

LIMS in the Laboratory

A Review of Lims1 Use

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Investment in capital software raises, as it should, the question of “What is the return on investment?” .

This situation can be particularly acute in justification of a Laboratory Information Management System (LIMS) where the cost of software is quite high in comparison to routine off the shelf software products.

The primary purpose of this document is to present a well established and solid case for our Lims1 Laboratory Information System. That is, to clearly identify the very significant cost saving and increase in overall laboratory efficiency to be expected through use of the system.

An analysis and justification of costs is provided on the following pages. This analysis is based on a review of typical laboratory operations and can be verified by Lims1 users. The improvement in laboratory efficiency, costs and time saving as well as the ability to conform to laboratory regulatory requirements are quite dramatic when a well designed LIMS product is employed.

There are a number of Laboratory Information Systems in the marketplace however we would estimate that less than 30% of laboratories currently use these systems. The reasons for this are varied however a general summary of these reasons would include...

- LIMS Costs are too high.
- Systems are too complicated to implement.
- LIMS software has a bad ‘track record’ for successful implementation.

The Lims1 system presented in this review can provide a very strong case against the above objections.

- 1) System prices are affordable. Lims1 has the best cost-feature ratio of any system of this type.
- 2) The system is very comprehensive, easy to implement and fully maintained by laboratory staff.
- 3) The system is well established across a wide spectrum of laboratory types and sizes.

In the documentation provided on the following pages a *Recovery of Investment Period of 20 months* is estimated for a typical Lims1 implementation. Laboratories who are using the system could not now imagine continuing operations without it. A realistic estimate of the overall reduction in workload for these sites is on the order 20 to 40 percent depending on the size and type of laboratory.

In addition, Lims1 offers a range integrated database functions which provide these laboratories with access to information and services which could not be provided by any other means including...

- Comprehensive daily laboratory management information.
- Sample tracking by work pending, status and location.
- Rapid access to client and sample information.
- Fully integrated Sample Label and Barcode capabilities.
- Automatic acceptance and range checking for analytical data.
- Direct import of data from laboratory instrumentation.
- Automatic calculation of raw data into final results.
- A fully integrated report system for Sample Receipt, Laboratory Worklists, Certificates and Invoices.
- Direct Email capabilities for laboratory reports and data.
- Long term storage and retrieval and analysis of all laboratory data through Filter/Search operations.
- Data Export capabilities to other software and corporate databases.
- Full compliance with Australian and International Laboratory Standards.

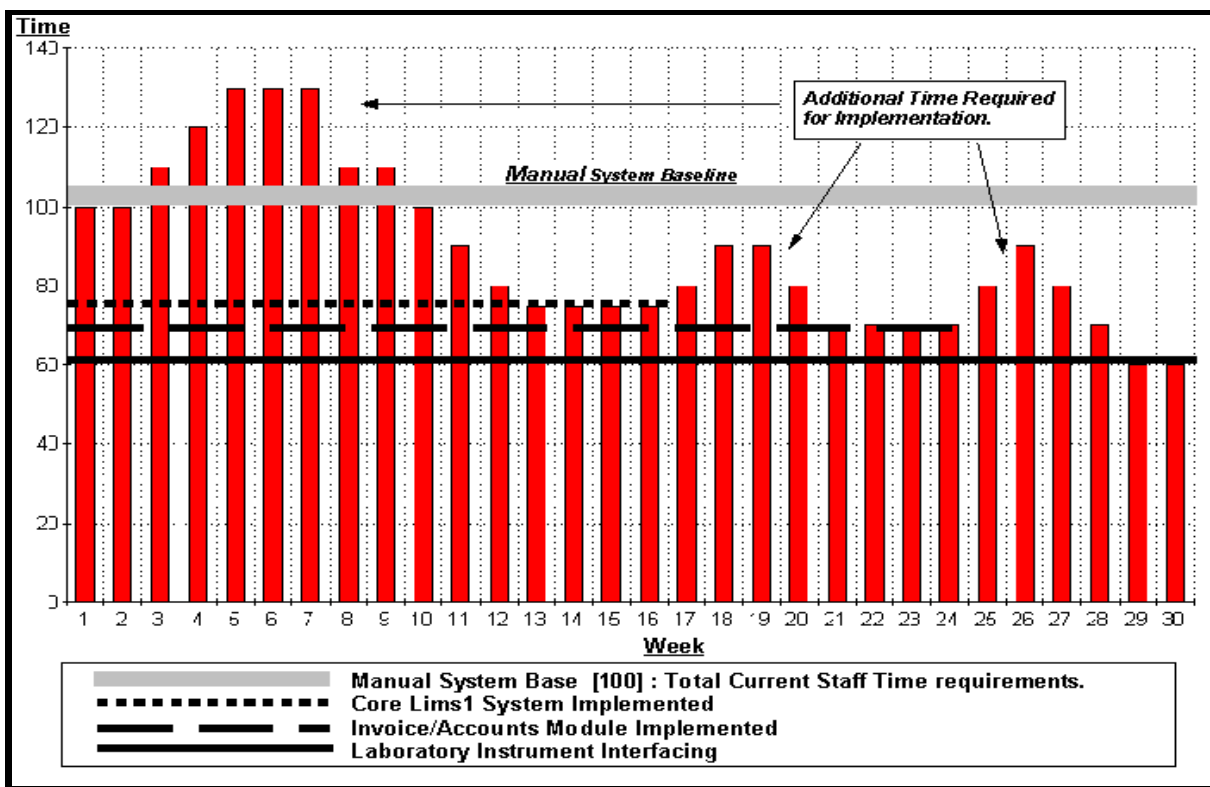
Management systems do not self-implement. The time required in system setup must also be factored into overall costs. *Lims1* implementation includes staff training, consultation and establishment of setup parameters before the system can be put into operation. From this point, laboratory staff have the ability to continue updates and modifications to the system as required. One of the interesting aspects of the implementation process is that the laboratory needs to review overall operations and current practices. It is often the case that, as a result of this review, the laboratory itself becomes more efficient.

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Lims1 Implementation

The graph below represents Laboratory Workloads prior, during and on completion of Lims1 implementation. A baseline of 100 is assigned to current staff time required for manual laboratory operations. An indication of additional time requirements during system implementation is shown. Reduced workloads are shown after implementation of the core system and various modules.



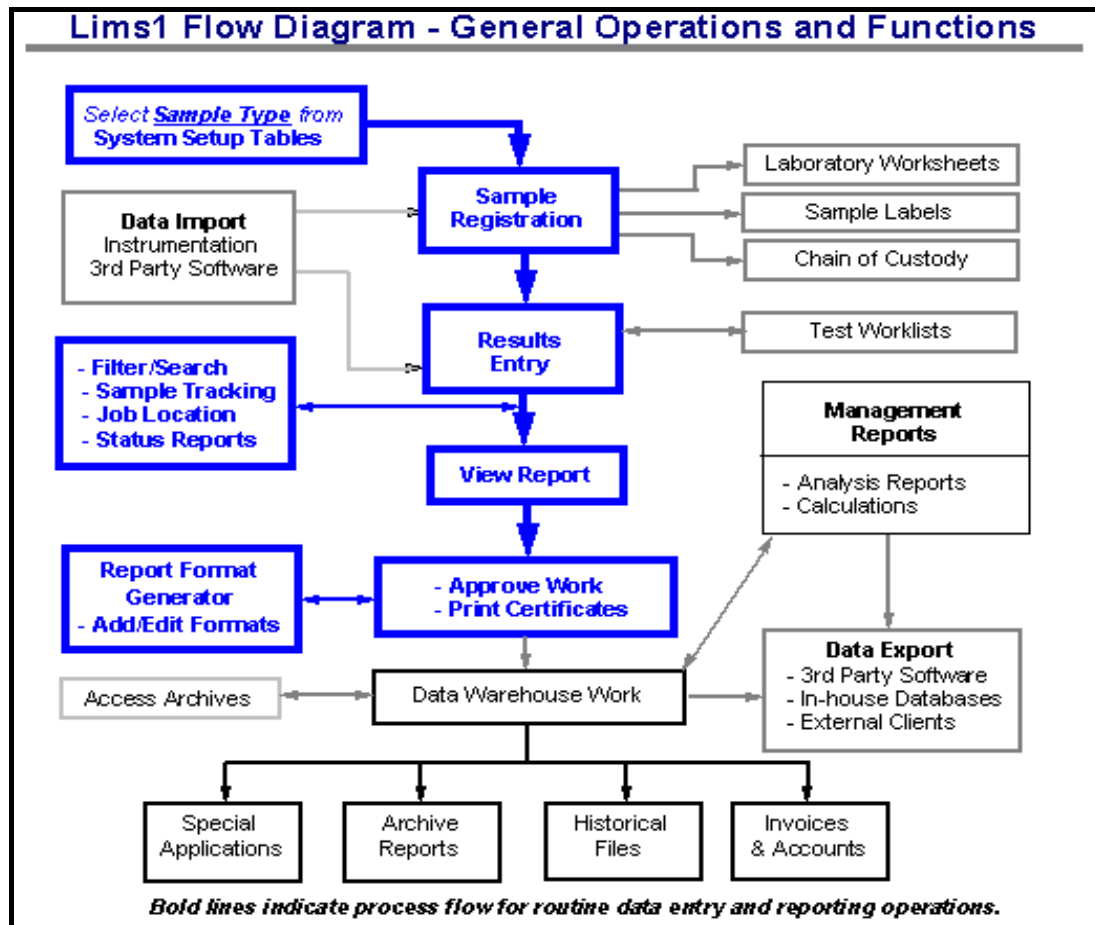
Example of Implementation

This example includes the core Lims1 system, Invoice/Accounts Module and Instrument Interfacing over a period of 30 weeks. Option modules actually implemented will depend on laboratory requirements.

Week	Activity	Comments
1-2	Use of existing manual laboratory methods.	Baseline of 100 = Current laboratory workload.
3-12	Implementation of core Lims1 system.	Workload increase during implementation period as staff are engaged in the following activities... <ul style="list-style-type: none"> • Staff training • Review of laboratory operations. • Establish system testing, data entry and reporting parameters.
13-16	Core Lims1 system in full use.	With core system in full use, overall reduction in laboratory workload typically reduced by 20 to 30 percent.
17-20	Implementation of Invoice/Accounts module.	Includes the following activities... <ul style="list-style-type: none"> • Review of current systems and best methods for system setup. • Establishment of laboratory Tests and other costs in the system. • Establishment of Client specific invoicing information.
20-24	Invoice/Accounts module in full use.	<ul style="list-style-type: none"> • Invoice costs automatically calculated for work performed. • Records of all invoices maintained. • Account Management Reports provided.
25-28	Implementation of Instrument Interfacing.	Connection of instrument(s) to network and import via the Lims1 Data Import Module.
29-30	Instrument Interfacing in full use.	Direct import of instrument data with optional pre-calculations of raw results prior to import.

Lims1 Functional Diagram

The diagram and Table below provides an overview of Lims1 Functions as discussed on the following pages.



Operation	Description
Select Sample Type	: See information on <i>Setup Tables</i> for description of establishing Sample Types.
Registration	: Sample Log-in with selection of Sample Type with editing capabilities.
Worksheets*	: Analysis Worklists for use by laboratory staff.
Labels*	: Sample Labels or Barcodes.
Custody*	: Chain of Custody for transfer of work to external laboratories.
Results Entry	: Entry of results with optional calculation of final figures.
Test Worklists*	: Entry of Results for specific tests across a range of Jobs.
View/Print Report	: Printout and Viewing of Laboratory Reports.
Finalise Work	: Approval of results and release of Certificate of Analysis or lab reports.
Text Files	: Create <i>Laboratory Report Text File</i> for archives or export.
Historical Files	: Add key indexed results of finalised work to <i>Result Historical File</i> .
Archive Reports*	: Archive <i>Finalised Laboratory Reports</i> to system disk or external medium.
Filter/Search	: Perform <i>Filter/Search</i> operations on Registration List & Summary Reports.
Management Reports*	: Create <i>Data Management Reports</i> from Results Historical File.
Access Archives*	: Retrieve <i>Archived Reports</i> from system disk or external medium.
Data Import*	: Import Data from instrumentation or 3rd party software
Data Export*	: Export Lims1 data to 3rd party software or in-house database.
Invoice/Accounts	: Creation of Invoices and Accounts Statistical Reports.

* Indicates optional modules and functions based on system type and options.

Basis for Analysis

This analysis is based on the following workload for a medium sized analytical laboratory...

Job Registrations (Sample Batches) per Year:	5,000
Average Number of Samples per Batch:	5
Average Number of Tests performed per sample:	8
Total Samples per Year:	25,000
Total Tests & Results per Year:	200,000

Laboratories which do not employ LIMS software typically follow the following procedures for processing of samples received including...

- A manual (handwritten) logbook or a spreadsheet used for registering of samples received.
- A word processor/spreadsheet program or paper based system is used for entry of results of analysis and other information. Data inputs from different areas of the laboratory need to be co-ordinated.
- A report containing results and other information is submitted for approval.
- Any errors noted are rectified and the report is modified and reprinted.
- Final printout of laboratory documents (Certificates of Analysis) from the above software.
- Re-entry of data to other software for statistical analysis of laboratory data is done as required.
- Collation of data from the above entries for total information on laboratory activities is required.
- Archiving of reports is paper-based, space consuming and archived data/documents is difficult to find.

Much of laboratory staff time is consumed by paperwork and it is not uncommon to find half of the day for technical and other staff consumed by data entry, reporting, tracking and compliance with laboratory regulations.

A comparison of the above processes with those provided by *Lims1* is provided on the following pages and divided into two sections.

1. Direct Comparisons with manual processes described above.
2. Additional LIMS capabilities, not available with manual systems.

1. Lims1 use in Routine Laboratory Operations.

A comparison study based on direct replacement of the manual laboratory processes described above.

- LogIn (Registration) of Samples received for analysis.
- Creation of Worklists/Worksheets and Sample Receipt Reports.
- Entry of Results of Analysis.
- Creation of laboratory Certificates (including Email capabilities).
- Routine Laboratory Management capabilities.
- Long term data storage and statistical analysis.
- Compliance with laboratory regulatory standards.
- Minimisation of sample data and result entry errors.

One of the unique capabilities of the *Lims1* is that all system setup conditions may be fully established and maintained by laboratory staff. That is, *Lims1* is a totally dynamic system which may be updated at any time to meet on-going laboratory requirements based on new client and/or analytical requirements.

2. Additional Capabilities available within the Lims1 System.

Other processes which are, in general, unique to LIMS capabilities which further improve overall laboratory efficiency.

These include...

- Automatic creation of sample labels.
- Automatic creation and reading of Barcode Labels.
- Direct Import of data from laboratory instrumentation.
- Automatic email of laboratory certificates and data.
- Export of sample data to corporate databases.
- Automatic creation of Invoices based on work performed.
- Creation of Quotations based on work pre-registered into the system.
- Creation of Accounts Management Reports.
- Export of Accounts information to corporate databases.

Provision of tools and reports specifically designed for individual laboratory requirements. These functions are offered through a range of *Lims1* Option Modules which directly link into core *Lims1* processes and databases.

Comparison: Routine Laboratory Work & Lims1 Functions

The following procedures are used almost universally by laboratories during receipt and processing of samples. A comparison of common manual methods employed and Lims1 operations is provided below.

Receipt and Log-in of Samples

Samples received into the laboratory are logged in along with information relating to the sample batch, client, sample information and analytical requirements.

Lims1 Operations

A Registration Form is provided for login of new work and the following procedures are performed. This process has been refined over years of development to provide the most efficient methods possible for sample login. Typical times for login of a batch of 10 routine samples would be on the order of 1 to 3 minutes including creation of sample receipts/worksheets.

1. A Sample(s) Registration Form is provided.
2. A unique Job Registration Number is created.
3. A default receipt date and due date is established.
4. The operator selects a pre-defined Sample Type from a list developed in system Setup Tables.
5. The Sample Type automatically assigns all Testing and Reporting parameters to the work. {These parameters may also be modified to suit individual sample requirements.}
6. The number of samples received is entered.
7. Information is entered as required against individual samples.
8. A Client is selected (may be pre-defined, selected from client list or manually established).
9. Information is entered as required relating to the Sample Batch.
10. The Sample (Job) Registration is Saved.
11. A Sample Receipt Document (optional) is created
12. A Worksheet (optional) for the samples is created for use by laboratory staff.

Comments

The above *Lims1* process also provides for extensive use of 'Pick Lists' (as defined by the laboratory) to allow selection of standard text, date, time and numeric values against data entry fields. This also insures that correct data is entered in the right place.

Item 11 (Sample Receipt Document) would require duplication of data entry in a WP or spreadsheet.

Item 12 (Worksheet) would require duplication of data entry in a WP or spreadsheet.

Time Comparisons {hours per week}

Lims1	: 2 - 3	{typical 3}
Manual System	: 8- 25	{typical 16}

Entry of Results of Analysis

On completion of analysis, results are entered against the range of tests performed. These results often, if not always, require comparison with pre-defined limits and/or calculations from raw result values to final result values. Results may also be numeric or qualitative (text entries). Raw result values may also require some form of calculation to obtain a final result to be reported to the client.

Lims1 Operations

- Results are entered into a Lims1 spreadsheet directly linked to Registration information.
- Result entries are automatically checked against pre-defined entry parameters for each test.
- Predefined default results may be rapidly set across a range of test-sample entries.
- Results may be entered for specific tests across a range of work (Job Registrations).
- Calculations may be automatically performed to obtain final results of analysis.

Comments

Data entry times, ease of entry and reduction of entry errors is significant.

Direct Import of data from instruments (not factored in Time Comparison) can provide further, very significant, reductions in time required for the results entry process (see following pages).

Time Comparisons {per week}

Lims1	: 2 - 5	{typical 3}
Manual System	: 8 - 16	{typical 12}

Approval of Work

All results and related information must be checked and approved prior to release of a laboratory report to the client (Certificate). There are a number of options relating to this process available.

- A Certificate containing all currently entered data may be previewed.
- The Results Spreadsheet may be examined.
- Results entered against specific tests via Worklists require Approval prior to inclusion in the certificate.
- Certificates which have not been approved for release are noted as such on the document.
- Work (Job Registrations) which have been approved (finalised) are locked from further modifications.
- Data from work which has been approved (finalised) is automatically added to a Historical database.
- An Audit Trail is maintained of all modifications to results entry.

Comments

The above processes provide laboratory management with rapid and efficient methods of insuring that reports and data released by the laboratory are correct. The system also protects this data from further modification without the express (password) approval of senior management and an audit trail of any data modifications is maintained.

Time Comparisons {per week}

Ave. Time (Lims1) : 2 - 3 {typical 2.5}
 Manual System : 5 -10 {typical 7.5}

Creation of Laboratory Certificates

Lims1 Laboratory Certificates are dynamically updated to immediately reflect any changes to work or results entry information. These certificates may be printed or previewed at any time. Work which has not been approved for release can be duly noted on printed certificates.

- At completion and approval of Work a Certificate of Analysis is printed.
- The Certificate may be previewed at any time prior to creation of final report.
- Any number of Certificate formats may be created by the laboratory and linked to Sample Types.
- A given Job Registration (sample batch) may be printed using different formats.

Comments

For routine operations creation of a Final Certificate of Analysis is transparent. That is there is no further requirement by the operator than to select a [Print] (Certificate) button. Laboratory Certificates (as well as other report types) may be established by the laboratory using the built-in Lims1 Report Format Generator. Options available for modification of formats, selection of different formats and custom formats to meet individual client, analysis types are impressive.

Time Comparisons {per week}

Lims1 : 1 - 3 {typical 2}
 Manual System {limited options} : 2 - 6 {typical 4}

Response to Client Enquiries

For many laboratories, routine enquiries from clients relating to the current status of work sent or information on specific results is an integral part of daily activities. In addition, there may be requests for statistical information based on specific tests or other criteria. This can be a major overhead in terms of time spent tracking down the information. Examples of how these situations are handled by the Lims1 system are provided below. The laboratory may evaluate these processes against current procedures.

Client enquiry of Status of Work or specific results

- The Registration List is Filtered for the client and (if provided) date in which work was sent.
- A listing of all work for the client (over filtered dates) is provided.
- A specific Job Registration (sample batch) can be retrieved from the list.
- The status of the work (samples/tests completed, due date, etc.) can be immediately reported.
- If required, the Client can be provided with in Interim Report based on analysis completed.

Typical Time Required: 1-2 minutes.

Client request data on a specific Test, range of Tests or Type of Sample over specific dates

- Data is collected from the Lims1 Management Report Module
- Filters are set based on Client, Test (or Sample Type) and Dates.
- A Report or Export Data File is created by the Module.
- The information is sent to the client.

Typical Time Required: 5-15 minutes.

Client request for copy of Certificate Report

- The Registration List is Filtered for the client and (if provided) date in which work was sent.
- A listing of all work for the client (over filtered dates) is provided.
- A specific Job Registration (sample batch) can be retrieved from the list.
- A copy of the report is printed and sent.

Typical Time Required: 1-2 minutes.

Comments

Time/Cost saving for the above operations will vary widely depending on laboratory requirement but, for many laboratories, can be very significant.

Time Comparisons { hours per week }

Ave. Times (Lims1)	:	0.5 - 1	{typical 1}
Manual System	:	2 - 8	{typical 5}

Routine Laboratory Management

This is an area which is very difficult, if not impossible to undertake efficiently without adequate information on what is going on. Good laboratory managers do an excellent job of coordinating laboratory operations using experience and best guess methods of what is going on and what is required. *Lims1* provides managers with a tool to gain a day to day perspective on laboratory operations. Examples provided below.

- Review all outstanding work and completion times.
- Provide reports on work undertaken and completed.
- Identify work by specific client and type of sample.
- Review completion times by specific tests or types of sample.

Comments

These and other services are integral to Lims1. Relational databases allow all data to be transcribed into various management reports and these reports are provided as part of the Lims1 system as well as the ability to selectively export this data into 3rd party software or corporate databases.

Time Comparisons {per week}

Ave. Time (Lims1)	:	1 - 2	{typical 1}
Manual System	:	3 - 8	{typical 5}

Comparison: Additional Lims1 Capabilities

While laboratories using manual systems may have requirements for any number of the processes described below. Where a manual system is employed, it is most common that double-entry of data is required to obtain the required final information or operations.

As a totally integrated, full relational database system, Lims1 provides these capabilities transparently. All information entered into the system is available for access and integration into various modules and functions as well as being readily available for transfer to other systems and/or clients.

Time/cost savings related to these Lims1 functions can be difficult to quantify as they will be highly dependent on individual laboratory requirements. We have however provided typical values for these savings and reduction of workload based on currently installed systems.

Many of the functions described below are offered as options to the core Lims1 system. Please consult Lims1 Price Lists for details.

Creation of Sample Labels and Barcodes

Depending on operations the laboratory may require these services in varying degrees. For example, using manual systems, sample labels may be created in bulk and applied to the current sample numbering system or sample identification may simply be written on sample containers.

The Lims1 Label Generator provides the ability to create (custom formatted) labels for attachment to sample containers and documents. Use of a Barcode Label Generator provides the ability to create (custom formatted) Barcode labels for attachment to sample containers and documents which may be read by laboratory instruments and/or barcode readers.

- Printout of labels for attachment to samples and documents.
- Printout and use of Barcode Labels for positive sample, container and document identification.
- User developed Barcode Label formats.
- A Library of Barcode Types for printing available from the Barcode Generator module.
- Automatic printout of labels prevents transcription errors.

Comments

See Barcode Reading for further information.

Barcode Reading

The Lims1 Barcode Reader opens a range of direct data import capabilities to the laboratory. Examples are described below.

- Barcode Labeled Sampling Kits, Sample Documents and Sample Containers.
- Automatic (Barcode scanning) of data into the system.
- Use of Barcodes for individual identification and access of analytical results entry.

Comments

Barcode reading can significantly reduce time required for entry of sample information. Perhaps more important, use of Barcodes eliminates data transcription errors.

Time Comparisons { hours per week}
 Ave. Time (Barcode Entry) : 1 – 3 {typical 2}
 Manual System : 4 - 6 {typical 5}

Direct Import of Data from Laboratory Instrumentation

Much, if not most, of the results information provided by the laboratory is obtained from laboratory instrumentation. Using manual systems, this information is transcribed onto worksheets or taken from instrument printouts and then entered into Certificate forms. Direct input of this information into the LIMS system offers the following advantages..

- Significant reduction of time required for data transcription.
- Consolidate data from a number of instruments into a single data format.
- Apply preliminary calculations to raw data prior to final import of results.
- Create and maintain audit trail files of raw data.
- Eliminate transcription and calculation errors.

Comments

The Lims1 Data Import Module can provide the above capabilities along with the ability to review, edit, approval raw results prior to final import of final results into the core Lims1 system. Final calculations may be applied to raw results prior to final data import.

Based on automatic entry of Ave. 100-200 instrumentation results per day as apposed to manual entry, calculation and checking of data.

Time Comparisons {hours per week}

Ave. Time : 1 - 3 {typical 2}
 Manual System : 4 - 8 {typical 6}

Emailing of Laboratory Certificates and Laboratory Results Information

Automatic email capabilities can be provided for both laboratory certificates and raw data to clients. This process is as easy as printing a certificate of analysis. The operator selects Email-Cert to send a secure copy of a Certificate to a client or Email-Data to send Results data in an Excel spreadsheet or ASCII file format to the client.

On approval of work for release a secure document file is emailed to the client.

The client may preview, print and save the certificate to disk as required.

Results data files may also be emailed for inclusion in client databases.

Comments

Use of email capabilities greatly reduces 'paper handling' and postage requirements for both the laboratory and the client as well as reducing the overall turn-around time for work.

Time Comparisons {hours per week}

Ave. Time (Lims1) : 1 - 2 {typical 1}
 Manual System {limited options} : 4 - 8 {typical 5}

Statistical Analysis of Work

The importance of laboratory data for on-going statistical analysis will vary depending on the type of laboratory and reporting requirements. For manual systems it is not uncommon for laboratory staff to spend days collating data on request for specific corporate or client information from various documents or software systems and then re-entering this data into a final database or spreadsheet. *Lims1* provides a Management Report Module which accesses all data entered into the system.

- Data for all work approved for release is copied into a Historical Database for permanent access.
- The Lims1 Management Report Module provides easy (transparent), rapid access to this data.
- A range of (user customised) reports are provided.
- User established data export capabilities are also provided to 3rd party software.
- Custom reports and export capabilities can be provided by LTech Australia.
- Third party report writers can also be employed to create custom reports.

Comments

The Lims1 Management Report Module and Historical database are currently employed across a wide cross-section of government, corporate and private analytical laboratories to create a wide spectrum of report types based on types of samples, specific tests, clients and other criteria.

Time Comparisons { hours per week}

Ave. Time (Lims1) : 0.5 - 1 {typical 1} Depending on requirements
 Manual System : 2 - 6 {typical 4} Requires manual examination and data entry.

Invoices and Accounts Tracking

Where Invoicing or Account records are required for laboratory operations, the Lims1 Invoice/Accounts module fully integrates and automates this process by providing account records for all work undertaken. The Invoice/Accounts module provides the ability to establish a range of costs based on Type of Sample, Test Groups and individual Tests along with discount structures bases on individual clients and/or quantity of samples processed. An Invoice may be created on a Job basis or on a Bulk Invoice basis (i.e. monthly invoice for all work performed). Account Summary Reports are also provided with the system.

- Setup of laboratory costs for creation of invoice records.
- Creation of Invoice records based on Job Registration, Testing and other costs.
- Creation of individual and Bulk Invoices.
- Extensive Invoice-Accounts Management reports by client, sample type, tests performed, etc.
- Export of Invoice data to 3rd party software.

Comments

For laboratories which create their own invoices this is a major time/cost saving. For corporate laboratories who export accounts data the system provides a automated laboratory costs specific method of calculating costs for export to corporate accounts databases.

Invoicing Time Comparisons { hours per week}

Ave. Time (Lims1) : 0.5 - 1 {typical 1} Automatic creation of Invoices.
 Manual System : 2 – 6 {typical 4} Requires manual examination and data entry.

Accounts Statistics Time Comparisons {hours per week}

Ave. Time (Lims1) : 0.5 - 1 hours. {typical 0.5} Depending on requirements
 Manual System : 1 – 3 hours. {typical 2} Requires manual examination and data entry.

Implementation Costs

In addition to system cost, costs (staff time) relating to training and establishment of the system should also be factored into overall system costs. An estimate of these requirements for a small/medium size laboratory is provided below.

Activity	Time (hours)	Comment
Staff Training	120	Lims Coordinator : 40 hours. Qty. 5 other staff : 16 hours each
System Setup	160	Staff establishment of system conditions (Setup Tables and Report Formats) to suit laboratory requirements.

Total Time:	280	Estimated Laboratory Staff time required for Lims1 Implementation
Total Cost:	\$5,040	Estimated Staff Costs for Lims1 Implementation

Hardware & Operating System

If a laboratory was required to 'start from scratch' in obtaining Network and PC hardware and software the following costs estimates would apply.

Requirements: WindowsNT Network, Server PC, Qty 5 Workstation PC's, Cabling, Installation, etc.

Cost: \$15,000 - \$25,000 depending on quality of hardware.

For further information please request Lims1 specifications on hardware and operating systems.

Summary Tables

In our experience, no two laboratories operate identically, have same requirements or the same workload. In this respect it is very difficult to exactly quantify or compare individual laboratory requirements. We have however provided in this document what we consider to be a very conservative estimate of typical time and cost saving related to implementation of a Laboratory Information Management System (LIMS). An additional factor is how well the system integrates into laboratory operations and the functionality offered by the system. The information provided is based on use of the LTech Australia – Lims1 system.

Two Comparison Summary Tables are provided.

Table S1: LIMS functions which would routinely be used by all laboratories.

Table S2: Ancillary functions which provide additional LIMS capabilities.

For Table S2, functions which are relevant to laboratory operations may be reviewed and factored.

Table S1: Routine Laboratory Activities

[Rounded to nearest 10 hours and \$500]

Activity	Manual System	Lims System	Savings (hrs-year)	Comments
Receipt & Log-in of Samples	800	150	650	Lims1 can virtually automate the sample login process based on selection of Sample Types. Sample Receipts and Worklists can also be automatically printed at time of log-in. Major time saving provided, sample log-in errors are minimized.
Entry of Result of Analysis (Keyboard)	600	150	450	Lims1 Spreadsheets across a range of samples and tests with pre-defined values available as well as listings of tests across a range of Job Registrations (sample batches) Result checking and pre-defined values minimize errors.
Approval of Work for Release	400	150	250	Results of analysis and Certificates can be directly previewed by laboratory managers prior to approval and release of Certificates.
Creation of Certificates	400	200	200	Certificates are created in seconds based on results and information entered into the system.
Routine Laboratory Management	250	50	200	Laboratory managers have instant access to all work currently underway including work completed, outstanding and due dates for completion.
Response to Client Enquiries	250	50	200	Invoice costs are automatically calculated and invoices produced as required. Account Management Reports are also available based on total work, tests, clients and other criteria.
Laboratory Staff - LIMS Maintenance	0	100	-100	This includes on-going modifications to system Setup Tables to reflect changes in laboratory requirements as well as routine system maintenance performed by laboratory staff.
Staff Totals-Year:	2,700	850	1850	<i>Total Hours per month.</i>
Cost/Yr@ \$18/Hr.	\$48,000	\$15,000	\$33,000	<i>Labour Cost/savings (per year) based on ave. hourly rate of \$18.00 rounded to nearest \$1000.</i>
Maintenance Contract Costs			-\$4,000	<i>Support Contract with Vendor including sub-version upgrades. Typical \$3,000 - \$5,000 per year.</i>
Total Saving:			\$29,000	<i>Per Year - Inclusive of all items above.</i>

Base Operations - Estimated Annual Cost Saving (rounded): \$29,000.

Table S2: Ancillary Laboratory Activities

Estimated Time/Cost savings based on use of Lims1 option modules.

[Rounded to nearest 10 hours and \$500]

Activity {Hrs. – Year}	Manual System	Lims System	Savings (hrs- year)	Savings (\$- Yr.)	Comments
Sample Labels	---	---	---	---	Not factored.
Barcode System	180	80	100	\$2,000	Barcode Generator & Reading.
Data Import	300	100	200	\$3,500	Import Instrument data (single instrument)
Email Reports	250	80	170	\$3,000	Direct Email of Certificates & data.
Statistics	70	20	50	\$1,000	Management and statistical reports .
Invoicing	200	50	150	\$2,500	Calculation and Creation of Invoices
Accounts Statistics	60	10	50	\$1,000	Accounts Summary Reports & Data Export.
Totals:	832	244	588	\$13,000	Use of all ancillary functions.

Recovery of Investment

The primary purpose of investment in a Laboratory Information Management System is to improve the efficiency of laboratory operations and reduce costs.

The realities of this investment will depend on the following factors...

- Initial System Cost
- On-going Maintenance Costs.
- Ease of Use and Efficiency of the System.
- Availability of functions to meet the laboratories requirements.

Notes

Lims implementation does not automatically save costs. *The system will significantly reduce the laboratories workload and provide much more efficient methods of running laboratory operations.* Cost saving are applied in the form of reduced staff requirements and/or an increase in the amount of work which can be performed using existing staff.

1. Calculation of overall Costs include system costs and laboratory labour time for system setup.*
2. Cost Savings are based on data supplied with this document.
3. Maintenance Costs include ongoing Maintenance Contracts .
4. Base Saving Less Maintenance is net Time/Cost Saving per Year.
5. Investment repayment represents period required to recover System Costs.

**based on current Lims1 price structure.*

Example 1: Small Laboratory Processing between 5,000 – 50,000 samples per year.

Item	Range	Average
System Cost	\$25,000 - \$30,000	\$25,000
Base Cost Savings per Year	\$10,000 - \$20,000	\$15,000
Maintenance Costs	\$2,000 - \$3,000	\$ 3,000
Base Savings {less Maintenance}	\$4,500 - \$8,500	\$12,000
Investment repayment period	-----	25 months

Example 2: Medium Size Laboratory Processing between 50,000 – 100,000 samples per year.

Item	Range	Average
System Cost	\$30,000 - \$60,000	\$42,000
Base Cost Savings per Year	\$25,000 - \$35,000	\$30,000
Maintenance Costs	\$4,000 - \$6,000	\$ 5,000
Base Savings {less Maintenance}	\$15,500 - \$24,000	\$25,000
Investment repayment period	-----	22 months

Example 3: Large Laboratory Complex Processing 100,000+ samples per year.

Item	Range	Average
System Cost	\$60,000 - \$150,000	\$100,000
Base Cost Savings per Year	\$40,000 - \$80,000	\$60,000
Maintenance Costs	\$6,000 - \$10,000	\$ 8,000
Base Savings {less Maintenance}	\$24,000 - \$60,00	\$52,000
Investment repayment period	-----	21 months

Other System Considerations

Beyond the considerable time/cost savings to the laboratory there are other aspects of LIMS implementation which are difficult to quantify on this basis yet provide valuable services to staff and management. These services include...

- Consolidation of all laboratory operations into a single integrated system.
- Reduction in transcription and reporting errors.
- Improved capability for meeting Government Standards for laboratory practices.
- Significant reduction in Turn-around Times for processing of samples (client service).
- Ability to access all historical data for statistical analysis and management reporting.
- Creation of itemised management reports on laboratory revenue streams.
- Improved completeness in the marketplace.

These capabilities can also dramatically improve overall laboratory operations and client services.