Chapter 13
A Case Study of a Laboratory Information System Developed at the Institute for Cancer Research at Candiolo

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ABSTRACT

Research laboratories produce a huge amount of complex and heterogeneous data typically managed by Laboratory Information Management Systems (LIMSs). Although many LIMSs are available, it is often difficult to identify a product that covers all the requirements and peculiarities of a specific institution. To deal with this lack, the Candido Cancer Institute decided to start a project, named the Laboratory Assistant Suite (LAS), with the aim of developing a new software platform that assists researchers throughout diverse laboratory activities. The proposed system can track laboratory experiments even in problematic environments, support the integration of heterogeneous biomedical data, and help in decision-making tasks. In this chapter, the authors present the current architecture of the system, some real-use cases, as well as statistics about stored data and user feedback in order to provide an overview of the functionalities and show the effectiveness of the platform in supporting research in the molecular oncology field.

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INTRODUCTION

Molecular oncology and biomedical processes produce a huge amount of heterogeneous and complex data, which is difficult to manage and analyze without a structured and well-organized system. The information embedded in the data needs to be made explicit, because data are usually not meaningful *per se.* This is especially true of oncological data, where different elements often cooperate together in multiple complex patterns. Genomic data decoding can be incredibly tricky, and this is why a supporting information system, equipped with state-of-the-art algorithms and data management tools, is a fundamental prerequisite.

A system that deals with this complexity is called a Laboratory Information Management System (LIMS). Some typical features offered by LIMSs include sample management, monitoring of laboratory activities, and recording of experimental results.. Sample management involves sample handling, registering and locating (to retrieve where a particular sample is stored). Analyses can also be defined through a workflow definition, and scheduled at a particular time. Data is stored securely and reliably, and can only be accessed by authorized users. In order to assure data quality, LIMSs usually comply with some standards, such as ISO/IEC 17025.

However, the definition of the tasks addressed by a LIMS can vary considerably from laboratory to laboratory, based on their different needs. In general, we can define a LIMS as a system that:

- Supports the rapid implementation of different workflows;
- Uses heterogeneous data;
- Has several built-in features to assist the users of a laboratory;
- Has several tools to support data import and export.

At the time of writing, several commercial LIMS solutions exist but they usually require a significant investment, in terms of either human or economic resources (sometimes both), in order to satisfy specific laboratory requirements (Haquin et al., 2008). Furthermore, if a closed-source project is discontinued, it may be impossible to either continue using the old platform, or seamlessly migrate to another project.

On the other hand, the research community has proven very active in this field, often releasing different LIMSs as free and open-source projects. For instance, LAMA (Milisavljevic et al., 2010) has been designed to support the tracking of different animal colonies.

However, since these systems are modeled to address the needs of a specific context, with a focus on few kinds of highly specialized data and sets of experiments, they might not suit the requirements of other research environments.

In 2004, the National Cancer Institute (NCI) started the Cancer Biomedical Informatics Grid (caBIG®) project (Kuhn et al., 2007), to develop an information infrastructure that enables the interdisciplinary collaboration for cancer research. Different tools have been developed under this project addressing both the management and the analysis of biomedical data. However, the adoption of caBIG® tools in research labs is not straightforward and presents many critical issues pointed out in London and Chatterjee (2010). In 2012, caBIG® was retired, and the NCI introduced the National Cancer Informatics Program (NCIP) as a successor.

As previously discussed, both open-source LIMS projects and commercial products may present issues, and their adoption is troublesome. For these reasons, the Institute for Cancer Research at Candiolo (Italy) started in 2011 to implement its own LIMS, named the Laboratory Assistant Suite (LAS) platform (Baralis et al., 2012). Its