A Computer Approach Toward Automation of a Chemical Services Laboratory: II. Management Information[1]

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ABSTRACT

A Real Time Information Management System is described which is based on several interacting data bases. Fifteen dynamic files are accessed by 70 chemists and microbiologists through the use of computer terminals and more than 25 programs. The System provides for real time work scheduling for a chemical laboratory and the generation of all reports. The System also handles accounting, billing, summarization, analysis and distribution of all laboratory functions. The system is open ended, and therefore, expandable. There is no dependency to a particular computer but rather only the need for a computer that can handle terminals and dynamic files.

The amount of information that is handled in our laboratory seems to grow by leaps and bounds with each passing day. This has created a large task of managing not only the information, but also the people who use and create the information. To handle this task, we developed a Real Time Information Management System which utilized several interacting data bases to provide controlling information for the purpose of work scheduling. The System performs accounting, billing, reporting, summarization, analysis and distribution of all laboratory activities.

The Chemical Laboratories of the Ralston Purina Company perform 800 assays per day on approximately 300 product and ingredient samples. We maintain expertise and carry out some 225 different chemical and microbiological assays. These analyses are carried out by a staff of more than 60 chemists and microbiologists using the full range of apparatus and equipment. There is a need to consider the range of apparatus because of the widely differing data rates that can be and are involved. Some methods have great human involvement and a slow data rate while others are highly automated with a comparatively high data rate.

The major problem we were faced with was the need for immediate information and the information had to be current. The usual data processing center operates in a batch processing environment; that is, each job is processed in order and by priority using static files that have been created sometime in the past and periodically brought up to date. This method would not be either timely enough or current enough for our needs. We were in need of a system that was dynamic and allowed for interrogation by many people with rapid response.

Most computer file systems use a file protect mechanism to prevent writing into the files, thus severely limiting the number of people who have access to the files. The master file in this system can be accessed from any of our terminals for either reading or writing. Since we allow the writing of information into the files, it is necessary that many error checks be written into the system. These error checks are written into the system and clear text error messages are given in response to detected errors. Where it is possible, the correction needed to eliminate the error is also given.

When a food or feed sample is received in the laboratory, the first step in our system is to place all known information about this sample into our data base. This is accomplished through our sample entry terminal and requires the relatively short time of 30 to 60 sec per sample. During this short period of time, we enter into the system, the product or ingredient code, the assays to be performed on the sample, the instructions for sample preparation, priority, description of the sample in clear text, distribution instructions for the final report, department designation, and the charge number to which the cost will be charged. All standard repetitive information is entered automatically from a standard assay file. Almost immediately, the computer assigns and types back the sample number and the date and time entered. This small amount of information that was entered in a short period of time is sufficient to accomplish many tasks. The first of these is the preparation of bottle tags for each of the bottles of the prepared sample that may be necessary for different analyses in different laboratories.

As soon as the sample has been delivered to the laboratory after sample preparation, work scheduling is accomplished automatically by the computer programs. The work scheduling is based on the date of entry and the assigned priority. When an analyst desires work, he follows the simple procedure of requesting work through a computer terminal for a particular assay and specifies the number of samples he desires. The priority is automatically adjusted when difficulties are encountered with a particular analysis. The pricing of that analysis is based on a flexible system which allows for different prices for different priorities.

As work progresses on a sample which is undergoing analyses for multiple assays, it is sometimes desirable to know the status of a sample part way through the stay period in the laboratory. Information on those assays completed, such as reported assay values and when they were completed is available through the terminals by any individual desiring this information. This availability allows us to answer customer questions over the telephone with an average waiting time of about 5 sec for the information.

An analyst who is responsible for a particular assay finds it is desirable to query the data base periodically to determine the amount of work to be done for his particular assay. This is done through the terminals by simply requesting the status of, e.g., protein. He receives the information as the number of samples to be assayed in each of 8 different priority categories and also how many samples he presently has under assay.

The terminals again come into play when the analysis has been completed. The analyst, through the terminals, reports results of sample assay by typing in report, sample number, value to be reported and the disposition of the report. We have allowed for three types of dispositions. The first of these is to report the value outright and place it in the system as the final value. The second is to allow for a questionable value to be placed in the data base and have the priority increased and the sample returned for another assay. In the third, we allow for the reporting of a value which is to be disregarded because of some problem with

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the analysis. Values that are reported outright may be further processed by several other programs. One of these programs allows for reporting to our quality control group when they are concerned with the clearance of ingredients that are being held pending analysis. This exception is done in less than 10 sec and provides hard copy to the user. Another program checks certain reported values for their compliance with federal regulations concerning the use of drugs as feed additives.

Periodically through the day, hard copy reports are prepared in the proper number of copies to cover all individuals and groups indicated in the distribution information provided at sample entry time. In addition, when this reporting is done, calculations are permitted such as adjusting analyses to a common moisture basis. For example, the trading of soybeans is done on a 12% moisture basis; therefore, all reports which give the results of analysis on soybean analyses are adjusted to a 12% moisture basis.

At entry time, we place a charge number into the data base which allows automatically charging of all analysis, sample preparation charge and handling charges. This information is passed along to be summarized later.

The flow of information into and out of our data base has been described, and the use of this information to provide controlling information is the work flow in the laboratory has also been discussed. From a management standpoint, I am also interested in the costs involved in running a laboratory, rerun rates of the various analyses, work performance of the individual analyst, service time and cycles that might be present in the work load by assay and laboratory area. All of the information noted above requires that when as assay is completed, we note its cost and the date and time of completion. This information was added to the date base at the time the sample was reported through the computer terminal.

Periodically (we have chosen the 15th and 31st of each month) reports are generated which provide much of the management information needed for accounting and budgeting.

Charges to other divisions within the company are prepared and presented to our corporate data processing group in machine compatible form. Our laboratory computer is in a sense talking directly to the larger corporate business oriented computer. This method has added greatly to the accuracy of our calculations and helped to reduce many errors that occurred when data was hand written and key punched before entry into computer. At the same time, we are also able to credit analysis work to the laboratory that performed the work. This information was not available under a manual system but now is provided routinely. When you consider that as many as nine different assays, performed in as many different areas, must be charged and credited, and that this is accomplished automatically, we have relieved the individual laboratory manager or supervisor of a major portion of his bookkeeping and freed more time for managing.

Information is provided daily to each manager and supervisor giving him the status of each analysis for which he is responsible. Weekly information is provided to the managers giving the samples and number of samples that have been in the laboratory too long. This report lists each assay still to be completed for each sample.

A report is generated every two weeks which provides each manager with service time by assay and in addition, the service time by priority within each assay.

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