

# Development of an Integrated LIMS for Microarray Facility Center

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## Abstract

Microarray has become a vital tool in functional genomics, providing a high-throughput means of genome-wide analyses. Capturing both the data and metadata that is required for the interpretation of such analyses is a crucial requirement for today's biologists. Adding in some additional requirements makes writing such a tool an interesting challenge. A LIMS is being developing for the Microarray Core Facility Center of Delaware Biotechnology Institute. The LIMS was designed to automate the management of the Center, easy the use of the facility, store the information of the samples, experiments, processes and accounting, and archive the raw image data and the result text data. The LIMS uses Oracle 9 DBMS and also has the capability to work with MySQL and Postgres DBMS. Object-oriented programming approach with Java is used to build the applications and Java Servlet/JSP technology is employed to develop the interface. Thus, it achieves high performance, high security and easy deployability. Although it was originally designed for the DBI Microarray Center, it is easy to be adapted for any other similar microarray facility.

## Introduction

Microarray technology is having a significant impact on functional genomics research by allowing scientists to measure the expression level of thousands of genes simultaneously. Due to the complexity of gene expression data, much detailed information besides results needs be recorded during the entire laboratory experiments so that the results can be appropriately interpreted and compared [1]. Because of the high-throughput nature, a central microarray facility needs a Laboratory Information Management System (LIMS) for tracking the operation of its instruments, the processes and the experiments.

LIMS is a system that tracks, manages and stores information associated with a laboratory, such as customers, samples, parameters, results, operators, passwords, etc. Over the past two decades, LIMS has become the workhorse of the laboratory, encompassing laboratory work-flow combined with user input, data collection, instrument integration, data analysis, user notification, and delivery of information and reporting. The broadly accepted microarray data standard called MIAME requiring much detailed information of the study plus security-sensitive accounting information post a challenge for development of such laboratory information management system.

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In this project, the author used the Microarray Core Facility Center at Delaware Biotechnology Institute (DBI) as an example and has been developing an integrated LIMS for the Center. This project includes three phases: 1. track and record the workflow, facilitate the management and easy the access of the voluminous data; 2. integrate the management of the inventory; 3. incorporate with analysis software. This reports the result of the first phase.

## **Architecture**

The LIMS was designed to facilitate the organization, storage, archive and retrieval of microarray experiment-associated information and data within a secure environment and for ease-of-use and flexibility. The system provides a clear management based on accession rights and user roles. All the access to the system is solely through web browsers. The laboratory manager (operator) creates a client account and assigns a password to the client upon his/her request. Users will receive defined privileges for the access of the system. The system will inform the client of the account information by sending his/her an email and asks the client to initialize personal and billing information in the system. The client can update the information anytime later once the account is created by the operator. The client can also check the sample status. The operator will process the samples and input experimental conditions. The system will assign the chip ID and the coordinates. The operator can update all the experiment-related information and also generate reports of clients, samples, experiments, usage and so on anytime. The system will automatically record the billing information including the balance according to the protocols (Affy GeneChip and customized array), the experimental procedure and the operator's inputs. Once the experiment is done, the raw image files and text files will be copied to the data server and the system will inform the cashier of that by sending a billing statement. Once the balance is received, the cashier can unlock the client account so that the client now can download the results. By default, client accounts are locked if there is any balance remained so that the clients will not be able to view and download the results. But the cashier has the privilege to intervene that. The system administrator has all the privilege to do anything with the system.

## **Implementation**

The LIMS is based on a relational database and has the capability to work with Oracle, MySQL and Postgres. The database of this example is Oracle 9i in the SUN Solaris 9 OS environment. The data processing applications and all the interface are implemented in Java according to Java Servlet/JSP technology.

## **References**

[1] Brazma A, Hingamp P, Quackenbush J, et al. 2001. Minimum information about a microarray experiment (MIAME) – toward standard for microarray data. *Nat. Genet.* 29(4): 365-71.