR headsets are at manageable price points. Hardware usability and battery life are now amenable for mainstream consumption.
- New applications are being elevated and old ones are being reimagined. For example, apps for cancer lesions and skin health have existed on smartphones for over a decade for in-person doctor visits. Today, data collection — via in-person AR glasses capabilities — is being combined with remote cancer lesion detection using apps.
- VR gear has been adapted into molecular modeling simulation for R&D engineers and scientific groups.
- VR is in used for molecular modeling, optimizing facilities, physician training and patient education. It is also being used in clinical therapies, such as cognitive behavioral exposure therapy, PTSD, depression and dysmorphia, stroke, attention deficit, and autism spectrum disorders.
- MR is being piloted by numerous companies in medical devices (such as robotic surgical instruments), in sales enablement for socially distanced medical devices sales reps, and in field service engineering on analytical equipment. It is currently in limited use in plant operations and warehouses, where engineers make virtual changes to substrates (bodies, tissues, software and hardware), with automation updating the changes in reality.
- Based on this broad range of early implementations and excitement about the technology, we position this technology at the peak.

Obstacles

- Many life science teams are piloting the technology in vacuums, without a clear vision, resulting in failed attempts to move beyond POCs.
- Many vendors offer AR/VR/MR capabilities, but only a few can really support compliance and regulatory needs in the life science market.
- Most AR/VR/MR vendors don't have specific life science capabilities and need to be educated on electronic protected health information (ePHI), Health Insurance Portability and Accountability Act (HIPAA), good x practice (GxP) and validation activities. Life science firms can't quickly adopt the technology due to limited applications and form factors, along with few vendors that deeply understand the life science domain.
- Creating and maintaining regulatory-approved content, especially for VR use cases in promotional settings, is costly.
- Hardware design for wearable devices has improved, but they are still not easily applied into life science environments. For e.g., many AR/VR headset users report fatigue and some report nausea.
- We don't expect MR to show broad value until applications, hardware and informatics mature.

User Recommendations

- Evaluate with business peers the business justification for offering an AR/VR/MR capability either by building, buying or partnering.
- Review adjacent industry spaces to see where the innovations are delivering value. Specifically, life science clients have a lot to learn about how to pilot and scale AR/VR/MR from aerospace and defense, retail, and healthcare providers.
- Factor in extra staff resources and time in project plans to educate vendors on your specific compliance issues, like ePHI, HIPAA, GxP and life-science-specific validation. This is especially the case when dealing with "platform vendors" that do not have life science applications or consulting practices.

Sample Vendors

Apprentice; EON Reality; FundamentalVR; Goodly Innovations; Nanome; NNIT; PIXACORE; SightCall; Simplifier; SimuLyve International

Gartner Recommended Reading

Emerging Tech: Impact of Metaverse on Edge Devices and Infrastructure

Emerging Tech Impact Radar: Display Technologies

Quick Answer: What Are the 5 Essential Attributes of an Emerging Metaverse in Manufacturing?

Market Guide for Corporate Learning Technologies

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

IoT-Enabled Laboratory

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

Internet of Things (IoT)-enabled laboratories leverage sensors, beacons and systems, such as instruments, informatics systems and smart consumables, for communicating information between lab entities. By leveraging analytics across the portfolio of IoT-enabled capabilities and connecting previously disconnected data elements generated from the existing instrumentation, users can monitor performance and generate new insights. IoT enablement is foundational for the laboratory of the future (LoF).

Why This Is Important

Connecting laboratory entities helps in contextualized data exchanges and the enhanced evaluation of test results and analysis. IoT is no longer nascent in the lab space. While many organizations are still exploring how to connect entities such as lab equipment (e.g., pH meters and balances), laboratory informatics (e.g., ELN and LIMS), and smart consumables (e.g., buffers and reagents) with enterprise assets (e.g., RFID badges, ERP and environmental, health and safety [EH&S]), a small number of organizations have gone into full production.

Business Impact

IoT-enabled laboratories and connecting labs help CIOs and IT leaders enable:

- Smart lab and LoF strategies, driving autonomous processes based on algorithms and machine learning that leverage IoT data
- Organizations to converge their virtual and physical work and create digital twins for lab processes, improving innovation, efficiency, quality and compliance

Drivers

- Both PRISME and Pistoia Alliance included LoF as a topic at annual meetings over the last four years.
- Nascent strategies related to LoF, such as digital lab, laboratory 4.0 and Internet of Lab Things (IoLT), have taken root.
- Several instrument vendors are offering cloud-based IoT platforms. However, these are initially designed for remote field service and asset tracking and monitoring.
- A variety of vendors now enable data-lake-based instrument data management, which divorces lab connectivity components from traditional lab informatics packages such as electronic laboratory notebook (ELN) and laboratory information management system (LIMS) software.
- Given that most lab staff are now realizing the larger consulting service firms have limited knowledge of laboratory processes, the lab IT consultants aren't as familiar with IoT best practices, and the traditional laboratory informatics and automation software vendors have challenges with data management and regulatory compliance, we position this technology just past peak hype. It will quickly slide into the trough within the next two years.

Obstacles

- Life science institutions with laboratories already have high capital spending, hence incremental spending with clear ROI will be hard to justify. We expect smaller proofs of concept for IoT before typical users undertake any extensive approaches to modernize laboratory environments.
- IoT devices and platforms can be complex, and the setup and configuration process may require specialized knowledge and expertise. This can be a barrier for some organizations, particularly smaller ones that may not have dedicated IT resources.
- Incremental technology investments in tools and staff will be required in order to make sense of the data and leverage the analytics for insights.

User Recommendations

- Outline the business benefits your organization can achieve by “going digital” in its laboratories. Focus on how people, systems and things on equal footing will create new possibilities to improve quality, accelerate innovation and improve operational effectiveness.
- Identify opportunities for LoF efforts by focusing on where IoT analytics can lead to innovation, quality, operational efficiencies and improved safety/risk monitoring.
- Define “digital business moments” and model examples for laboratories that will have direct impacts on creating new value by identifying outcomes such as faster time to data lock, improvements in instrument operations and higher compliance.

Sample Vendors

Apprentice; Bosch Digital; Connected Labs; Elemental Machines; Labforward; Monnit; Scitara; Simplifier; TetraScience; WattIQ

Gartner Recommended Reading

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You’re Building a Truly Digital Life Science Lab of the Future?

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Sliding into the Trough

Blockchain in Life Sciences

Analysis By: Michael Shanler

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition:

Blockchain platforms provide the foundation to create and run blockchain solutions and decentralized networks. This includes support for distributed ledgers, decentralized consensus, tokenization and smart contracts. They enable the creation of blockchain solutions that provide immutability, transparency, decentralized contract execution, and tokenization of physical or digital assets. In life science (LS), blockchain can facilitate the secure exchange of health and LS manufacturer information.

Why This Is Important

Primary applications of blockchain technologies in the LS industry include anti-counterfeiting (serialization), genomic and/or clinical data sharing, revenue management and materials transfer. It is a popular strategy topic with Gartner clients, especially as blockchain-based topics run rampant in the mainstream media and organizations attempt to transform operations. Although blockchain is still hyped across many industries, the LS industry continues to be slower than others to develop use cases into production.

Business Impact

The impacts of blockchain in LS are:

- Blockchain and distributed-ledger concepts hold the promise of transforming LS industry operating models. Transformations are just beginning with projects such as PharmaLedger, Zuellig Pharma Holdings and MSD, and are largely unproven at scale.
- LS organizations want to reach new customers, extend relationships with supply chain partners, improve quality and create more complete links between events.
- Executives want to move the boundaries of traditional LS businesses including enabling direct-to-consumer models.

Drivers

- The number of active blockchain projects within the LS industry grew from 2020 to 2023. For example, Merck & Co. and Novartis are running very public supply-chain POCs. Gartner clients report a rise in blockchain to support platform-centric ecosystems including projects such as PharmaLedger. See Supply Chain Executive Report: Realizing the True Potential of Ecosystem Partnerships.
- Industry consortia have been active as well with 12 pharmaceutical companies joining PharmaLedger, an EU blockchain consortium.
- Some clients are exploring concepts where blockchain would streamline clinical trials and extended regulatory filings, exchange genomic information, manage intellectual property generation, handle payments to drug distributors, and conduct health record and exchange transactions.
- Blockchains are supporting technology architectures and digital interoperability for transitioning toward more tailored medicines, patient-centricity and virtuous cycles of data centered in and around cradle-to-grave product life cycle management.

Obstacles

- LS industry stakeholders are learning that blockchain-based models are difficult to scale due to disagreements on the degree of centralization and channels.
- Most industry professionals have still not settled on the right type of governance to drive the necessary innovation, collaboration and cultural shifts.
- Digital maturity, legacy infrastructure and siloed work practices could limit value realization for blockchain discovery or readiness to deploy.
- Today, there are few vendors, IT consultant firms and sponsor organizations that have a deep LScapability and that understand blockchain models and underlying technologies.
- There are only a few successes with scaling blockchain pilots for track and trace, verification services and wholesalers, much of which is driven by regulations such as the Drug Supply Chain Security Act (DSCSA) via stakeholder-led models.
- Blockchain was extremely hyped a few years ago, but many clients now realize the limitations and challenges. For this reason, this technology is positioned on the trough.

User Recommendations

- Assess the impact of change across the LS sector. The terminology surrounding blockchain is also in flux. This uncertainty masks the potential ability to meet business use cases.
- Identify how the term “blockchain” is being applied, both internally and by providers, to better understand the return on capital employed, especially compared to (or augmented with) existing, proven technologies.
- Proactively learn the differences between the four implementation options as part of your organization’s strategic planning efforts, especially as they relate to specific business use cases and operational risk assessments.
- Assign resources to track the evolution of blockchain across industries, such as consensus mechanism development, sidechains and distributed ledger.
- Develop knowledge around vendor solutions’ evolution, especially through formal stakeholder-led models addressing critical requirements, compliance mandates and the success of resulting proofs of concept (POCs).

Sample Vendors

Bloqcube; Chronicled; EncrypGen; EY; Genecoin; Nebula Genomics; Schrocken; ServBlock; Tech Mahindra; Wipro

Gartner Recommended Reading

Guidance for Blockchain Solution Adoption

Power of the Profession Supply Chain Awards 2023: Global, Social and E2E Innovation Rise

The Future of the Supply Chain for Life Sciences — 2023 Report

Supply Chain Executive Report: Fostering a Digital Supply Chain Ecosystem

Gartner’s Top Strategic Predictions for 2023 and Beyond — Seizing Uncertainty

SaaS Workbench for Genomics Research

Analysis By: Reuben Harwood

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

A SaaS workbench for genomics research integrates cloud computing with a suite of bioinformatics tools for analysis and discovery using genomic data. Analysis of high throughput genomics data is a complex and compute-intensive task that generally requires numerous software tools and large reference datasets, tied together in successive stages of data transformation and visualization. A SaaS workbench helps researchers manage, analyze and visualize genomics data effectively.

Why This Is Important

The field of genomics is maturing as a demanding domain that requires a complex ecosystem of tools, technologies, computer power and data management capabilities. A SaaS workbench can provide access to the required computation resources, at scale, to process, analyze and generate insights from experimental data through multistep pipelines.

Business Impact

The value of SaaS workbench for genomics research is demonstrated across multiple areas, including:

- Extended support for data pipeline and platform operations (e.g., data annotation, visualization and application integration).
- Streamlined processes and improved stakeholder collaboration.
- Dynamic scaling of workflows with business demands, and integrating multiple data types to support new ventures (e.g., multiomics research).
- More secure and reliable infrastructure via big cloud vendor services.

Drivers

- Next-generation sequencing (NGS) technology has radically democratized access to data and is enabling genomics experimentation with larger datasets.
- The rapid proliferation of NGS data and analytic bottlenecks means that demand has far outpaced the supply of bioinformaticians, who often spend a significant amount of time managing data through common workflows. Researchers require a SaaS workbench with more advanced tools and streamlined processes.
- Maturation of analysis workflow platforms allows biologists with little expertise in programming to manipulate and analyze data on high-throughput computing clusters, lowering the barrier to entry and expanding the potential end-user group.
- Many genomics SaaS providers leverage the services of leading cloud providers that have also developed offerings to support genomics workflows (e.g., Amazon Omics, Microsoft Genomics on Azure and Google Cloud Life Sciences).
- Researchers need a workbench that supports both genomics analysis (tools to process and analyze large amounts of genomics data, such as Bowtie, BWA, GATK) and genomics visualization (tools to reveal and communicate insights into patterns and relationships in genomics data, such as IGV, JBrowse, NCBI Genome Data Viewer).
- Algorithms and tools developed for new omic technologies (particularly sequencing), as well as visualization tools for exploring data, prompt iterative updates to the genomics workbench. Data analytics, including AI and machine learning, now have great potential to aid new discoveries leveraging that data.
- Pressure on researchers to demonstrate reproducibility of findings from experimentation drives leaders to establish consistent workflows and stability across the multistep genomics pipeline.
- With this renewed emphasis on genomics, Gartner is accelerating this innovation's Hype Cycle advancement to midway between the Peak of Inflated Expectations and the Trough of Disillusionment. We believe it will achieve mainstream adoption within the next two to five years.

Obstacles

- The tools, platforms and data services needed for best-practice genomics are generally complicated to install and customize. They also require significant computational and storage resources, and usually involve a high level of ongoing maintenance to keep the software, data and hardware up to date.
- Establishing an appropriate computational platform requires a large upfront investment in hardware, experience and expertise. This challenge is compounded by the trend toward larger experimental data.
- Historical, laboratory-level technology investments and researcher bias toward existing vendors can hinder the genomics workbench implementation needed to solve IT scalability and flexibility challenges.
- Researchers and life science and healthcare providers demand genomics raw sequencing data, analysis and recommendations from sequencing data be integrated into their electronic health record (EHR) system. Interoperability remains a barrier to information exchange among scientists, providers, patients and families.

User Recommendations

- Assess the preparedness of your organizational genomic data collection and analysis strategy and plan to modernize legacy applications toward the packaged business capability (PBC) model.
- Opt for the attributes of composability when assessing new vendor capabilities or solution offerings and when renewing contracts with incumbent vendors.
- Prepare IT architecture to accept a diverse array of patient data sourced from genomics and other omics technologies, as well as from mobile apps and devices, wearables, patient-reported data, social determinants of health and other sources.

Sample Vendors

10x Genomics; DNAnexus; Dotmatics; Genedata; Igenbio; Illumina; L7 Informatics; QIAGEN; Velsera; Watershed

Gartner Recommended Reading

Quick Answer: What Are the Advantages of Leveraging Cloud Technologies in Life Science Omics R&D?

Healthcare and Life Science CIO's Genomics Series: Part 1 — Understanding the Business Value of Omics Data

Healthcare and Life Science CIO's Genomics Series: Part 2 — Formulating an Omics Vision

Healthcare and Life Science CIO's Genomics Series: Part 3 — Prioritizing Omics Investments

AI in Drug Discovery and Early Research

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

Artificial intelligence (AI) in drug discovery and early research represents the use of AI disciplines to improve aspects of early R&D and scientific research activities. This umbrella covers machine learning (ML) and deep learning (DL), natural language processing (NLP) and generation (NLG), and generative AI and AI-enabled advanced analytics to evolve drug discovery and related scientific, molecular and biologic leads before next-stage clinical phases of R&D.

Why This Is Important

AI in early drug discovery is a fast-moving area of innovation. New investments proliferate in various AI types and use cases, and the number of application areas that have moved from proofs of concept (POCs) into production is accelerating.

Business Impact

R&D application areas with impacts on time, cost, quality and new insights include:

- Generative AI for research positioning, including large language models and ChatGPT
- NLP for publication search
- Causal ML for preclinical toxicity testing

- Semantic knowledge graphs for biomarker research
- Advanced text analytics for experimental protocol optimization
- Deep learning for molecular structure modeling
- Knowledge graph creation for key opinion leaders
- Advanced search and curation for research metadata
- ML and NLP for target identification and discovery
- Neural networks and ML for repurposing compounds

Drivers

- Despite recent hype in the popular press about AI generally, the technology is already well-known and well-advanced in life science. AI in pharmaceutical research is already establishing a track record among scientists for accelerating drug discovery activities and reducing the time to preclinical phases. In some organizations, use cases like scientific searches, lead selection and toxicity predictions have reduced precious time for processes that previously took years down to weeks or months.
- R&D IT leaders understand there is truth behind the hype. AI in drug discovery and early research areas increases efficiency, and thus, reduces both costs and the timeline to achieve R&D milestones and improves confidence in the R&D portfolio. AI tools enable R&D organizations to be more insightful and achieve faster decision making.
- Adoption continues to accelerate. Most large life science organizations have already built out ML and data science capabilities, including platforms and low- and no-code developers' tools for researchers. In contrast, smaller life science firms often bring in AI capabilities via partnerships with academic research organizations, biotechnology companies or IT and vendor partners that offer as-a-service models.
- High-value use cases continue to evolve and mature. Aspects of AI, such as ML and DL, can enable better predictive capabilities based on patterns in static data supplemented by ongoing learning from evolving datasets, including real-world data. This learning typically validates or invalidates assumed relationships or enables the discovery of new ones.
- Other types of AI, such as NLP and large language models (e.g., GPT), enable the structuring of large unstructured datasets, making sense and order from scientific research observations, enabling the automated discovery of previously hidden insights.

Obstacles

- Quality and business leaders will struggle to overcome challenges with the validation of AI processes as new data formats and scientific datasets become ML-ready. Therefore, we see this group of technologies sliding down into the Trough of Disillusionment as IT and business partners wrestle with the difficulties of AI.
- Many organizations remain challenged in building up a bench of AI experts to support initiatives. R&D, informatics and IT teams must continue to develop governance, skills and the technology platforms to drive business success in AI.
- With so much AI being driven into individual groups of scientists by vendors, there is a high probability of competing platforms, vendor management issues, validation challenges and governance issues that will require orchestration and ongoing mediation.
- Many R&D groups apply AI in isolation and will see difficulty in expanding AI capabilities across research platforms. Many clients continue to report that their initial POCs are not scaling easily.

User Recommendations

- Align specific technologies and datasets with the associated research and drug discovery business activities to succeed with AI. R&D IT leaders must evaluate potential applications in specific disciplines and specify the leading technologies and vendors with associated competencies.
- Develop data science and engineering capabilities in parallel with AI technology acumen. Resourcing, technical abilities, management focus and investment, maturity, and culture are major elements to consider when making the decision to develop AI capabilities.
- Leverage hosted AI services, and build this out with a blend of internal and contract resources.
- Build AI capabilities using a data science or ML platform as a foundation.
- Purchase or rent software solutions from “niche,” industry-specific vendors that have an existing AI capability, a competent bench of experts and mature use cases.

Sample Vendors

Dassault Systèmes; Databricks; Google; IBM; KNIME; Microsoft; Palantir; RapidMiner; Vyasa

Gartner Recommended Reading

Quick Answer: How Is AI Being Used in Preclinical Drug Development?

Predicts 2023: Digital Transformation of Healthcare Beckons New Era for Life Sciences

Healthcare and Life Science Business Driver: Strategic Technology Change

Quick Answer: 4 Factors for Build, Buy or Ally Decision Making in Life Science R&D

Genomics Medicine

Analysis By: Reuben Harwood

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

Genomics medicine enables the use of genetic information for medical research and treatment (for example, diagnosis, therapy, risk management). It is a component of precision medicine and focuses on leveraging a patient's genomic data and clinical insights derived from it. Technologies include gene sequencing, variance calling, high-performance computing, AI-informed risk assessment and clinical decision support.

Why This Is Important

Genomics medicine is already saving lives, and its promise to improve health outcomes is driving adoption in healthcare. Upstream technologies supporting research and gene sequencing data collection are well-developed and yield increasing amounts of efficiency in genomics. Technologies that use genetic information in clinical care delivery are progressing toward delivering quick, reliable and actionable patient-specific insights.

Business Impact

Genomics medicine's business and population health impact is substantial and an essential component of precision medicine. The value of genomics medicine is demonstrated across multiple areas, including:

- Targeted therapies for cancer and rare diseases

- Accurate and patient-specific clinical diagnosis and treatment decisions
- Patient-genetics-based diagnostic tests to eliminate or reduce extra costs during treatment
- Precision care for prenatal and genetics-directed therapies

Drivers

- Next-generation sequencing (NGS) and third-generation sequencing (such as nanopore sequencing, single-molecule real-time [SMRT] sequencing) have enabled vendors to bring new capabilities at the end-user level, broadening the utilization of genetic information across multiple clinical specialties (such as chronic disease management) and beyond oncology.
- Achievement of key milestones has brought additional momentum to genomics medicine, such as the Broad Institute's launch of a $1,000 sample-to-report clinical whole-genome sequencing service and the new Guinness World Record awarded to a team at Stanford University in California, U.S. for the fastest DNA sequencing at five hours and two minutes.
- Technology and services related to genomics are progressing as the cost of genomic sequencing decreases. Research has identified more practical uses in diagnosing and treating patients, for example, companion diagnostics that indicate an individual's likely receptivity to a specific medicine by measuring a specific genetic biomarker. Other uses of genomics range from genetic testing for rare and undiagnosed diseases, next-generation therapeutics including gene therapy and RNA therapy, testing for treatment receptivity, to precision cancer treatment.
- Adoption will continue to grow as researchers identify more correlations between genetic biomarkers and health, disease prevention and treatments. The adoption of electronic health records (EHRs) globally creates rich sources of health data ripe for epigenomic exploration.
- EHR vendors have begun incorporating discrete genomic data into the patient record, enabling genomics medicine via point-of-care pharmacogenomic clinical decision support (CDS).
- Data analytics, including AI and machine learning, now have great potential to aid in discoveries leveraging that data. For these reasons, we move this innovation further along on the Hype Cycle with five to 10 years to the mainstream.

Obstacles

- Translating genomic data into actionable clinical insights has required decades of research. However, the maturation of AI and machine learning approaches will accelerate the pace of scientific discovery and translation into clinical action.
- It is equally challenging to make this knowledge actionable by physicians. Many are not well-trained to incorporate actionable insight from genomics within their workflows.
- Although new genetic markers are constantly being discovered, they require frequent reanalysis of patients' sequencing data. This comes with high costs that hinder the development of new tests, drugs and therapies.
- Researchers, life science and healthcare providers demand more genomics information integrated into the EHR, including raw sequencing data, analysis and clinical recommendations. Interoperability remains a barrier to information exchange among scientists, providers, patients and families for collaboration and counseling.

User Recommendations

- Establish a surveillance process to stay updated with the practical use of genomics in diagnosis and treatment and the implications for IT. Initiate discussions with peers as to whether it is worth pursuing an in-house genomics center of excellence or outsourcing this function.
- Outline business process, compliance, laboratory, regulatory and IT implications when including genomics medicine disciplines for decisions about research, therapies and business opportunities, while ensuring patient privacy.
- Architect an IT infrastructure, inclusive of outside services, that supports the acquisition, storage, collaboration and analytics requirements demanded by genomic datasets and therapy delivery.
- Evaluate your EHR vendor for their plans to support genomics medicine needs. Determine if the EHR can record, store, secure and access genetic marker data from patients, and their ancestors and family members at the point of care.

Sample Vendors

DNAnexus; Genedata; Helix; Igenbio; Illumina; L7 Informatics; NantHealth; Velsera

Gartner Recommended Reading

Healthcare and Life Science Business Driver: Medical Technology Innovation

Healthcare and Life Science CIO's Genomics Series: Part 1 — Understanding the Business Value of Omics Data

Healthcare and Life Science CIO's Genomics Series: Part 2 — Formulating an Omics Vision

Healthcare and Life Science CIO's Genomics Series: Part 3 — Prioritizing Omics Investments

Bioprinting for Scientific Research

Analysis By: Michael Shanler, Reuben Harwood

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

Bioprinting for scientific research is the use of 3D printing technologies to understand disease and drug responses in lifelike 3D environments. Its use cases span printed cells, impregnated hydrogels, DNA, proteins, chemicals and biologics. It is primarily used in drug discovery, metabolism, cell-cell interaction and cell cultures; target identification assays; autologous and allogeneic cell therapies; and testing new techniques for generating vasculatures, tissues and organs.

Why This Is Important

Life science researchers are looking for ways to create more realistic cellular models for testing potential drugs and exploring disease mechanisms with greater efficiency. Research costs have escalated as reagents become more specialized and expensive to create. Bioprinted materials, both synthetic and organic, represent an opportunity for scientists to perform massively parallel studies in miniaturized fashion. It also enables printing multiple cell types to create more realistic tissue models.

Business Impact

- 3D bioprinting leads to new scientific insights. R&D groups need lifelike assays to improve leads going into human trials.
- 3D assays are often reported as more representative of in vivo conditions than traditional 2D, cell-adherent models.
- This technology helps researchers find new discoveries and develop innovations for drugs and therapies. This includes advancing the science of complex organ development and tissue regeneration (such as skin, cartilage, bones and blood vessels).

Drivers

- In 2022, a significant amount of research was continued by the academic and industrial communities using both scaffold-based and scaffold-free printing in addition to new piezo-electric, acoustic-deposition and inkjet-spotting techniques. That progress validated the long-term potential of this technology.
- The mainstream media has mostly covered bioprinting for studying complex organ development, reconstructive and aesthetics, and tissue regeneration (such as skin, cartilage, bones and blood vessels). However, the bulk of the activities within the life science industry are instead targeted at improving assays for drug toxicity in vitro organ models, organ-on-chip studies and cosmetics assays
- As more scientific methods are developed and proven, the 3D bioprinting market is expanding, and the number of bioprinting use cases and customers is increasing.
- There are now over 55 different vendors and service providers selling automation, consumables or contract services for 3D bioprinting, and over a dozen platform vendors. Nearly thirty of these vendors have incorporated in the last 10 years. Many of these companies may have a strong foundation in science.
- R&D teams have already started to leverage information generated from assays run in these environments from early-stage drug discovery through later-stage pharmacokinetic analysis.

Obstacles

- While small and inexpensive benchtop 3D printing instruments have become available to researchers, the support models for end users are inadequate. This, in turn, inhibits end-user progress.
- The lack of widely available low viscosity fluid (bioinks) limits validated methods, as the droplet size and placement is not as precise as needed for many scientific applications.
- Experimental information from bioprinting will confirm some existing hypotheses, but will also conflict with other findings. We expect a long trial-and-error process with bioprinting as the informatics components improve.
- While 3D bioprinting accelerates, life science organizations continue to be frustrated with the lack of support between the instrument and informatics interfaces. Many Gartner clients report vendors positioning future capabilities, while currently being saddled with quality and delivery issues.
- Bioprinting technology is currently limited in its ability to print complex structures, which can curb its utility.
- For these reasons, the technology is in the Trough of Disillusionment.

User Recommendations

- Use in-silico modeling and informatics approaches to “close the loop” between the physical testing and simulations to improve predictive capabilities using bioprinted models.
- Work with R&D IT or informatics teams to define the data repositories and platforms that will be used to perform confirmation testing prior to acceptance for any new 3D bioprinting technology.
- Factor in workforce development for the 3D bioprinting space — such as design specialists (biomedical engineers) and printer operators (laboratory automation technicians).
- Develop a plan to harmonize and/or scale 3D bioprinting methodologies with a focus on analytics to compare 3D bioprinted methodologies versus previous legacy assay approaches.

Sample Vendors

Allevi by 3D Systems; Aspect Biosystems; Brinter; CELLINK; Desktop Metal (EnvisionTEC); Fluicell; Inventia Life Science; Organovo; Poietis; REGENHU

Gartner Recommended Reading

Predicts 2023: Digital Transformation of Healthcare Beckons New Era for Life Sciences

Innovation Insight: Synthetic Biology in Medical Sciences

3D Printing Will Accelerate Design and Product Innovation in Existing Manufacturing Setups

Healthcare and Life Science Business Driver: Medical Technology Innovation

Mobile Lab Apps

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

Mobile lab apps enable scientists and researchers to create and consume electronic laboratory data via mobile applications, and grant access via smartphones, tablets, and other connected devices. These purpose-built applications address laboratory science, process, experimentation, quality control and informatics.

Why This Is Important

Many laboratory automation, electronic lab notebook (ELN) and laboratory information management system (LIMS) providers support web enablement that allows user access to existing systems via mobile devices, such as smartphones and tablets. While true mobility has been hampered by ill-conceived layouts, devices that are incompatible with sterile or highly regulated environments, and difficult screen sizes, mobile-enabled lab apps represent a chance to improve user experience and productivity.

Business Impact

There are multiple opportunities for mobility to have an impact on lab and quality efficiencies, research innovations, and lab logistics. It can lead to strategic initiatives for improved operational efficiencies, quality and innovation. Mobility enables employees to have unfettered access to systems, which supports productivity. It also enables collaboration beyond the firewall, particularly when conveniently deployed onto personal devices.

Drivers

- Vendors have started to release a plethora of lab capabilities for smartphones and tablets, such as data review, instrument control, and operational analytics. More laboratory and scientific informatics providers have released specific cloud-native or progressive web apps with purpose-built mobile interfaces.
- The majority of enterprise informatics vendors offer some mobile applications. Many vendors are using HTML5 to facilitate adoption in the mobile laboratory space. Gartner expects this space to evolve quickly, as the remaining ELN and LIMS providers deploy solutions.
- The number of science-based apps that are relevant to the industrial laboratory has exploded. As these apps become more powerful and sophisticated, and have better integration with existing laboratory automation and informatics systems, the adoption rate will increase.

Obstacles

- Most companies are reviewing mobile security, as it relates to potentially patentable information and sensitive data being stored on personal mobile devices.
- Many clients report that these applications are often driven at the laboratory level with little oversight from corporate IT. This raises the potential for noncompliance and other challenges, due to a lack of IT involvement and limited processing power.
- While vendors are able to accommodate a variety of use cases, clients struggle to get value out of solutions, as remote access to equipment for simple functions often isn’t worth the investment in the application development.
- Many clients report that the interfaces being developed for lab equipment by lab-IT consultancies include too many features and functions, which makes the application difficult to use. There is a “sweet” spot for functionality that seems to be elusive by many teams.

User Recommendations

- Engage laboratory staff to build a comprehensive understanding of how both personal and company-issued mobile devices are used today in the laboratory, in the office, and beyond the firewall.
- Perform a preinstallation assessment with business teams to determine if mobile apps and software access via mobile devices for the laboratory are compatible with work processes, security, compliance, and culture.
- Work with business leaders to prioritize investments for mission-critical apps that have clear alignment toward innovation, collaboration, quality, compliance, effectiveness and traceability, as well as alignment with inventory visibility initiatives.
- Engage supplier R&D groups actively for their input into the next iteration of mobile apps. Many vendors actively seek customer participation to help guide the design of such systems and inform their app roadmap.

Sample Vendors

BioData (Labguru); BookitLab; Dassault Systèmes; LabArchives; LabCollector; METTLER TOLEDO; PerkinElmer; Sartorius; Tecan; Thermo Fisher Scientific

Gartner Recommended Reading

JavaScript: A Single Language for Web, Mobile and Microservices Apps

How to Effectively Test Mobile Apps

Key Considerations When Building Web, Native or Hybrid Mobile Apps

Decision Point for Choosing a Mobile App Architecture

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

SaaS LIMS

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition:

A SaaS laboratory information management system (LIMS) is a vendor-managed laboratory informatics solution that focuses on sample- and process-centric laboratory testing — spanning results login to certificate of analysis issuance. Laboratory test data is used to support key processes, including R&D, clinical and production.

Why This Is Important

Many large life science organizations have become more comfortable with having their critical laboratory data in the cloud while smaller organizations are aggressively moving to SaaS models. Gartner expects the percentage of on-premises systems to continue to fall, especially as the functionality and configurability of SaaS-based solutions continue to improve.

Business Impact

Life science organizations are driving “cloud-first” IT strategies to better globalize lab capabilities. SaaS-based LIMSs significantly reduce upfront costs and fit with trends toward rationalizing legacy systems and reducing overall IT complexity, support and maintenance. Depending on the life cycle of existing applications, the ROI for hosted services is favorable, especially when legacy systems are at the end of life and implementation, and are in smaller or midsize organizations.

Drivers

- With organizations' intent on "going paperless," improving quality, creating knowledge platforms and driving collaboration, SaaS LIMSs will continue to see wider adoption and drive "digital lab of the future" strategies.
- Customers that have a legacy system, as well as smaller and midsize businesses and institutions, have a hunger for SaaS models as a means to lower costs and maintain a smaller IT profile.
- As-a-service options can ease the number of IT requirements for maintenance and validation and simplify the overall approach using internal resources to support lab capabilities.
- SaaS LIMS solutions can be easily scaled up or down depending on the needs of the laboratory. This flexibility is particularly beneficial for laboratories that experience fluctuating workloads or need to adapt quickly to changing market demands.
- IT groups are attracted to any means in reducing maintenance, patches and fixes that can be provided by vendors. Even though SaaS LIMS may still require some professional services for deployment, ongoing validation, upgrades, and connections are greatly simplified via the SaaS model.
- The technology is near the middle of the trough on the Hype Cycle with a plateau in two to five years.

Obstacles

- Larger organizations have been slow to adopt SaaS LIMSs due to system complexity and customizations for business processes.
- While most industries are subject to regulation, industries like food and beverage, materials and cosmetics do not require the same level of validation. Many lower-cost LIMS do not meet expectations for regulatory compliance in life science and represent a low end of the spectrum for lab testing methods and complexity. In life science, SaaS LIMS is easier to deploy in non-GLP research environments.
- While many vendors market cloud-hosted LIMS as SaaS LIMS, the lack of transparency in cloud architecture creates a confusing market landscape.
- Systems that have extreme quality and integration requirements are limiting the adoption of SaaS-based solutions.
- While cloud and SaaS are becoming more central to CIOs' strategies for lab processes, many organizations encounter difficulties satisfying Good X Practice (GxP) validation, intellectual property performance and risk-related requirements.

User Recommendations

- Pursue SaaS LIMS only if you have a strategy for cloud validation. GxP environments for labs, manufacturing, and clinical will require extra care, upfront discussions, revised quality policy, and planning to support risk-based validation, security, compliance and controls. These systems are not yet widely implementation-ready for manufacturing environments without a revised GxP validation process and support infrastructure.
- Explore SaaS-based LIMS opportunities if the application does not require customization, the instrument integration needs are light and the system does not need to support a complex environment (e.g., R&D).
- Investigate the degree of elasticity and multitenancy before investing. Solution vendors often use the terms "SaaS" and "cloud" interchangeably. This creates confusion within the marketplace, as most LIMS vendors sell single-tenant, managed hosted environments via partnerships — as opposed to multitenant, shared environments.

Sample Vendors

AgiLab; Autoscribe Informatics; CloudLIMS; Eusoft; LabVantage Solutions; LabWare; Sapio Sciences, STARLIMS; Thermo Fisher Scientific; Veeva Systems

Gartner Recommended Reading

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You're Building a Truly Digital Life Science Lab of the Future?

How to Establish Effective SaaS Governance

SaaS ELN

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition:

SaaS electronic laboratory notebooks (ELN) are cloud subscription-based laboratory informatics solutions. They are used by laboratory staff to securely collect intellectual property, store laboratory data, exchange findings and disseminate experimental data in the R&D process. They are also used as a collaborative platform for connecting with external scientific partners.

Why This Is Important

Many life science companies have been investing in more sophisticated, SaaS-based ELNs to support globalization and externalization strategies. These solutions replace on-premises and cloud-hosted versions and enable more collaborative approaches, thereby making data visible and available at a more optimized cost with simplified management. SaaS adoption will accelerate as leaders become more comfortable with storing intellectual property in SaaS solutions.

Business Impact

Adopting a SaaS-based ELN can reduce capital costs, increase the speed of deployment and reduce IT complexity, especially as it relates to management, revisions and upgrades. In many cases, using SaaS-based software ultimately reduces the validation challenges, system interfaces or APIs (if available from the vendor), and has positive impacts on IT staffing and operations.

Drivers

- Efforts to “digitalize” the research and laboratory processes are driving adoption of SaaS software for the laboratory.
- Many organizations are looking to reduce IT complexity and improve global standards for experimental data collection. SaaS-based ELNs are gaining popularity due to the ease of deployment and low startup costs when compared with on-premises or hosted ELNs. These solutions prove to be much more scalable for global organizations, as well.
- We expect SaaS adoption to increase more rapidly as ELN technologies improve and vendors begin to either acquire or build out solutions that are true SaaS as opposed to just managed/hosted in the cloud.
- Gartner estimates over 40% of ELNs are SaaS-based, which is following the general year-over-year adoption trends for SaaS software in scientific R&D environments.

Obstacles

- Many users are adjusting to SaaS models and are confronted with some restrictions — namely reduced capabilities due to the configuration-only approach supported by SaaS models.
- Many older generation ELNs were deployed on-premises and were heavily customized, making transitions out of those environments extremely difficult.
- The vast majority of ELNs in use in life science manufacturing still have not migrated to cloud due to good x practice (GxP) compliance and validation challenges. Vendors are struggling with support models for GxP.
- Although the platforms are evolving, many users are struggling with promised functionalities and inflated expectations set by vendors. For these reasons, we are accelerating this innovation profile toward the trough.

User Recommendations

- Evaluate your laboratory's needs, the depth of the vendor's domain expertise and your own internal capabilities in managing a SaaS-based ELN vendor.
- Ensure solution features are clearly aligned with business expectations to ensure successful adoption. Although many vendors claim to have the same features in cloud-based products as those that are deployed on-premises, there are often differences between the packages.
- Pursue cloud-based ELNs to facilitate scientific collaboration and reduce cost (particularly if you are a smaller company that does not have legacy systems or deep instrument integration requirements).
- Implement SaaS-based ELNs primarily for driving collaboration with external parties or to bridge scientific groups that operate in multiple facilities.
- Investigate security, maintenance costs and a software release schedule before committing to a solution.
- Outline the procedures for retrieving your data, and have a clear "exit strategy" when engaging a SaaS vendor.

Sample Vendors

Benchling; Bruker (Arxspan); Collaborative Drug Discovery; Danaher (IDBS); Dassault Systèmes; Dotmatics; Revvity (Perkin Elmer); Sapio Sciences; Scilligence; Thermo Fisher Scientific

Gartner Recommended Reading

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You're Building a Truly Digital Life Science Lab of the Future?

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Market Guide for Laboratory Informatics

Semantic Knowledge Graph Tools

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition:

Semantic knowledge graph tools comprise software and technology that enable staff to search, mine and draw relationships on information. This includes exposing relationships in journal texts, chemical structures, biomolecular content, clinical and scientific relationships, genomics data, real-world data, disease pathways and other complex scientific research.

Why This Is Important

Knowledge graphs arrived in many different forms a decade ago and quickly reached peak hype. However, only over the past three years have the applications and infrastructures been injected with semantic search capabilities, cloud data processing and graphical relationship models necessary to handle scientific big data. They have also been instilled with massive cloud computing power needed to improve performance.

Business Impact

The use of these systems can:

- Help accelerate innovation activities, such as the discovery of new pathways, disease indications and therapeutic targets.
- Expose complex relationships and correlations to scientific stakeholders.
- Support collaboration and innovation strategies as they relate to drug discovery, translational medicine, competitive intelligence and clinical research.
- Interpret relationships among very complicated processes.

Drivers

- Life science organizations need better tools for mapping an array of available data sources (such as data warehouses, data marts, application silos, subscription databases or data from the public domain) to more efficiently derive insights. New scientific data is being exposed by systems on a continuous basis. It is impossible for individual humans to interpret and draw relationships on concepts without tools when the information is so complex and presented at such high volumes.
- Precursor systems were never designed for performance when handling large datasets, and they suffered from severe performance limitations due to a lack of computing power and poor orchestration. New SaaS tools have alleviated many of these early defects and enabled life science organizations to pilot these projects without significant risk.
- As companies continue to expand the use of generative AI and other natural language processing (NLP) techniques and share scientific knowledge sets, these systems have become easier to use and have higher performance, leading to increased client adoption. These enhancements drive adoption, which accelerates improvements. In the next two years, the infrastructure for handling big scientific datasets will evolve and enable a better ROI.

Obstacles

- Due to both scientific data challenges and R&D IT complexities (e.g., variable governance and lack of data standards within labs), the learning curve for using this software is steep, which is slowing the adoption rate. Few users within organizations will know the holistic R&D and IT requirements.
- Processes, cultures and skills gaps in data cataloging and enrichment have created challenges for larger enterprise adoption of semantic knowledge graphing. We expect these challenges to continue for two to three more years before the major issues are sorted out. For this reason, we position the technology on the hype curve sliding deeper into the Trough of Disillusionment.

User Recommendations

- Explore these systems with the goal of improving knowledge mapping and collaboration by developing insights from complicated scientific big data. The conversation about ROI will involve strategic R&D heads in addition to IT.
- Partner with scientific leads, data scientists and informaticians to develop internal best practices for their use since there is a high level of complexity associated with learning these systems. Cross-functional teams should address data quality, data standards and common ontologies.
- Work with department subject matter experts to understand which datasets need to be connected and which catalogs to update before building out new systems to connect internal and external data that is relevant to R&D.
- Educate end users on the different aspects of big data, because the volume, velocity and complexity will dictate which systems deserve investments.

Sample Vendors

Cambridge Semantics; Clarivate; Cytoscape; Elsevier (SciBite); IO Informatics; LabVantage-Biomax; LeapAnalysis; ONTOFORCE; Sinequa; Stardog Union

Gartner Recommended Reading

Graph Technology Applications and Use Cases

How to Build Knowledge Graphs That Enable AI-Driven Enterprise Applications

Quick Answer: 4 Factors for Build, Buy or Ally Decision Making in Life Science R&D

Quick Answer: How Is AI Being Used in Preclinical Drug Development?

Predicts 2023: Digital Transformation of Healthcare Beckons New Era for Life Sciences

Climbing the Slope

SaaS-Regulated CSP

Analysis By: Jeff Smith

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition:

SaaS-regulated content services platforms (CSPs) are life-science-specific, cloud-based systems for managing documents and unstructured data in compliant, regulated environments. Previously known as electronic document management systems, CSPs support areas such as clinical, quality, pharmacovigilance, manufacturing, regulatory and marketing. Features include collaborative authoring, metadata management, search, regulatory tracking and publishing.

Why This Is Important

SaaS-regulated CSPs have been gaining traction among CIOs in the life science industry, largely due to their increased robustness, security and cost advantages over traditional on-premises systems. Although this transition has been uneven across various life science domains, SaaS-regulated CSPs are rapidly maturing and now offer some of the most mature cloud offerings.

Business Impact

Adopting SaaS-regulated CSPs can simplify deployments and reduce support resources, especially when content services platform as a service (CSPaaS) capabilities are used. Furthermore, SaaS-regulated CSPs enable and facilitate both global deployment and centralized control and governance, providing a cloud-native CSP, including built-in content workflow, automation, governance and content processing tools. This, in turn, provides more content flexibility and control to supported business areas.

Drivers

- At many larger companies, older systems are now at the end of their service lives and are unsustainable. As a result, there is new interest by life science companies in exploring simpler cloud-based solutions, rather than upgrading older on-premises IT systems with significant maintenance burdens.

- Life science companies are increasingly shifting from legacy CSPs to cloud-native CSPs, particularly in clinical development and regulatory, as well as quality areas. These are taking advantage of more powerful CSPaaS capabilities and robust global implementations supported by multitenant cloud deployments.
- Companies have started moving away from single-tenant-hosted cloud CSP due to more acceptance of multitenancy.
- The regulatory environment for life sciences is becoming increasingly complex, with multiple agencies and regulations governing different aspects of drug and device development and approval. SaaS-regulated CSP can help life science companies manage this complexity by providing a centralized platform for storing, managing, and sharing regulatory content.
- With continuous change in the regulatory environment, SaaS-regulated CSPs can be scaled up or down as needed, depending on the size and complexity of a life science organization's regulatory requirements. They can also be customized to meet the specific needs of different stakeholders, including regulatory agencies, internal teams and external partners.
- As many of the initial obstacles to acceptance of SaaS-regulated CSPs have evaporated and GxP validated cloud technology matures, this profile proceeds quickly past the trough and starts up the slope with two to five years' time to plateau.

Obstacles

- Some larger life science companies are challenged in adopting SaaS-based solutions in niche areas, due to overly complex processes that have resulted in legacy customizations on overengineered, monolithic systems.
- Many clients report the movement from on-premises CSP to cloud as challenging, especially when dynamic and historical data and documents are stored within the same system. Upgrading a CSP from a legacy system with lots of historical data to a new system often turns into two projects — a migration project and a software upgrade. In most cases, these are intensive projects with considerable professional services expenses.
- Many vendors use the terms "cloud" and "SaaS" interchangeably and are less clear about tenancy in the cloud. This adds confusion and slows adoption of more advanced CSP approaches.

User Recommendations

- "Think digital" and emphasize the need for search, analytics and dashboarding capabilities that will be more self-service-oriented. When going to a SaaS model, consider that adopting SaaS may also require different service and support models.
- Evaluate the differences between cloud-hosted and single-tenant versus multitenant SaaS architecture during vendor assessment. Be aware of vendors' hype and creative license around these terms, and ensure they support the correct type of cloud for business needs.
- Work with quality assurance and regulatory teams early in the process, to bring them along into cloud deployments from internally hosted architectures. Set expectations about SaaS license costs and ensure that cost projections reflect application growth under new licensing models.
- Review solutions that address all overlapping components of development — including clinical trials, quality and regulatory, and contract management — when considering pure CSP deployments.

Sample Vendors

Aurea; Box; DXC Technology; Egnyte; Generis Group; IQVIA; M-Files; OpenText; TransPerfect; Veeva Systems

Gartner Recommended Reading

Electronic Trial Master File Strategy Alignment

Market Guide for Life Science E-Clinical Platforms

Life Science Manufacturer CIO Top Actions for 2023

2023 CIO and Technology Executive Agenda: A Life Science Perspective

Market Guide for Content Services Platforms

Precompetitive Alliances

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition:

Precompetitive alliances are nonprofit industry groups that work to solve common technical problems that affect participating members. They can develop shared technology platforms and/or processes, scientific, informatics and data standards. Participating members are expected to pool resources to achieve a common goal.

Why This Is Important

Precompetitive alliance participation is now part of the general life science industry vision for accelerating R&D, and there is a much higher degree of openness within the scientific community to conquer shared IT and data challenges. Along with industry consortia, they play a critical role in accelerating scientific and technology initiatives, developing common standards, and laying the groundwork for future innovative products and approaches.

Business Impact

The business impacts of precompetitive alliances are broad:

- Engaging in precompetitive discussions will yield positive implications for collaboratively solving IT challenges, networking and knowledge building.
- Successful engagements with precompetitive alliances will reduce IT complexity, integration challenges and the overall burden on internal staff for validation efforts for “shared industry” problems.

Drivers

- The Pistoia Alliance, which originally focused on solving data aggregation, sharing and analytics for pharma research, has nearly 200 contributing organizations including technology and scientific startups, not-for-profit, government, academic and small, medium and large pharmaceutical companies.
- The R&D IT community is looking to solve common technical issues and is increasing participation with other organizations including the Allotrope Foundation, BioCelerate, Digital Therapeutics Alliance, and the Pharmaceutical R&D Information Systems Management Executive (PRISME) Forum.
- Many other foundations, organizations and institutes allow for community involvement with a focus on standards development, transparency, collaborative projects and scientific and medical knowledge sharing. Examples include: The U.S. National Institutes of Health (NIH), Accelerating Medicines Partnership (AMP), Biomarkers Consortium, European Molecular Biology Laboratory-European Bioinformatics Institute (EMBL-EBI), Innovative Medicines Initiative (IMI), The IMI's European Lead Factory, i2b2 tranSMART Foundation, Open Targets (formerly the Center for Therapeutic Target Validation), Clinical Trials Transformation Initiative (CTTI), Transcelerate Biopharma, Clinical Data Interchange Standards Consortium (CDISC), and Accumulus Synergy.
- Technology vendors are also investing, e.g., Accenture with mostly Oracle customers created a consortium to drive common technologies onto its own platform INTIENT. Veeva Systems launched Align Biopharma to develop technology standards with HCPs and has since integrated components into their product offering. Finally, laboratory informatics providers such as Thermo Fisher Scientific and PerkinElmer Informatics created a cloud-based platform for collaborative academic research.
- Most large and midsize companies are now involved and yielding benefits with precompetitive alliances, and thus this is positioned on the Slope of Enlightenment.

Obstacles

- Challenges with culture, shared investment and active participation still plague precompetitive alliances. Sometimes individual contributors at organizations participate, such as scientists, so they can solve issues related to their projects, but do so without sanctioned involvement by leaders at the enterprise level.
- Because many organizations have a variety of issues, engaging in open forums and discussions can quickly become a distraction.
- With the growth in participation, we anticipate that most organizations doing life science R&D will participate, but not all of them will see benefits from these activities within the next five years.
- Many clients report a high level of frustration in dealing with the shared objectives and project prioritization of these alliances, and are unsure about what is the right level of participation and investment.

User Recommendations

- Encourage R&D stakeholders to explore industry community activities for programs that have common elements at competitor companies. When engaging precompetitive alliances, evaluate the business benefit (such as reducing IT complexity, developing interoperability standards, determining shared clinical site quality standards and so on) versus the likelihood of solving an issue on your own.
- Determine which alliances and at what level of participation your enterprise will support. Standards don't always add equal benefits to all industry participants. Only invest time and effort into alliances if it will lead to long-term innovation, improvements to quality, improvements to efficiency or improved profitability.
- Invest in industry consortia if the key partners provide a long-term strategic advantage and if the working group has a strong chance of success. Many industry consortia have only short-term impacts and little value beyond a handful of modest initiatives.

Sample Vendors

Allotrope Foundation; CDISC; Digital Therapeutics Alliance; Pistoia Alliance; TransCelerate BioPharma; Veeva Systems (Align Biopharma)

Gartner Recommended Reading

Life Science CIOs Need to Improve Their Organization's Digital Partnerability

Build Industry Ecosystem Culture, Connections and Capability to Solve Issues Beyond Your Enterprise

3 Steps for Effective Supplier Engagement in Sustainability

Quick Answer: How Do You Know That You're Building a Truly Digital Life Science Lab of the Future?

Enterprise IP Management

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition:

Enterprise intellectual property (IP) management spans the systems that manage all aspects of IP assets, including invention disclosures, patent portfolios, trade secrets, trademarks and copyrights, as well as the operational activities associated with partnerships, agreements and licensing.

Why This Is Important

- IP management is often a very manual process involving many disparate systems, and requires a more coordinated, enterprise-driven approach as companies expand.
- Updating portfolios often was a spreadsheet-based exercise, proving incredibly inefficient for large companies with complex IP landscapes.
- IP is the root of most life science organizations' valuations. As life science firms increasingly leverage external partnerships to drive innovation, they must more aggressively defend IP positions.

Business Impact

Enterprise IP solutions:

- Lead to better visibility into the maintenance costs of carrying all types of IP.

- Improve the analytics across the IP systems, ensuring financial, legal and R&D groups will have robust streamlining activities for managing IP capital and assets.
- Drive better decisions by having a more effective invention disclosure records (IDR) submission process and method for vetting IP positioning.
- Expose submission portals to more employees which drives innovation processes.

Drivers

- Many legal groups report to Gartner that organizations lack visibility into their native IP and into the costs and strategic and financial benefits of supporting IP positions. Also, continuing to maintain poor IP positions on a global basis is a costly endeavor.
- Organizations need better visibility into retiring IPs in a timely manner so that they don't spend money needlessly on protections that are no longer relevant. Not all IPs should be blindly protected. Rather, it should be frequently reassessed with strong visibility into future spend (for example, retired products, products that are no longer central to the business strategy and low-performing product lines).
- IP asset management companies have begun harmonizing and developing templates for end-to-end workflows involving IP. Many software providers now offer portals for IDRs to help scientists, engineers and other innovators submit new ideas into the legal process.
- For the most part, these systems are not yet tightly integrated with ideation software, innovation management, content management, collaboration platforms (such as Microsoft SharePoint), project (or program) and portfolio management (PPM), project management offices (PMOs) or ERP systems. However, vendors are developing APIs, which signifies growing maturity and a desire for process integration.
- UX evolutions continue to improve and RPA tools are enabling more self-service application development. These tools are being extended into R&D and innovation hubs.
- These types of solutions have been used in practice for over a decade and have seen fairly wide adoption. The drivers are further accelerating use. For these reasons, we position this technology in the Slope of Enlightenment phase of this Hype Cycle.

Obstacles

- The biggest obstacle for adoption of these systems is culture. Many R&D organizations or companies that have innovation processes often have a loosely defined, manual process for capturing ideas, performing ideation and managing content associated with IP.
- In many cases, the IP is managed in file share systems, email and spreadsheets. Many groups are reluctant to change the process if they are more focused on “development” versus “research.”
- There are a variety of software vendors that provide different aspects of innovation for manufacturers. Disparate systems often capture only a narrow slice of the overall process, but they market the solutions as “innovations” with confusing messaging about what the solutions actually do. This confusion in the marketplace inhibits decision making.

User Recommendations

- Evaluate enterprise IP management as an upgrade to existing patchworks of systems. IP management can be a strategic, enabling system that drives protective and financial benefits. Work with legal, financial and R&D stakeholders to understand the business impacts and process workflows for IP and outline the gaps and opportunities.
- Factor in the costs of doing nothing and allowing inefficient processes (for example, paying for baseless IP protection for products that have been retired).
- Explore the fit of SaaS offerings, but understand that not all organizations are ready to put IP into the cloud, and that there may be significant risk management and cultural barriers.
- Map IP processes and determine how much bidirectional visibility or integration is required with adjacent PPM, PMO, ERP, content management and collaboration systems that are associated with new product development.

Sample Vendors

Anaqua (Lecorpio); Clarivate (CPA Global, IPfolio); Dennemeyer; GQ Life Sciences (Aptean); Innovation Asset Group; Patrix; Patsnap; Questel; SAP

Gartner Recommended Reading

Jump-Start Your Innovation Journey With a Customizable Innovation Framework

Market Guide for Innovation Management Tools

Approaches to Intellectual Property Valuation

R&D Intellectual Property Management Benchmarking Report

Product Development Innovation Management Tools

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition:

Innovation management tools for product development shepherd new product and process ideas for the business. The software helps users collect, rank, store and facilitate collaboration on scientific, engineering, health, and new therapeutic ideas. It supports open innovation and crowdsourcing where product development teams harvest valuable information from both internal and external parties. It harmonizes the collection, refinement and development of new intellectual property.

Why This Is Important

- Innovation management tool vendors have broad functionality impacting the front end of innovation and portfolio value.
- Until recently, these tools were only capable of storing and ranking ideas; however, now they can be integrated with ideation portals, product information management (PIM), product development, portfolio management and product life cycle management (PLM) solutions.
- As CEOs have made innovation a higher priority, these tools are moving to the center of the innovation process.

Business Impact

Product development innovation management tools enable:

- Leaders responsible for the innovation process to execute with greater effectiveness and speed for commercialization
- R&D, strategic marketing and innovation teams to drive an automated and collaborative process
- Innovation leaders to share information and collaborate while facilitating more transparency among functions
- Companies that adopt these technologies to see healthier pipelines, as well as an increase in downstream patent applications

Drivers

- Vendors are adding key capabilities, such as ideation and patent drafting, which is attractive to next-generation research operations leaders.
- Technology advances allow for more efficient and faster ideation, rapid evaluation and smarter selection to support the overall innovation portfolio. Most R&D teams have increased their spending on SaaS innovation platforms.
- The establishment of idea management technologies with enhanced collaboration capabilities is taking root, enabling and expediting the refinement of ideas with more automation. Analytics and reporting for innovation management tools are much improved, with enhanced graphics, analytics and trending capabilities. Also, the new social software features that support different functional disciplines, dispersed facilities and extended partners allow users to tag a running commentary to ideas and create opportunities for enhanced collaboration across the enterprise and beyond.
- In the next one to two years, Gartner believes that at least 50% of consumer goods and life science companies with innovation strategies will have elements of innovation systems in place. Additionally, easy user access to “open innovation” technologies and marketplaces is putting more pressure on user organizations to have a solid outside-in innovation process backed by the right enabling technology.
- Many midsize and large organizations have already adopted this technology for managing elements of product innovation and are expanding its use for full-service capabilities for innovation management. As such, this technology is on the Slope of Enlightenment.

Obstacles

- Simply adopting the tools is not enough. Firms need to adjust product development processes to capitalize on the opportunities these technologies enable.
- The original wave of innovation management technologies had overpromised capabilities with a focus on “platforms.” Integrations with other R&D and product-development-related solutions are required to maintain a dynamic portfolio.
- Sustaining innovation is a continuous process and requires changes to corporate governance, skills and even organizational models.
- Many adjacent groups and business units struggle with building process connections with these tools, especially when innovation cultures are lagging.
- Several other software categories, including CRM, PPM and PLM, have elements of these tools, which can create conflicts with organizations’ architecture and competing platforms.

User Recommendations

- Prioritize investing in these tools when you need to accelerate innovation, especially if you have a complicated organizational structure and diverse portfolios and customers.
- Identify the tools that will fit into your R&D-oriented systems and the specific vertical you occupy within life sciences. While you can tailor other systems like CRM, PIM, idea management and PLM to handle elements of innovation management, they may be too complicated to adjust to dynamic workflows.
- Include key functional stakeholders (marketing, quality and operations) when outlining the deployment strategy.
- Focus on opportunities where tools can enhance synchronous and asynchronous collaboration.
- Evaluate how to use the tools with innovation boards, scientific advisory team meetings, NPD team meetings, brainstorming sessions, focus groups, patent explorations, social media monitoring sessions and social network analyses.
- Maintain a digital thread among ideas, product data and audit logs when making design changes.

Sample Vendors

Alludo (Corel); Anaqua; IdeaScale; Inova; Jive Software; MindMatters Solutions; Planbox; Planview; Sopheon; Wazoku

Gartner Recommended Reading

Market Guide for Innovation Management Tools

Scientific Literature Text Analytics

Analysis By: Reuben Harwood, Michael Shanler

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Definition:

Scientific literature text analytics extracts data from unstructured internal and external text sources that contain scientific information. These applications and services aggregate information and competitive intelligence for use in R&D programs. Text and data are mined and used for content search, summarization, sentiment analysis, and investigation and classification of data types.

Why This Is Important

- Scientific information and the number of journal articles have exploded, representing a wealth of information for mining and graphing. This is a difficult, manual exercise without computer systems.
- Recent attention and advances in natural language processing (NLP) and generative AI (including large language models [LLMs]) have given rise to a myriad of tools for searching, analyzing, summarizing and generating scientific content.

Business Impact

Scientific literature text analytics can have the following business impacts:

- Combining extracted, unstructured data with traditional, structured data to provide a more complete view of the issue or topic.

- Use of sorted data downstream with traditional data mining or business intelligence and intellectual property (IP) tools.
- Knowledge graph, NLP and other tools can simplify insight discovery and classification approaches, enabling rapid analysis of new research and cross-indexing with research topics.

Drivers

- R&D programs engaged in product development seek more ways to leverage insights from scientific text analytics and annotators. This approach creates new opportunities, as scientific journals are published, competitive products are launched and ideas are filed at patent offices.
- The price point for such software and supporting services is moderating, and software is consolidating into larger products via company mergers and acquisitions. This environment makes the technology more attractive to small and midsize engineering companies, academic institutions, contract research organizations, biotechnology companies and medical device manufacturers.
- The recent explosion in tools leveraging NLP and generative AI, such as those built on OpenAI's ChatGPT, continues to increase the availability of specialized text analysis tools across life sciences R&D disciplines. Advancements in context enrichment, search and translation capabilities are expanding the global footprints of these systems, especially for drug discovery, clinical development and competitive intelligence.
- New cloud-based systems have removed some of the heavily customized legacy systems and allow for more agile end-user configuration.
- Based on our assessment of adoption trends and the diverse use cases being driven by life sciences organizations, we position this technology just entering the Plateau of Productivity.

Obstacles

- Many services offer similar outputs for text analytics, and increasingly NLP and text analytics are being included in content platforms. CIOs have to make decisions about where this capability becomes “core.” Options include search engines, content curators, content platforms or text analytics platforms.
- NLP-based mining often produces too much information. Vendors are combining NLP with ML to filter noise/false positives, which is a complex process requiring domain discipline that many organizations lack.
- Some organizations desire a centralized platform, whereas others want the capability built into specific applications, such as discovery, development or regulatory applications. This tension is delaying some decision making on how much development should be done in the individual domains.
- Vendors often offer competing and overlapping capability, but the technology and delivery mechanisms are not clearly communicated, clouding the vision.

User Recommendations

- Design a text analytics strategy with direct support to R&D and patent mining, and select spaces such as mechanism of action and pathway analysis for competitive advantages.
- Work with R&D groups to develop subject matter experts in text analytics to directly support R&D product development, IP submission teams and technical marketing groups.
- Examine the life cycle stage and costs of your difficult-to-support, customized legacy system.
- Evaluate new vendor packages that reduce the complexity of supporting R&D innovation. Uncover overhyped AI-enabled vendor offerings by understanding how AI affects analysis quality, efficiency and scalability.
- Prioritize cloud-based systems that will support mission-critical R&D innovation and competitive intelligence activities over technology-based systems that do not have workflows and plug-ins (e.g., bioinformatics, sequencing, chemical reaction symbology) designed for scientific literature mining.

Sample Vendors

Cambridge Semantics; Clarivate; DeepDyve; IQVIA; LabVantage; Lexalytics; Ontotext; ONTOFORCE; PharmGKB; SciBite

Gartner Recommended Reading

Market Guide for Intelligent Document Processing Solutions

Quick Answer: How Is AI Being Used in Preclinical Drug Development?

Infographic: Artificial Intelligence Use-Case Prism for Life Science Manufacturers

2023 Planning Guide for Analytics and Artificial Intelligence

Entering the Plateau

Electronic Laboratory Notebooks

Analysis By: Michael Shanler

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition:

Electronic laboratory notebooks (ELNs) are informatics solutions to help research and production analysts in R&D, manufacturing and quality organizations capture and manage scientific laboratory data. Additionally, ELNs are used to record potential intellectual property, perform calculations, port information from instruments to repositories, leverage operational technologies, initiate lab instrumentation instructions and execute processes within the laboratory.

Why This Is Important

With lab of the future initiatives and efforts to go paperless, ELN adoption continues to drive toward the mainstream with success stories for improving quality, creating knowledge platforms and driving collaboration. ELNs have moved from thick- and thin-client solution deployments toward web- and cloud-based solutions. This has made them integral to scientific processes and enables more streamlined scientific and experimental data capture approaches.

Business Impact

ELNs have a high impact on laboratory productivity in R&D and quality assurance (QA) and quality control (QC) groups and support innovation and automation strategies. They improve collaboration efforts between dispersed lab personnel and provide a system of record in lab test environments. ELNs enable replacing paper-bound notebooks and disparate electronic systems. Some ELNs can be augmented with scientific plug-ins, sophisticated workflow automation and instrument integration.

Drivers

- Business leaders demand capabilities from ELNs to increase productivity, improve quality and reduce the amount of paper used in laboratories. The technology is now widely available, and ELNs fit with modernization strategies for capturing, analyzing and reporting laboratory and scientific findings.
- Initially, ELNs were used as “electronic sticker books” to replace paper-bound laboratory notebooks. They now have technology embedded in the software that expands capabilities well beyond capturing electronic data for experiments and ideas, and are replacing paper-bound notebooks. In fact, ELNs have much deeper functionality spanning biology, chemistry and QA/QC.
- As scientific laboratories have become more virtualized and electronic, ELN providers have created application-specific templates, and solutions have been optimized for different disciplines, including materials, polymers, biology, chemistry, proteomics, genomics, bioanalytical contract services and QA/QC manufacturing.
- ELNs are being used as scientific knowledge management system portals and have been augmented with semantic search capabilities to leverage both internal and external data. Some laboratory information management system (LIMS) vendors are now offering ELNs as well.
- The new versions of ELNs enable organizations to increase productivity, improve quality and reduce the amount of paper used in laboratories. As organizations push to reduce transcription and writing errors, improve collaboration, and reduce the time it takes to recover necessary files during internal and external audits, ELNs will become a more standard tool and fully replace traditional paper notebooks.
- Due to all these drivers, we advanced ELN to the plateau on the Hype Cycle and expect mainstream adoption in two years.

Obstacles

- Many organizations support multiple ELN environments (such as biology, chemistry, QA/QC, formulation and analytical), with competing capabilities, which makes scaling those solutions difficult.
- The predominantly LIMS vendors have “bolt on” ELN capabilities, which have been marketed for extending into other non-LIMS groups, but most lack deep functionality.
- Clients report being overwhelmed and confused by the number of overlapping vendor messages. This hampers harmonization, rationalization and vendor selection processes.

- Most of the ELN companies are small, early stage businesses and lack the professional services required to sustain midsize and large organizations.
- Many legacy vendors have overengineered customized environments, which has damaged some of their credibility with clients.

User Recommendations

- Collaborate with decision makers who are familiar with laboratory processes when selecting a system. Different disciplines and research labs have divergent needs.
- Plan for the fact that an R&D-centric ELN will not function well in a quality/operations environment, and a quality management-oriented solution may not operate well in an R&D area.
- Evaluate ELNs with enhanced bioinformatics, analytical and reporting capabilities in organizations that conduct drug discovery or therapeutic research.
- Stay informed about future features that enhance collaboration by securely connecting scientists and analysts (such as tablet compatibility and handwriting recognition). Also, consider hybrid models that can be deployed as client/server and web-based models to support decentralized research activities.
- Assess laboratory execution system (LES)-centric ELNs for use in good x practice (GxP) environments or environments that have stringent quality, regulatory and compliance requirements.

Sample Vendors

Agilent Technologies; Benchling; BioData; Dassault Systèmes; Dotmatics; IDBS; LabVantage Solutions; Revvity; Sapio Sciences; Thermo Fisher Scientific

Gartner Recommended Reading

Your Lab of the Future Strategy Must Enable Life Sciences Digitalization

Quick Answer: How Do You Know That You’re Building a Truly Digital Life Science Lab of the Future?

7 Key Questions Life Science CIOs Should Ask When Selecting Laboratory Informatics Software

Market Guide for Laboratory Informatics

Analytics Platforms for Research Informatics

Analysis By: Michael Shanler

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition:

Analytics platforms for informatics encompass analytics and aggregation software used for processing large amounts of scientific, clinical and experimental data. Typically, these solutions are used to evaluate big data, test hypotheses, define trends and predict outcomes. These tools allow rapid analysis of a large R&D data mine, emphasize the scientific relevance of the resulting insights and often contain an aggregation layer that is optimized for R&D content.

Why This Is Important

R&D disciplines typically handle complicated queries and analyses by using a scientific subject matter expert as a guide. In recent years, business and laboratory users have found that enterprise tools lacking scientific plug-ins (such as molecular files) are not suitable for doing scientific research. Scientific informatics analytics solutions include dedicated tools with the core functions required to facilitate the scientific method.

Business Impact

These scientific-oriented solutions deliver high value to researchers, primarily through broader end-user access to analytics capabilities (empowering users to perform analyses, rather than relying on data scientists and engineers). Also, these analytics platforms provide better maintenance of existing models by increasing their reuse and performance and improving product design by enabling the detection of patterns in large volumes of scientific data, with data mining and advanced analytics.

Drivers

- The life science industry — an early leader in applying R&D analytics by giving tools directly to scientists — hungers for more analytics plug-ins in native applications, such as open-source R statistical programming language. R&D organizations are increasingly elevating templates, workflows and automation for science, raising the profile of capable analytics platforms to support the scientific method.
- Scientific staff members and engineers increasingly request the ability to ask questions that impact design, and they want the ability to make inquiries with a few variables for a large dataset — without having to engage a data scientist. This has increased interest in platforms that can natively provide these capabilities.
- Now that vendors have simplified these tools for addressing big data in R&D, the tools are being extended to a broader group of biologists, chemists and engineers who do not have deep informatics backgrounds, thus increasing the interest and hype.
- These solutions are known entities and have been in use for more than a decade at a wide variety of R&D organizations. Therefore, we position this technology on the Plateau of Productivity and it will reach mainstream adoption next year.

Obstacles

- R&D business users are increasingly purchasing a wide variety of tools designed for specific domains without IT's involvement. Fragmented analytics approaches can result from issues arising at some organizations in the form of competing platforms, challenges with customization or configuration support, and licensing agreements.
- A variety of IT consultant vendors are pushing nonscientific enterprise tools into the space. While this may simplify support and create an enterprise-level of familiarity, scientists often push back on these tools and elevate poor experiences back to IT and management. This can create divisions and lower trust between IT and R&D business areas.

User Recommendations

Swamped with extremely complicated design, scientific, clinical and regulatory information as the data deluge continues, R&D organizations with legacy systems must decide on one of three strategies:

- Deploy general tools and adapt them into scientific environments that may involve customization.

- Use specific tools designed for science, which may have limitations for configuring the tools for other enterprise purposes.
- Leverage analytics-as-a-service platforms focused on science, simplifying IT management and providing business-focused insights.

Also, take these steps:

- Gain exposure to new tools to visualize data and develop insights, as these will only grow in importance for scientific staff.
- Model investments in these tools for R&D and manufacturing as datasets get larger, and develop a core skill set supported by IT.
- Pay particular attention to vendor capabilities for pivot table analysis, visualization tools, and predictive modeling and analytics. Prioritize vendors that enable more self-service capabilities.

Sample Vendors

Dassault Systèmes; IBM; LabVantage-Biomax; MaxisIT; Palantir; PerkinElmer; Saama; Stardog; Talend; Tamr

Gartner Recommended Reading

Predicts 2023: Analytics, BI and Data Science Composability and Consolidation

Survey Analysis: Industry Cloud Platforms — A Life Science Perspective

Life Science Manufacturer CIO Top Actions for 2023

Life Science CIOs: Adopt Latest Data and Analytics Platforms to Manage Clinical Data Challenges

Solution Path for Building Modern Analytics and BI Architectures

Appendixes

See the previous Hype Cycle: Hype Cycle for Life Science Discovery Research, 2022.

Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 2: Hype Cycle Phases

(Enlarged table in Appendix)

Phase	Definition
Innovation Trigger	A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.
Peak of Inflated Expectations	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.
Trough of Disillusionment	Because the innovation does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
Slope of Enlightenment	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the innovation's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
Plateau of Productivity	The real-world benefits of the innovation are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
Years to Mainstream Adoption	The time required for the innovation to reach the Plateau of Productivity.

Source: Gartner (July 2023)

Table 3: Benefit Ratings

Benefit Rating ↓	*Definition* ↓
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
High	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
Moderate	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Low	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (July 2023)

Table 4: Maturity Levels

(Enlarged table in Appendix)

Maturity Levels	Status	Products/Vendors
Embryonic	In labs	None
Emerging	Commercialization by vendors Pilots and deployments by industry leaders	First generation High price Much customization
Adolescent	Maturing technology capabilities and process understanding Uptake beyond early adopters	Second generation Less customization
Early mainstream	Proven technology Vendors, technology and adoption rapidly evolving	Third generation More out-of-box methodologies
Mature mainstream	Robust technology Not much evolution in vendors or technology	Several dominant vendors
Legacy	Not appropriate for new developments Cost of migration constrains replacement	Maintenance revenue focus
Obsolete	Rarely used	Used/resale market only

Source: Gartner (July 2023)

Document Revision History

Hype Cycle for Life Science Discovery Research, 2022 - 26 July 2022

Recommended by the Author

Some documents may not be available as part of your current Gartner subscription.

Understanding Gartner's Hype Cycles

Tool: Create Your Own Hype Cycle With Gartner's Hype Cycle Builder

2023 Life Science Business Drivers of Technology Decisions

Predicts 2023: Digital Transformation of Healthcare Beckons New Era for Life Sciences

Healthcare and Life Science Business Driver: Medical Technology Innovation

Life Science Manufacturer CIO Top Actions for 2023

Table 1: Priority Matrix for Life Science Discovery Research, 2023

Benefit ↓	*Years to Mainstream Adoption*			
	Less Than 2 Years ↓	***2 - 5 Years*** ↓	***5 - 10 Years*** ↓	***More Than 10 Years*** ↓
Transformational		Generative AI in Life Sciences Large Language Models in HCLS	Blockchain in Life Sciences Digital Life Science Platform Genomics Medicine	
High	Analytics Platforms for Research Informatics	AI in Drug Discovery and Early Research Augmented Analytics Product Development Innovation Management Tools SaaS ELN SaaS-Regulated CSP SaaS Workbench for Genomics Research Scientific Literature Text Analytics Semantic Knowledge Graph Tools	AI-Synthetic Biology Tools Bioprinting for Scientific Research Cell and Gene Therapy Platform IoT-Enabled Laboratory Quantum Computing as a Service in Drug Discovery Single-Cell Multiomics Systems	

Benefit ↓	*Years to Mainstream Adoption*			
	Less Than 2 Years ↓	***2 - 5 Years*** ↓	***5 - 10 Years*** ↓	***More Than 10 Years*** ↓
Moderate	Electronic Laboratory Notebooks	Enterprise IP Management Precompetitive Alliances SaaS LIMS	AI Material Informatics AR/VR/MR in Life Science Cloud-Based Instrument Data Integration Platform Lab as a Service/Robotic Cloud Labs Mobile Lab Apps	
Low				

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Phase ↓	Definition ↓

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