eLabJournal

Whitepaper

Bringing ‘All Digital’ to Your Lab

The barriers to lab digitization are gone

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Digital “big data” is in every lab

Key Points

- Life science labs across academia, industry, and government are producing, storing, analysing, and sharing a massive amount of digital data
- Yet, many researchers still rely on paper lab notebooks that don’t have the capacity, formatting, or sharing capabilities to accommodate or integrate digital data
- An all digital approach using an electronic lab notebook (ELN) can solve these issues through improved searchability, time-saving functionality, decreased data entry errors, and more
- eLabJournal is an intuitive, flexible, all-in-one ELN that improves lab efficiency when documenting, organising, searching, and archiving data, samples, and protocols

Nearly every experiment in the modern-day life science lab generates digital data. Optics-based techniques, from real-time qPCR to microscopy, are ubiquitous across biological research and rely on digital cameras to capture high-resolution images and/or videos. Compounded over the weeks and months that an experiment can run, the amount of digital data generated can become massive. And with the increasing reliance on high-throughput, next-generation sequencing for nearly every aspect of life science research, the amount of digital data generated by the genomics field alone is estimated to equal or surpass the amount of data generated by social media or streaming video platforms by 2025.[1]

Data generation and acquisition is only the first step in the digital data lifecycle. Once acquired, data must be stored to ensure privacy, protection, and verification by the broader research community, analysed and visualised using software, and distributed across collaborators, partners, and various stakeholders.

While all of this is complex and sometimes convoluted, the breadth of data produced, stored, analysed, and shared has led to the era of breakthroughs in modern medicine, diagnostics, and other fields that have improved the quality of life worldwide.

[1] *Stephens ZD, Lee SY, Faghri F, et al. Big Data: Astronomical or Genomical?. PLoS Biol. 2015;13(7):e1002195. doi:10.1371/journal.pbio.1002195*

Coping with digital data, in a paper world: The shortcomings of a hybrid approach

Fast-forward to 2025: The future of genomics and the digital data lifecycle

Genomics datasets have been called a "four-headed beast" of digital data. The explosive growth of its use in the life sciences and the launch of third-generation sequencing platforms ensures that genomics will continue to pose computational challenges across the digital data lifecycle.

By 2025:[1]

- **Data acquisition** will grow to 1 zetta-bases (1021 bases)/year
- **Data storage** will grow to 2-40 EB (1 EB = 1,000,000 GB)/year
- **Data analysis** with grow to ~2 trillion central processing unit (CPU) hours for variant calling and ~10,000 trillion CPU hours for all-pairs genome alignments
- **Data distribution** will require the movement of many small (10 MB/s) and fewer massive (10 TB/s) datasets

Supporting the current digital data lifecycle presents several challenges for scientists. Currently, many laboratories rely on paper lab notebooks for data acquisition, storage, analysis, and distribution as a central hub for information and data. This paper-based infrastructure has stood the test of time and is still a mainstay in most life science labs, despite the explosion in digital life science data, the digitization of many other industries, and the practical, day-to-day challenges that using paper presents. Many scientists struggle daily to combine paper lab notebooks with digital data in a hybrid "Frankenstein" approach that combines analogue and digital formats.

Traditional, paper-based methods have become prisons, limited in their capacity to:

- Store the breadth of data generated
- Capture the complexity of data analysis techniques used with digital data, such as bioinformatics pipelines or other software platforms
- Be easily distributed to collaborators or future lab members

To get around this, scientists have developed a few "band-aids" to connect the paper and digital worlds. However, these are temporary, quick fixes, and act as barriers to innovation.

[1] *Stephens ZD, Lee SY, Faghri F, et al. Big Data: Astronomical or Genomical?. PLoS Biol. 2015;13(7):e1002195. doi:10.1371/journal.pbio.1002195*

Band-aid #1: Transforming digital into paper

Printing, cutting, and pasting into lab books are a coping mechanism for some labs, a futile attempt to transform digital data into a hard, paper copy. As digital data becomes larger and more complicated, this is rarely an adequate solution. Can you imagine printing the raw sequencing reads and associated metadata from an RNA-seq experiment and pasting them in your lab notebook? Doing so creates an impermanent copy and doesn't fully capture the information in the original digital version.

"Band-aids" to connect paper and digital worlds are temporary, quick fixes, and act as barriers to innovation.

Band-aid #2: Portable storage devices

External hard drives, writable optical discs, and USB drives are another coping mechanism to bridge the gap between paper lab notebooks and digital data. While they can be leveraged for data storage and contain valuable information, these physical storage devices can be broken or scattered throughout the lab. The information can easily be lost as laboratories go through regular turnover or move locations.

Digital data saved on various media in the lab is not secure. To guarantee absolute data safety and security, best practices call for data on these media to be refreshed in three-year cycles onto new media types in at least one geographically separated location to ensure redundancy in the event of fire, theft, or loss.

Such an approach is risky and inconvenient, particularly for smaller, centralised labs. Finding the results of a specific experiment and all its associated details on scattered media and hard copy records could take many hours of work with no guarantee of success. Even if you track down the specific information, it remains nearly impossible to compile a report of similar experiments efficiently and exhaustively, causing precious information to be lost.

The “all digital” solution to paper problems

As digitization increases and expands, it’s time for the life science industry to “rip the band-aid off” and embrace an “all digital” approach. If data are digitised completely using well-established, validated information management systems, such as electronic laboratory notebooks (ELNs), the benefits are numerous:[2]

- **Improved searchability:** Searches and queries of an entire collection of protocols, datasets, or biological samples are just a few clicks away.
- **Reduced data loss, breach, or corruption:** Data are securely stored in dedicated datacentres that are, by design, resilient against failure of data carriers and services.
- **Expanded functionality:** Full integration of an ELN with Protocol Management and Sample Management Software is possible, meaning that a complete experiment can be planned and documented within seconds.
- **Time-saving templates:** Integrated ELNs use adjustable templates that consider the association and organisation of the samples in the freezer with the data that is being generated. Laborious, detailed protocol rewrites are no longer necessary, and previous ELN entries can be easily searched using simple queries.
- **Decreasing human error and variability:** Lab equipment can pair directly with ELNs, so there’s no need to transcribe data onto paper or print from a computer. This improves the quality and reproducibility of experiments by minimising human error and variability. And importantly, data can be found, extracted, and compiled in any form.

2 Common arguments against ELNs

Of course, there are common complaints associated with transitioning away from paper into a fully digital world. Admittedly, no ELN can cure every woe associated with recording laboratory activities.[2] Here are the common critiques of an all-digital ELN solution:

- "I don't want to lose the flexibility and convenience of pen and paper."

– Writing with pen and paper is no longer flexible when you're working from home due to a virus and don't have access to your paper lab notebook because you left it at work. Is it really more convenient to spend 2 extra hours in the office area just to transfer all your notes from paper that smells like reagents in the lab?

- "We do not have the IT infrastructure."

– Choosing a cloud-based ELN is more economical and eliminates the need for internal IT support. System maintenances, software updates, and support are often included in the offered cloud license.

[2] *Higgins SG, Nogiwa-Valdez AA, Stevens MM. Considerations for implementing electronic laboratory notebooks in an academic research environment. Nat Protoc. 2022;17(2):179-189. doi:10.1038/s41596-021-00645-8*

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Bringing an “all digital” approach to life

The question is not whether all life science labs will go entirely digital but when and how.

The benefits are overwhelming: Reliable, efficient, and secure software is available and has stood the test of time, adopted early by some of the most prominent players in academia, biotech, pharma, and government.

Labs competing for funding in academia or supporting innovation in industry that continue to use hybrid analogue and digital systems will fall behind, plagued by inefficient processes and lost data. Many ELN systems are highly configurable and can adapt to any laboratory, operating in any regulatory environment.

With many labs already jumping into the all digital world, there are many ELN choices available. When considering an ELN solution, it’s essential to choose a system that properly fulfils the needs of your lab. Sitting down with your colleagues and making a solid plan will make all the difference and help you better assess the different ELN options.

Some labs, organisations, and institutions can get paralysed by trying to plan for the future rather than focusing on their present needs. But many ELNs are built to expand their functionality as a lab’s needs, tasks, and data types evolve.

ELNs in Action

Streamlined Testing and Production Processes at Deka Bioscience

The Situation

Deka Bioscience is a biotechnology R&D startup focused on the discovery and development of the next generation of cytokine therapies to treat devastating diseases such as cancer, Crohn's disease, sepsis, psoriasis, and rheumatoid arthritis. Deka uses dual cytokine (Diakine™) combinations and an enhanced manufacturing scaffold platform to extend the half-life, target specific tissues, and deliver disease-controlling therapeutics directly into affected tissues. They also use precision medicine to select patients with the highest likelihood of responding to and benefiting from Diakine therapy. Recently, Deka secured $20M in Series A funding and is planning to file an IND for their lead oncology molecule, cutting a path to scientific progress, therapeutic advances, and sustainable profitability through partnering or M&A.

The Challenges

Working in a highly regulated environment, requires rigorous compliance and robust, safe, and secure inventory management and processes. To achieve and maintain excellence in all aspects of the discovery, development, and deployment of a novel set of biological and biotechnological tools, Deka decided that they needed to implement a laboratory information system.
Their internal stakeholders determined that the most important attributes were:

- Compliance
- Data safety and security
- Ease of use
- Focus on the needs of biotech startups
- Customer service

Implementing such a system would ensure that the rigorous regulatory requirements of the biotech industry were met, operational productivity increased, and management of archived biological samples was reliable and organised.

The eLabNext Solution

eLabJournal stands out for simple and rapid implementation, ease of use, and excellent customer service. At this particular stage in the company's history, Deka relies heavily on it for the development and documentation of new processes. And on the day-to-day practical level, the management of inventory has become completely reliable, safe, and secure, with virtually no chance of human error.

The Results

By implementing eLabJournal, Deka was able to streamline their production and testing processes and establish a robust, impregnable foundation of data management systems. In doing so, they also enabled rigorous compliance with the external regulatory requirements and significantly increased productivity in multiple areas of the company.

About eLabJournal, an all-in-one, flexible ELN solution

eLabJournal offers an intuitive and flexible solution to manage information in your lab. The all-in-one Electronic Lab Notebook also includes sample tracking and protocol management modules. It also enables you to flexibly expand the functionality with add-ons, so you can tailor eLabJounal to your specific needs. Our sample management add-ons include:

- **Sample Batch Import:**
  Increase productivity when handling up to 200 samples at once. Import from the Sample List and import batches of samples of the selected sample type into one or more compartments.

- **Sample Batch Update:**
  Lets you handle up to 200 samples at once. Increase productivity by updating batches of samples from your Sample List. Update samples from the same sample type into oneor more compartments.

- **Barcode Automation:**
  Configure and generate barcodes to perform Sample Update actions in eLabJournal or eLabInventory. Simply scan the generated barcode(s) and the data is immediately input into your digital lab notebook.

- **Sample Lineage:**
  Visualise the lineage tree of your samples with the click of a button.

eLabJournal improves efficiency when documenting, organising, searching, and archiving data, samples and protocols. The software is suitable for any lab ranging from small academic laboratories and start-up companies to large academic institutes and globally operating companies.

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All of our product specialists have a scientific background and are happy to discuss your needs. Schedule a demo for a free, no-obligation product demonstration.

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