BIO-ITECH
LABORATORY INFORMATION MANAGEMENT

Transitioning to the digital lab

With the rapid digital advances it is easy to forget where we came from. 2008 marked the beginning of smartphones and it was not before 2010 that tablets were invented. 2010 also marked the beginning of mainstream acceptance of mobile data and always being online with mobile carriers offering high quality data connection. All sorts of products and services were created, changed, or disrupted while this digital revolution was taking place (Crockett et al., 2013). At the foundation of these changes lies the added value that digital solutions provide as compared to its analog counterparts. While this also rings true for the Life Sciences, there are some caveats that you need to be aware of while starting with a digitalized system.

Digitalization in laboratories

Digitalization of experiment results is not a new concept for life science labs. A clear example is in imaging labs. In these labs, probe detection with light-sensitive photo paper has been replaced by highly sensitive digital cameras, no longer requiring a darkroom. In addition, microscopy now allows for taking as many pictures as needed and discard failures instantaneously. Live recordings using a digital video camera are now possible spanning multiple days or weeks instead of the short length of a magnetic tape that gave two hours of recording, at most. There are numerous other examples where digital applications are being used, such as in genomics/proteomics, and where large amounts of data is generated. A vast amount of data is produced every day, giving rise to countless approaches to data mining and analysis of experiment results. For this purpose, many software packages are readily available (Rustici et al., 2012).

Classic paper lab notebooks: failure is eminent

Many scientists struggle every day in combining digital data with analog methods (paper books) while conducting their experiments. Printing, cutting, and pasting into lab books might be a coping mechanism for some, but as digital data have become more complicated and larger in size, this is rarely an adequate solution. As a result, external hard drives, writable optical discs, and USB drives containing valuable information are scattered all over the lab. The information can easily disappear with time or get lost due to misplacement, physical damage or old age (+3 years). The only paper-based solution scenario that would prevent these issues is each member of a lab being organizational fanatics who organize their lab notebooks in a strict and orderly fashion using an elaborate indexing system. While digital data in datacenters are safe from the elements and failure due to multi-redundancy and autofailover techniques, data saved on consumer grade media are not. To guarantee absolute safety, data on these media would have to be refreshed in three-year cycles onto three new media types, including at least one geographically separated location, to ensure redundancy in the event of fire or theft (Rizk, 2013).

One might imagine that this solution is a step away from convenience. Finding results of a specific experiment with all associated details on scattered media and hardcopy records could take hours of work without a guarantee it can be retrieved. Even if you do find the specific details, it remains nearly impossible to compile a report of similar experiments in an efficient and exhaustive manner, causing precious information to be lost.

Digital experiment recording offers more than solutions to existing problems

If data are digitalized completely using information management systems, the type of searches or queries described previously are only a few clicks away. More importantly, the data are securely stored in dedicated datacenters that are, by design, resilient against failure of data carriers and services. Being afraid of losing the flexibility and convenience of pen and paper, some scientists refrain from moving towards a digital system. Generally, the opposite is true. Platforms exist that fully integrate an Electronic Lab Notebook with Protocol Management and Sample Management Software. This means that a complete experiment can be planned and documented within seconds. Lab software uses adjustable templates while taking into account association and organization of the samples in the freezer with data that is being generated. The laborious detailed (re)writing of protocols is no longer necessary, anything that needs to be known is instantly available. Effectively, this means that scientists who record experiments digitally spend less time writing and more time conducting experiments. There are additional benefits, such as the possibility to automatically control and integrate data readings from lab equipment, which improves the quality and reproducibility of experiments by minimizing human error and variability. Another benefit is that data can be found and compiled in any shape and size.

Pitfalls

The benefits of digital experiment recording systems are paramount and it is hard to foresee a near future without labs having embraced the possibilities the current digital era provides. Still, the shift towards these systems requires careful planning and is preferentially assisted by life science experts that have thorough understanding of the software. Many systems are highly configurable and can adapt to any type of laboratory. However, long term negative effects may occur if sub-optimal decisions are made in the initial phase. It is important to realize that you don't necessarily need to know what type of data you want to store. This can be adjusted and evolve with the lab itself. What you do need to know is the kind of questions you will be asking the system and the type of reports you wish to receive. Sitting down with colleagues and making a solid plan first will make all the difference. Or better yet, ask the vendor to offer consultancy services that can aid in this process.

References

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