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What are the Benefits of ELN?

In today's dynamic market, there are several sets of answers to this question

Editors Note: This is the first of a new bi-monthly series of articles on electronic laboratory notebook (ELN) technology. The objective of this series is to provide an educational resource on ELN and its application.

Back in September of 2004, I wrote an article for this publication titled "It's Not About the Paper: Benefits of Electronic Laboratory Notebooks."[1] In this piece, it was discussed that electronic laboratory notebook (ELN) systems are much more than just simple electronic representations of their paper counterpart; they had the opportunity to help create an institutional memory and enhance data quality. It also was noted that ELN should be able to help improve the efficiency of resources by increasing the available time for experimentation through simplification of mundane paper-based tasks, integrated scientific tools and a searchable experimental repository.

A lot has changed over the last five-plus years. The use of ELN is much more widespread, particularly in the biopharmaceutical market, growing from under five percent of companies leveraging ELN to over 30 percent today.[2] There are now product offerings from a multitude of suppliers and those systems have matured greatly in their features and capabilities.[3] "Electronic only" environments with digital signatures are currently the norm for intellectual property management versus the "hybrid" approach of printing paper renditions of notebook records and applying manual signatures in 2004. Due to the dynamic nature of the market, it was felt that a new look was in order, examining the actual benefits achieved by some of the first ELN pioneers.

User experiences

There are both tangible (e.g., measurements of efficiency gains) and intangible (e.g., knowledge sharing) benefits resulting from most informatics projects properly led, analyzed and implemented. ELN projects tend to be justified to upper management based on an assumption of tangible gains in operational performance through a return on investment (ROI) study. Financial managers in particular want to examine hard numbers; though, in practice, the net effect of a project is rarely reviewed to see if targeted gains were actually realized.

Schering-Plough (now part of *Merck & Company*) is one company that did examine the return on investment of ELN before and after implementation in the areas of medicinal chemistry and biology. Before system deployment, the project team mapped representative workflows from key departments and studied the time it took scientists to execute paper-based tasks. Estimates of savings were developed through process analysis, forming the basis of the project's ROI. After a two-month period of acclimating to the system after introduction, the users' workflows were studied once again, recording activity times based on the new processes. According to Mark Atkinson, section leader for molecular design and informatics, the team realized the anticipated time savings, freeing scientists to undertake additional experimentation and analysis.

A majority of those who have implemented ELN place a greater emphasis on the intangible outcomes of their project, rather than gains in work efficiency. This naturally depends upon where one lives in the organization (Figure 1): In early discovery research, where measurements of efficiency often can be nebulous, ELN plays a different role than in development or quality control, where calculations of improvements in cycle time, throughput and costs of compliance can more easily be derived. With the majority of all ELN installations to date occurring in research, it is natural that knowledge retention, collaboration and intellectual property protection rise to the top of many of users' lists when examining ELN broadly across many markets and domains.

Johnson & Johnson's Pharmaceutical Research and Development (J&J PRD) division began exploring technology to replace paper laboratory notebooks in the early portion of the last decade. J&J's ChemPharm group invested in ELN in 2005 with subsequent roll-outs to active pharmaceutical ingredient (API) and Pharmaceutical Development completed by 2008. The company is currently expanding the use of ELN into adjacent domains. The technology has assisted in a number of ways — some were anticipated, a few not. According to Sharon Sperber, IT manager at J&J, the project's original ROI was based on an estimate of 10 percent time savings for scientists.

"The time savings goal was attained, but other benefits such as knowledge sharing, knowledge retention and improvements in compliance and quality have had a much greater impact on the organization," says Sperber. "Knowledge sharing has turned out to be a terrific benefit, especially with the increasing globalization of our work. This enables the ability of the work to 'fol-

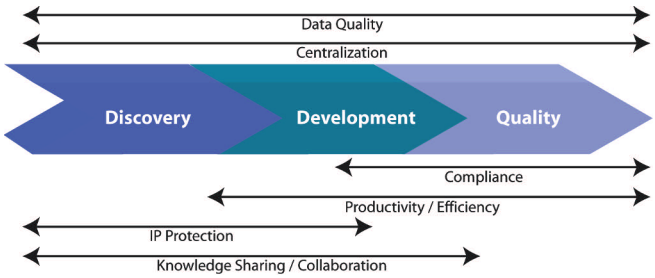

Figure 1: ELN benefits can vary by area

low the sun' and retains a historical perspective on projects that could never be obtained with paper notebooks."

The collaborative capabilities of the ELN also have resulted in J&J scientists providing more detail on experiments with additional supporting data than they did during the paper era; an often unforeseen phenomenon experienced by many other ELN users. Knowing that others will be viewing their work across many sites and over several years, scientists using ELN tend to spend more time in experimental write-up and data analysis to support their conclusions. ELN leaders at several companies report this increase in data quality and level of detail can offset productivity gains early in the project, but the organization benefits markedly in knowledge management, IP protection and re-use of experiments through "cloning" over the long term. After the repository has a large number of high quality experiments, cloning in later years can greatly enhance experimental throughput.

Michael Kopach, principal research scientist at *Eli Lilly and Company* and project lead for their process chemistry ELN said, "the searchable library capability of the ELN is by far the greatest benefit of the technology. It takes time, but the importance of the library builds as you grow the number of experiments. This enables cloning, which results in faster setup of the next experiment." Lilly's system has been in use since 2004 and is "100-percent paperless" according to Kopach.

Array Biopharma was one of the earliest ELN pioneers, with first deployments as far back as 2000. "While I am skeptical of formal ROI measurements, the ELN clearly improves the efficiency of our scientists in a number of ways — integrated analytical data, barcode scanning of reagents, integration to chemical registration, etcetera," says Daniel Weaver, associate director of scientific computing. Echoing a viewpoint similar to Kopach's, Weaver goes on to say "However, we see centralization of data as the primary benefit. This affords the organization the opportunity to review and improve workflows around the execution and documentation of experiments. Centralization enables most of the other ELN benefits, such as accessibility and searching. We have used this benefit for other related business needs, such as supporting collaborators, seeding new projects, synthetic path improvements — the list goes on and on."

Another long-term user of ELN, *AstraZeneca*, implemented different supplier products across process chemistry, medicinal chemistry and quality assurance. The process chemistry team began looking into the possibility of using ELN back in 2002, completing their deployment in 2004. Since implementation, the process group has experienced tangible gains in efficiency, as well as the intangible benefits of an integrated knowledge repository and security over intellectual property.

Senior information manager Ian Menzies says "cloning experiments has been the number one benefit in development. Over 80 percent of the write-ups in the repository are clones with the commensurate time savings. In addition, easier hand-over to manufacturing teams has resulted in considerable time savings and reductions of errors."

In the medicinal chemistry implementation installed a few years later, the project was justified based on a number of benefits, including a 10-percent increase in productivity, information sharing, IP security, quality improvement and information integration.[4]

At the recent ELN conference in Brussels, David Drake, informatics chemistry lead for discovery information, stated the department achieved the targeted efficiency gains largely through experiment cloning and via integration that enables a single user interface for multiple repositories. Nevertheless, other advantages afforded by the system are considerable:

- automated stoichiometry has reduced calculation errors
- integration to the chemical registration system ensures data consistency
- a coupling to the company's chemical inventory system flags any hazardous materials to make certain safety procedures are followed.

Conclusion

In summary, due to the diversity of application areas where ELN can be leveraged, as well as differences between corporate objectives and cultures, there is not one single set of answers to the question "What are the benefits of ELN?" Those who have been using ELN for many years report indisputable operational improvements ranging from increases in productivity to knowledge retention, sharing and re-use. The companies reporting the greatest positive impact of the technology and the highest levels of user satisfaction are also those who have carefully and methodically managed their project from conception through deployment. In many ways, what you get out of the project depends largely on what you are willing to put into it. SC

References

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