'…scientists found electronic laboratory notebooks user-friendly, time saving and generally hard to live without.'

editorial

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Electronic lab notebooks – do they work in reality?

In most organizations any new IT system is carefully scrutinized with regards to return on investment and how the system fits within corporate strategy. There have been extensive discussions about the legal validity and practical feasibility of electronic laboratory notebooks (ELN). Would they really work in the laboratory? What about electronic archiving? Usually it is assumed that the current practice is satisfactory, albeit slightly inefficient, and that any new system needs to justify its existence. For the traditional bound notebook – a fundamentally important document for Pharma companies – the reverse question might be more relevant: 'do we dare not go for ELN?' No company would probably like a deeper dig in their archives. Poor handwriting, incomplete records, non-signed pages and loose leaves are nightmares in a future court trial where the company's patents (and potentially entire future) are at risk. From a corporate point of view the lack of control over the vital pieces of information that the laboratory notebooks represent is embarrassing. In reality the notebook is a private matter for each scientist, out of reach for anybody and any standard operating procedure in the organization. 'Knowledge sharing' remain only buzzwords as long as key information is stored in private drawers. ELNs could – and undoubtedly will – change all of this.

The potential rewards of ELNs are of course many: increased documentation quality, sharing of methods and data, easy delivery of project details and – not to forget – an improved working environment for the scientists who are expected to deliver more with less. Sometimes the expectations represent severe pitfalls for a new ELN implementation project. What is an ELN? A repository for raw data is tempting, if you don't have one. A document-management system? A database of all reactions invented in the company? The questions usually boil down to a 'would an electronic form of the classic notebook be sufficient to attract users?'. If not, we could be stuck with one ELN per scientific discipline, where the ELN is more of a toolbox fixing all the problems that should have been solved by, for example, laboratory-information management systems or chemical-property calculators. Such an approach would severely block any attempt to make ELN a bridge between projects and a common corporate asset.

User satisfaction survey

Biovitrum – a spinout from former Pharmacia Corporation, now a mid-size biotech of 500 employees – went through the process of designing and implementing a common ELN system for the entire

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R&D operation. The system was built based on the user's requirements, tested in an iterative fashion and finally rolled out to some 250 scientists, ranging from molecular biologists to drug formulation scientists. The process from initialization to roll out in the laboratories took less than two years. A small consultancy company, Contur AB, built the system on the latest Microsoft technology and the result was an easy-to-use program where scientists can copy and paste data from various applications, save their own templates and search for other people's experiments. Under the hood there is a solid and redundant IT infrastructure which saves all notes into a relational database. Meta-data are used to connect to other systems, structures are automatically extracted to enable chemical searching and the intellectual property is protected through a novel use of bar-coded security paper, archived with full corporate control.

An internal user satisfaction survey performed in October 2004 clearly revealed that the Biovitrum scientists found ELN user-friendly, time saving and generally hard to live without. Why? There seems to be some outstanding ingredients:

(i) Ease of use. Most people have started without any training. Smooth integration with the standard PC environment, including copy and pasting of text and images and the use of Excel spreadsheets, is appreciated but ELN also improves the organization of data. All experiments are auto-saved and auto-organized into project folders. Usually the degree of acceptance for new IT systems varies heavily among user categories, but according to the survey there is no difference in opinion related to age, gender or area of work.

(ii) 'Searchability'. Not only the fact that you can find your colleagues' experiments – you can actually find your own. In addition, each experiment has a unique identifier making it easy to discuss issues, either by e-mail or at meetings. Any experiment can be accessed at any location in the building. Contrary to a common view that books are superior for finding your data rapidly ('it's on the page where I spilled coffee') the answers indicate that even for the own records electronic searching is efficient.

(iii) The user-controlled templates. Any experiment can be saved as a template, either private or public, following some standards of the department. Apart from the obvious fact that templates save time and make records more complete, they also improve the overall logic, resulting in clearer and more readable experiments. 'It's easy to make structured notes and keep track of several ongoing experiments', was a comment from several users.

An improved record quality is mentioned by 70% of the users. Has this been achieved at the expense of recording time? Our expectation was that writing would take approximately the same time regardless of whether the record is typed or scribbled by pen. In the survey 50% of the users answered that time spent on recording in ELN and bound books is similar, but a typical comment is 'you include more in ELN than on paper and it takes about the same time'. There is some variation in the answers, although: 30% says it's faster or much faster and 20% claims that recording in ELN is slower than with bound books. The latter seems to be especially true for biologists, where handling images (e.g. gels) represents an extra step. However, the recording phase is only one side of the coin. The fact that data only need to be inserted once and thereafter can be read by other systems or that reports can be easily created using ELN as a source for copy and paste save time later in the process. The time saving is also a result of connecting different research data systems, where ELN is just one component. Compound registration is a good example. It has been reported that some organisations expect their chemist to draw the same chemical structure up to five times in separate systems. Biovitrum chemists can now import their end-product data directly from ELN into the compound registration system, saving time and avoiding errors. ELN is a key component for any laboratory automation effort because it is experiment centric, but it doesn't alone solve all problems.

And the hybrid system? Isn't paper printing a poor result of an electronic notebook project? Not really. No users indicate that the paper handling is a heavy burden. Each person has full control over when printing is done. Printing the last two weeks of experiments takes a few minutes and witnessing is easy when the pages are readable. Signing and witnessing are important steps for IP protection and they are now possible to survey. We estimate that 60% of all records are signed and sent to the archive within two weeks of finishing the experiment and 90% are signed within six weeks. This is probably an outstanding industry golden standard which is even more impressive given that there has been no attempt to force people to improve their record submissions.

Sometimes one might get the impression that a breakthrough for ELN is dependent on a new tablet PCs or wireless connections in all laboratories. None of these are true according to the Biovitrum users. Standard – but admittedly compact – stationary PCs spread out in the laboratory are sufficient. They cost less than US$1000 and can be instantly replaced if broken. We've tried wireless laptops, but most of them are still unused or at least not carried around. ELN is not about technology toys, neither is it restricted to chemists or reaction searching. In fact, the survey showed that only ~30% of the chemists used the structural searching regularly but they still found ELN extremely useful.

Conclusions

The key ingredient for successful implementation of ELNs is a user-friendly software that supports the general need to record what is done in the laboratory. It is also about

supporting the company's need for IP protection. A hybrid system where wet signature security paper printouts are part of the workflow is a straightforward and easy way to get around the as yet unsolved problem of how to store electronic records for 20 years or more.

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