A brief history of LIMS \(^{1,2}\)

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Abstract

The final programs of the Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy are reviewed to trace the origins of laboratory information management systems (LIMS) both as a topic in the technical program and as a product available in the exposition.

The development of the literature of LIMS is examined, from the early articles in the trade press, through the key papers in the ‘A’ pages of Analytical Chemistry, to the peer-reviewed journal published by Elsevier. The concurrent publication of books on LIMS is described.

The origins and growth of the International LIMS Conferences and the LIMS Institute are described. The LIMS activities of the ASTM, the currently available short courses, and the most recent newsletter activities are summarized.

Keywords: History of LIMS; Literature on LIMS

1. Introduction

The information in this article is based, to a large extent, on the final program books of the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy \(^3\). The review starts in 1973, two years before I started attending the Pittsburgh Conference with a specific job assignment related to laboratory automation. In order to be brief, each year will not be covered; instead, key papers and vendor announcements from 1973 to 1995 will be discussed. No attempt will be made to trace the state-of-the-art of laboratory information management systems (LIMS) or the development of computer technologies relative to LIMS, rather the history of the discipline itself will be explored.

2. The Pittsburgh Conference

The roots of LIMS were in laboratory automation. The first relevant Pittsburgh Conference session was a 1973 symposium titled Guidelines for Defining and Implementing the Computerized Laboratory System [1]. The symposium was organized by ASTM...
Committee F-31 (discussed below) and the papers presented represented issues of current interest. The authors and titles of the papers were J. Frazer, Lawrence Livermore Lab, *Design Procedures for Chemical Automation*; S. Perone, Purdue University, *Specification and Design Procedures as Applied to GC/MS Automation*; T. Brubaker, Colorado State University, *Accuracy Specifications in Chemistry Data Processing*; and C. Klopfenstein, University of Oregon, *A Planned Data System*.

Contributed paper sessions in 1973 included *Automated Data Handling in the Laboratory and Laboratory Computer Selection* [2]. The majority of these papers dealt with the use of micro- and mini-computers, with a major emphasis on custom-built interfaces and writing programs in second- and third-generation programming languages [4]. Companies describing laboratory automation products in the exposition included Perkin-Elmer, Varian, Digital Equipment Corporation, Hewlett-Packard, and IBM Instruments [5].

In 1976, no symposia addressed laboratory automation. However, contributed paper sessions included *Automated Analyses I & II and Computer Applications and Laboratory Automation* [3]. The latter session included the first paper describing what is now called the LIMS at the Pittsburgh Energy Technology Center. The title, *The Application of Automated Data Processing to Coal Analysis*, indicates the perspective that the authors brought to the system [4]. Many automation papers were presented in contributed paper sessions about techniques; e.g., several papers on chromatography data systems were presented in sessions on chromatography.

1976 was the first time that the American Chemical Society (ACS) offered the short course *Laboratory Automation: Micro-, Mini-, or Midcomputer*, by Ray Dessy, Virginia Polytechnic Institute and State University, at the Pittsburgh Conference. The ACS short courses date back to the late 1960s; however, this was the first offering of an automation course at the Pittsburgh Conference.

The 1979 Pittsburgh Conference program offered a symposium on *Laboratory Data Management* organized by myself and Frank Plankey, University of Pittsburgh [5]. The speakers were R. Megargle, Cleveland State University, *Symposium Overview*; P. Fletcher, PPG Industries, *Laboratory Systems Management Progress Towards the Computerized Laboratory*; J. Cupps, Gulf Oil Chemicals, *Sample Inventory Management and Quality Control*; F. Madsen, OSHA, *The Paperwork Problem of a Regulatory Agency Laboratory*; and R. Johnson, Upjohn, *Laboratory Data Management in the Pharmaceutical Industry*. It should be noted that the organizers invited four speakers to address wide ranging and different laboratory data management issues.

*Computer Software for Scientists* was the 1980 symposium relating to automation, with an accompanying contributed paper session titled *Computer Hardware in the Laboratory* [6]. The contributed paper session was predominantly build-it-yourself reports with commercial interfacing products mentioned in only two of the ten abstracts. The exposition included Hewlett-Packard -- Laboratory Automation Systems, Varian -- Chromatography Data Systems, and Purvis Systems -- Custom Lab Management Systems, the first mention of laboratory management in a product description.

The symposium *Analytical Laboratory Computer Networking*, in 1981, presented five papers that primarily described custom-built networks [7]. The related contributed paper sessions stressed similar issues and, once again, practical albeit custom solutions. The Pittsburgh Conference offered a short course, *Approaches to Laboratory Computerization*; six user systems were described along with two vendor presentations [8]. The exhibitors' product descriptions included Perkin-Elmer -- Computer Aided Chemistry, Hewlett-Packard -- 3556 Lab Automation.
System, and Purvis Systems – Computerized I.S.

1982 was the watershed year! Perkin-Elmer announced LIMS 2000. Purvis Systems offered a ‘Turnkey LIMS’, and Spectrogram Corporation introduced a LIMS (laboratory management information system) [9]. Thus, the term LIMS entered the commercial world (no mention of the acronym was found prior to 1983). In 1983 Perkin-Elmer presented a paper on LIMS 2000 [10]. Frank Plankey, Polaroid Corporation, organized the symposium Solving the Laboratory Management Problem for the 1983 Pittsburgh Conference [11]. Frank asked me to keynote the session. One of the slides I used showed the distances allowed for RS-232 cabling as a function of conductor size. Although commercial systems were then available, building the communications interfaces in the laboratory was still a struggle. The exposition included the following vendors: Computer Inquiry Systems. Digital Equipment Corporation. Fein Marquart, Hewlett-Packard, IBM Instruments, Laboratory Microsystems, Nelson Analytical, Radiation, Spectrogram, and Perkin-Elmer.

Having established the critical events, the survey skips forward over many years of LIMS symposia and contributed paper sessions to the 1995 Pittsburgh Conference where 24 papers were found in the keyword search with LIMS as the search entry [12]. LIMS products were indicated by 42 vendors in the American Laboratory product search program [13]. It is interesting to note that these two numbers were obtained using computerized searches in less than five minutes, whereas the above discussion for the period 1973 to 1983 required hours of searching through literally pounds of paper documents. The focus now changes from the Pittsburgh Conference to a discussion of the International LIMS Conferences, which, like many other single topic meetings, has become the premier place to present papers on LIMS.

3. The International LIMS Conferences

In 1985, Dave Nelson and Harmon Brown of Nelson Analytical and Graham Martin of ICI approached me with the idea of holding a meeting dedicated to LIMS. We agreed that such a meeting made sense and planned to meet again in the spring of 1986 after discussing the idea with peers and colleagues. The second meeting was held in March 1986 and there was a unanimous agreement that a series of LIMS conferences should be held with alternating venues in the United States and Europe. I agreed to chair the first meeting, with the condition that it would be held in Pittsburgh, PA, and Graham Martin volunteered to chair a subsequent meeting in the United Kingdom.

A starter grant was obtained from the Society for Analytical Chemists of Pittsburgh (a co-sponsor of the Pittsburgh Conference). The first conference was held in Pittsburgh in 1987 and was very successful, with an attendance of over 400, and a technical program of 38 papers. Because of the high interest among the delegates at the meeting, Victor Zadnik of ALCOA quickly agreed to chair the second conference in Pittsburgh in 1988. Graham Martin graciously agreed to this action and set about planning the first UK meeting for 1989. The 1988 Conference was as successful as the 1987 Conference: 388 attendees, 25 papers, and 20 poster presentations, and the organizers were ready for the move across the Atlantic.

Graham and his committee (both the US and European conferences are organized by volunteer committees) obtained their initial support from the Automated Methods Group of the Royal Society of Chemistry and selected the Anugraha Conference Center, Egham, Surrey as the location for the 1989 meeting. LIMS-89 (the European nomenclature) or LIMS-3 (the US nomenclature) attracted almost 400 delegates with a technical program of 22 papers and 22 poster presentations. Table 1 shows the venues, general chairmen, and references to the meeting reports of the Conferences to date. Of particular note is the 1995 Conference as it is the first time a continental European site was used. Alex Williams, Laboratory for the Government Chemist, retired, and his committee are to be commended for the effort they put into making the most recent conference so successful. LIMS 10 will be held in Pittsburgh, PA, June 3–7, 1996.

When it became obvious that the US LIMS Conferences had a future, it became necessary to create a fiscal entity to maintain the funds from year to year. The LIMS Institute is a non-profit, 501(c)3, corporation that serves this purpose. The Institute’s by-laws...
state that its purpose is 'To establish and maintain an international forum for the communication, dissemination and exchange of information, ideas and experiences concerning laboratory information management systems...'. The original Board of Directors of the Institute included Gerst Gibbon, Harmon Brown, Graham Martin, Robert Megargle, and Victor Zadnik. Richard Mahaffey, Eastman Chemicals, has since replaced Vic Zadnik and Alan McLellan, Glasgow Royal Infirmary, has become the UK representative in place of Graham Martin. The Institute interacts with the organizing committees of both the US and the European conferences. It also presents the annual LIMS award and serves as the advisory board of the LIMS / Letter, which is discussed below.

4. Standards

The development of good standards and an adherence to them are hallmarks of the maturity of an enterprise. The American Society for Testing and Materials (ASTM) is a voluntary, consensus-based standards organization. Committee E-31 on Computerized Laboratory Systems was an early driving force in laboratory automation. An example of this is the book Computerized Laboratory Systems [14], published in 1975, which was based on a symposium of the same title presented at the 1974 Pittsburgh Conference [15]. The ASTM Subcommittee on LIMS has recently moved from Committee E-31 on Computerized System, subcommittee 40 to committee E-49 on Computerization of Material and Chemical Properties Data, subcommittee 07. The subcommittee is still very active in the development of definitions, nomenclature, and guidelines and welcomes new members. Information about the subcommittee and its activities can be obtained from Steve O'Connor, Procter & Gamble, P.O. Box 8006, Mason, OH 45040, tel.: 513-622-2080. Additional information about the ASTM may be obtained from the Society at 1916 Race Street, Philadelphia, PA 19103, tel.: 215-299-5400.

5. The LIMS literature

The development of the literature of LIMS has followed the same growth pattern as the LIMS industry. Early articles were spread between the 'A' pages of Analytical Chemistry and the trade press, in particular American Laboratory and Scientific Computing and Automation. In 1991, Laboratory Information Management appeared as a part of Chemometrics and Intelligent Laboratory Systems, published by Elsevier. The editors are Bob McDowall, UK, and Richard Mahaffey, US, who have taken on the challenge of serving the LIMS community by offering the following as part of their introductory editorial: 'The concept of a journal which continuously modifies its form and content is new. Yet that is what you, science and technology demand.'

Three major books on LIMS have appeared; an edited volume by McDowall [16], an information technology perspective on LIMS by Mahaffey [17], and an implementation and management treatment by Nakagawa [18].

6. Short courses

Short courses are an important mechanism for disseminating new knowledge and an effective way for new practitioners to acquire needed knowledge. In the US, Joe Golden and I offer a LIMS short course through the American Chemical Society, and Bob McDowall has taught a course at the Pittsburgh Conference for several years. In Europe, McDowall and John Booth are popular course instructors.
7. Newsletters

Newsletters are an effective way to disseminate current information to targeted technical audiences and Helen Gillespie has started the LIMS/Letter. Her intention is to provide "... your resource for LIMS issues in particular and laboratory data management topics in general" [19]. The first issue of the newsletter appeared in June 1995.

An electronic mechanism for sharing information is an Internet USENET group. Stu Miller, Ministry of Northern Development and Mines, has created such a group for LIMS and has described its intent and how to gain access to the service in a recent American Laboratory issue [20].

8. Summary

The past twenty years has seen LIMS develop from a nebulous concept for improving laboratory activities to a mature discipline with its own journal, newsletters, annual conference, short courses, and standards activities. A large vendor community offering an impressive slate of products has appeared. An increasing emphasis on the quality and productivity in analytical laboratories makes having a LIMS essential. The LIMS industry and its practitioners are well prepared to meet this challenge.

References

[23] R. Megargle, Department of Chemistry, Cleveland State University, Cleveland, OH 44115, unpublished.