

# Walk, Don't Run – Why you Need to buy an ELN Today!



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I've been an Electronic Lab Notebook (ELN) user since 1990.

Granted, the first ELN I used was something I wrote myself, in Hypercard, to help me organize my time and data when I was a graduate student. PowerNotes actually made it big in the shareware world - I sold 10 copies, not counting the one I used myself.

I wrote it because the research I was doing - molecular phylogenetics - was producing data that just couldn't be easily put into a paper notebook. BLAST search results, multiple sequence alignments, PHYLIP tree output and intermediate files - I watched one of my fellow graduate students in the lab meticulously and laboriously print out and fold, spindle, and mutilate her datasets to make them fit in her paper notebook. And forget about those 20" x 50" autorads that represented our polyacrylamide sequencing gels!

I knew there was a better way. Hence, PowerNotes. It let me add files of any type, any size, link data to references and notes - and best of all, it was keyword searchable - and legible, which was a serious concern for me (I had problems reading my own handwritten notebook entries from only a few months back).

Modern ELNs, of course, are much more sophisticated than my now-ancient Hypercard Stack. But the basic needs they address are still very similar - help the researcher record their experiments and make the science accessible. But the similarity ends there.

Two hundred years ago, when Sir Isaac Newton and his colleagues implemented a major paradigm shift from alchemy to *science* - rational thought, hypothesis, test, repeat - it was fine to record your results on paper. Observation was everything, and the only type of scientific data they had to represent could be done so with numbers, letters, and simple sketches. And they would work in isolation for years, until finally presenting their results to the Royal Academy.

That model doesn't work as well today. Science is more collaborative, more dispersed - we have collaborators down the hall as well as across the oceans. And we need to collaborate *instantly*, because we aren't the only ones fighting for that grant/patent/publication. Everything has to happen *now*, and it needs to be validated and time-date stamped and adhere to standards and regulations.

Add to that the fact that we are generating more data, and more elaborate *types* of data, and paper just doesn't cut it anymore.

So what *are* the benefits of a well-designed, well-implemented ELN?

### **1. Better, faster collaboration**

A modern ELN will allow you to instantly view all of the information to which you are granted the proper access permissions. This means not just files and folders, but the notebooks of your peers and colleagues - see the work they are doing as they are doing it! But it's much more than that - you should also be able to annotate entries on other individual's notebooks - the digital equivalent of sticky notes. By leaving comments and feedback, or even files and protocols, on an *electronic* lab notebook, we now have instantaneous collaboration - you don't even have to wait for the user to be done using their notebook, or for another colleague to finish reviewing it - multiple users can simultaneously see the same notebook.

And of course this works whether you are in the same building or on other sides of the planet - a good ELN will allow you to access the information anytime, anywhere - as well as perform crucial validation and signature steps. More on that later.

### **2. IP Security & Automatic compliance (time/date/user stamps, audit trails)**

Securing your Intellectual Property (IP) is crucial. Even an academic lab faces competition from other researchers. In the race to patent (or publish) nothing is less critical than time. That means getting there first, and being able to *prove* it. The 21CFR11 requirements mandate time, date, and user stamps (as well as audit trails) for all of your research. And to validate the data it must be signed off on, by the researcher as well as a manager. But how many times do we gloss over the details? How many companies have lost a patent battle because of the logistical necessities of signing not instantly, nor even daily, but *whenever all the individuals involved* can actually be gathered into the same room? Monthly signing parties are the standard at some organizations - which means that the life-blood IP is not secure until well after it was created.

With an ELN, data entered into the system is *automatically* time, date, and user stamped - saving the researcher precious seconds, which over the course of the days - and months - and years - significantly add up. More importantly, audit trails tracking all the changes to the record (as well as even access tracking, important when you're trying to either verify compliance to a protocol, or who read which data, and when they read it) - again, all automatically.

And last, but certainly not least, the ability to use digital signatures means that signing can actually occur asynchronously - a user can sign off on their own work and move on to the next experiment; the ELN system itself can function as a "witness", and the peers and managers can review the work electronically (as pointed out above, from *anywhere*), and cosign when they are finished. No waiting until the end of the month,

the signing can be done whenever, wherever - and most likely sooner than it ever would be on paper.

### **3. No more reinventing the wheel**

There is more to securing intellectual property than simply making sure you have properly captured the basics of time/date/user stamp and resource audit trails. While this is sufficient to ensure legal compliance, the real advantage of securing that IP is that it will be readily available to anyone in your organization quickly and easily.

In the paper world, notebooks are single-instance - meaning you can't easily back them up, you certainly can't keyword search them, and when they're archived, they are essentially lost - trying to find information in a paper notebook world is often so cumbersome and difficult that it's faster to just redo the experiment. We've all been there - having to re-run a gel to get a pretty picture because we drew on the original (and then having to reamplify the DNA because the sample in the fridge had degraded). How many hours - days - weeks of rework do we do simply because we don't have easy and quick access to the original data?

The problem is really worse, because often we repeat an experiment because we simply don't *know* the organization already has the data. I can't tell you how many times a pharmaceutical company has told me that a large proportion of their experiments (as high as two out of three - that's 66%!) are inadvertent duplicates. They aren't repeating the science to validate it, but because they simply don't have good access to their own intellectual property!

A well-designed ELN with good search capabilities can prevent both of these problems. It will still be up to the user to actually do the search in advance of a new study (to avoid the problem of repeating an experiment that someone else in the organization has already done), but the time savings can be potentially huge. Imagine spending a few seconds doing a query every time you start a new project - a small investment of time - only to discover that someone has already optimized a protocol for your specific conditions? Even if that only happens once a year (or less frequently) it will *still* be time well-spent, and a huge cost savings for the organization that doesn't now waste up 66% of its R&D budget for time, reagents, and salary!

### **4. Rapid approval and validation**

Building on the above, it should seem obvious how the ability to sign off on an experiment rapidly and asynchronously could be applied equally well to protocols, SOPs, and IRBs. Not only can the design and approval of such documents be managed and tracked in an ELN, but compliance can be automated, and the audit trail easily enables managers to see who has (and who hasn't) read and signed off on the use of any of these documents.

### **5. Reduced cost of records & archiving**

Many researchers often don't realize that even their paper notebooks can cost a significant amount of money - much more than the simple composition book that it appears to be. Even a simple notebook costs *something*; the more sophisticated paper notebooks used in the pharmaceutical and biotech industries involve tracking and management, and can cost *significantly* more. Now add in the cost of the archivist and librarians involved in this management, as well as the cost of *archiving* the paper, which may involve anything from duplication and preservation locally to off-site secure archiving - for several years, if not decades. These costs rapidly become non-trivial, and in comparison an ELN can end up *saving* the organization money simply by reducing the archival costs (let alone the time and money already saved through better search and retrieval, outlined above!).

One good friend of mine pointed out that their paper notebooks were even costing them money during their everyday progress reports - each scientist would create duplicate copies of vital experiments and hand them out to every attendee, only to have these duplicates thrown out (hopefully, at least, to be recycled) at meeting's end. How much simpler to simply connect a laptop to an overhead projector, display the relevant results, and then send direct in-system links via the ELN itself to the data so that each scientist could peruse the data directly - with no additional cost, or waste of time?

## 6. Data/Notebook Portability

There's a lot of transience in science - particularly in academia. So it's no surprise that one of the questions I hear frequently from my academic colleagues is "who gets to keep the notebooks?"

We've all been there - you spend several months to several years on a project, it's nice to have something to show for it. It's common for graduate students and postdocs to "liberate" their notebooks when they leave the lab. Who can blame them, other than the PI, who *also* poured their life blood into the project? Other than the grant-managing institution, which technically owns the data?

Yes, notebooks can be photocopied. But the amount of labor and resources involved often prevents this from happening. And what about data that simply isn't amenable to duplication? Much of my data from my grad school days lived in the form of large autorads (exposed x-ray films) of polyacrylamide sequencing gels. These autorads were on the order of 20" x 50" in size - *not* something I could just tuck into any old notebook, and *definitely* not something easily duplicated. And that was a geological epoch ago in terms of scientific data - nowadays our data comes off of high-speed sequencers and microarray machines and in-situ imagers that can all be pre-loaded with days worth of runs, resulting in an absolute profusion of data - you just can't take it all with you.

Enter the well-designed ELN. All data, all formats, all sizes. No copying and pasting (not in the literal sense, with scissors and tape and glue, anyway). Nightly incremental backups of *everything* - lab data, journal articles, and notebooks. And - if the ELN is truly well designed - data portability. PDF printouts of the entire notebook (or just select portions, if that's what you need) - beautifully rendered, containing everything the scientist put into the experiment, and best of all, legible. Exported, portable archives of notebooks, ready to import into the *next* ELN system that researcher works with. Exported, portable archives of all the actual datafiles - text files, spreadsheets, instrument data, *everything!*

The above is hardly an exclusive list, but hopefully you've found some compelling reasons as to why an ELN is not just useful, but *essential*, to any organization that wants to stay competitive in the modern world of science. The question shouldn't be "Do we need an ELN?"; rather the questions should be "Which ELN is right for us?".