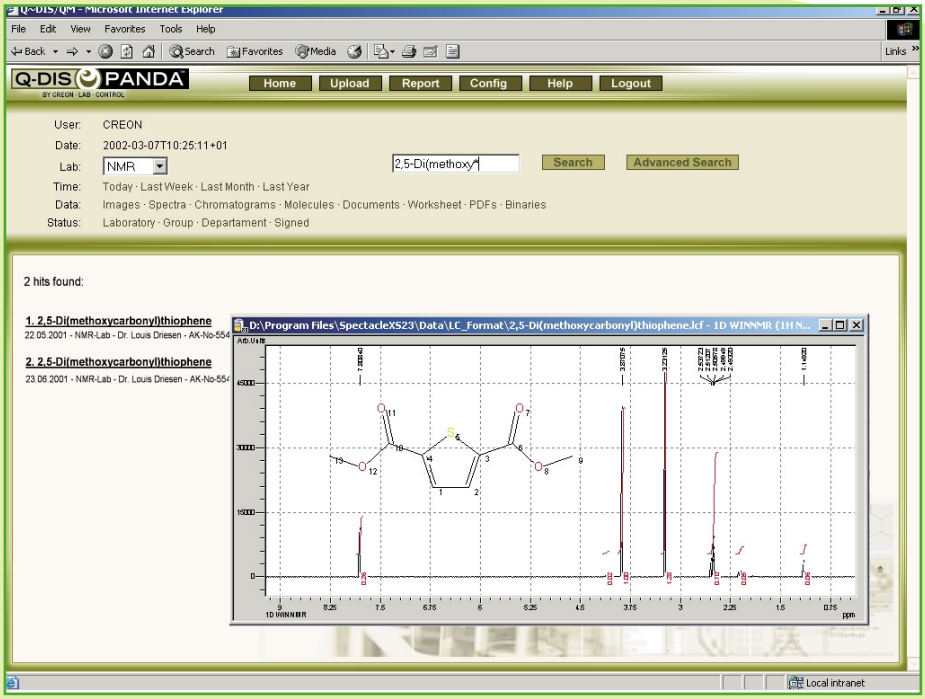
LIMS – New Trends in Software

By definition, laboratory information and management systems (LIMS) support the working processes which form part of the research activities in a laboratory. The range of functionalities offered by the LIMS products available in the marketplace varies. Some are determined by customer demands and the company strategy of the LIMS manufacturer, whilst the development of other LIMS products is driven by new challenges in EDP technology and also regulatory requirements. Customers wishing to use data-processing to assist in running the laboratory therefore have a wide range of software solutions to choose from.



Q-DIS/PANDA - Portal to the Analytical Data Warehouse for raw data retrieval and storage from a LIMS. www.creonlabcontrol.com

Technology and application

The development of LIMS for sample tracking and quality assurance began at the end of the 1970s when suitable minicomputers became available. The first individual solutions were soon replaced by standard products, conceived for operation on mainframe computers with terminals. In the past few years, the technology of LIMS has changed radically, thanks to the indomitable spread of the PC and local networks. The following EDP components are typically used in modern LIMS solutions for multi-user systems:

- A database server on which the LIMS database is stored and which is often also used to run the application software. This market is dominated by the ORACLE relational database system. UNIX or Windows NT/2000 computers are generally used as the server system.
- PC workstations linked to the server system via a local area network. The PCs are generally run with Windows 9x, NT, 2000 or XP and offer the user the LIMS applications with a graphical interface. The LIMS usually has a client/server configuration, i. e. the application and the database are separated, and communicate via a network.
- Network infrastructure, most often in the form of an Ethernet – or token-ring-based local area network (LAN). TCP/IP is the most frequently used network protocol.

The functionality of the LIMS applications marketed over the past few years has been continually extended and they now represent high-performance tools for laboratory management. Basic functions offered by all LIMS are:

- Order and sample login for the definition of the type of job and identification of the materials to be investigated
- Assignment of the test scope for the investigation, whereby individual analysis, and also test profiles can be assigned to a material
- Distribution of samples and tasks for task- and priority-driven allocation of analyses and materials to defined workstations
- Manual result entry in various different ways at the monitor, or optional automatic acquisition by the laboratory instrument.
- Evaluation of data using defined calculation functions and comparison with stored specifications, and also a function to asses the results
- Reporting function which prepares, analyses and presents the results obtained

Furthermore, there are functions for the management of master records, test planning and laboratory management. When considering different LIMS and the functionalities they offer in detail, differences emerge which have to be assessed with regard to the suitability of the system for one's own laboratory. Some of the products are especially suited to the pharma sector, whilst others better serve the needs of service laboratories. Characteristic of modern LIMS is also that the standard version of the software can be customised to suit the user's needs. Since, in practice, the basic version of the system is never used, adaptability is an important factor, and also widens the spectrum of applications for a system.

Development trends

The LIMS market is changing gradually with new technologies and vendors as well as the tendency to greater integration with other systems. Although the possibilities offered by new technologies are often not fully exploited and integrated into the expanded LIMS solutions, the trend is clear, as is illustrated by these examples:

- The requirement that laboratories be integrated into organisationally higher business processes in companies has resulted in LIMS applications often being extended with interfaces that make it possible to link them with other EDP systems. These are most frequently planning systems which are used to manage

projects, production, or finances. These systems supply the LIMS with orders of analysis and it passes results, assessments or performance data back. The type of communication ranges from extremely simple ASCII data exchange to formats based on XML and even to standardised programme interfaces such as links with SAP R/3.

- The necessity to automate laboratories led very early on to the use of intelligent laboratory instruments. However, there was some hesitancy to link these into the LIMS and the solutions used were often not at all user-friendly. This changed with the use of PC-controlled devices. Bi-directional communication for the transfer of sample lists and the transfer of analysis results to LIMS can be performed with a reasonable amount of time and work. With new databases, the storage of images and spectra is also now offered. Here, however, the trend is towards the use of special raw data archival systems which perform this task instead of the LIMS.
- New requirements for companies from regulators are also influencing the way that LIMS are used. The regulatory instrument "21 CFR 11" (Code of Federal Regulations) from the Food & Drug Administration in the USA has forced LIMS to introduce higher data storage security. A result of this, for example, is that password protection has been introduced into some systems which also cover biometric methods and optionally permit the data to carry a digital signature.
- With the advent of web technology in everyday work, LIMS vendors have also had to confront this subject too. Whilst a few years ago the optional production of LIMS results reports in HTML format was greeted with great enthusiasm, now functions such as sample registration or data retrieval via the Internet are nothing unusual. Some vendors have converted their user interfaces completely into web browsers or have redeveloped their systems with new languages such as JAVA for this purpose, which makes operation via the Internet possible.

The list of trends in LIMS can, of course, be further extended; for example, there are links with Office applications, document management tools, and graphics or statistical applications. The most important factors in the successful introduction of a LIMS are, however, to define the core requirements of the system from the laboratory's point of view, implement an appropriate LIMS, and then extend it step-by-step with sensible new functionalities making use of new technologies.

Conclusions

LIMS applications have progressed considerably over the past few years. Rather than innovative changes to standard functions, this has taken the form of a greater integrability into business processes, making use of new technologies. This has not made it any easier for users to choose the best system for their purposes, particularly since a LIMS is no longer defined only by the requirements of the laboratory, but other business aspects have to be taken into account.

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