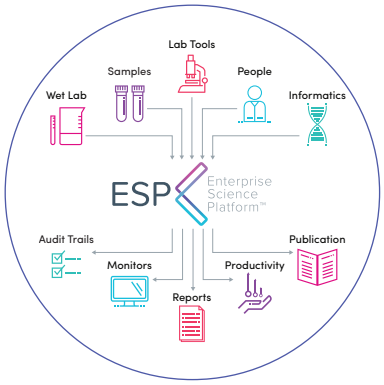
WHITE PAPER

L7INFORMATICS

SPDM: applying business process management principles to better manage laboratory operations



"Business process management is a systematic approach to making an organization's workflow more effective, more efficient, and more capable of adapting to an ever-changing environment."[1]

Business process management (BPM) focuses on improving corporate performance by managing and optimizing a company's business processes to achieve business goals. BPM enables organizations to be more efficient, more effective, and more capable of customer-driven change

By translating the core principles of BPM to scientific laboratory operations, L7 Informatics is creating a new category of enterprise software: scientific process and data management (SPDM). Think of SPDM as taking all your scientific processes to the next level of organization by having all the machine and human components blended together into one seamless workflow. SPDM is the bridge between information technology (IT), science, and people that integrates organizational and technological silos.

The L7 Enterprise Science Platform™ (ESP) software is the first platform to fully enable SPDM. It is designed to provide full transparency into your operations by streamlining sample tracking and process coordination between IT, lab technicians, managers, scientists, programmers, bioinformaticians, biostatisticians, and data scientists. In this white paper, we will review the core principles of BPM and take a look at how ESP can help your lab implement SPDM.

SCIENTIFIC PROCESS & DATA MANAGEMENT PRINCIPLES OVERVIEW

While we don't have the time (or paper) to write a comprehensive review of BPM, we would like to distill some of the central concepts to tie them to SPDM. SPDM consists of the following structure that has direct analogues from BPM:

- **Design**—Identifying existing processes and designing future processes. For example, how do samples move from ingest through reporting? What protocols are used to process samples?
- **Modeling**—Developing a model representation of the theoretical design, introducing combinations of variables that directly impact the process. What are the relationships between sample states? Do all samples initiate from patients? Are all samples used to create libraries?
- **Execution**—Automating processes by developing or purchasing applications to execute the required steps. In the lab, you can automate routine bioinformatics to allow lab techs to run jobs and free up bioinformatics resources.
- **Monitoring**—Tracking individual processes so that information related to those processes (e.g. status, errors) can be seen easily, and providing statistics on the performance of one or more processes. Which instruments are currently in use? How many samples will be processed today?
- **Optimization**—Retrieving process performance information from the modeling or monitoring phase and identifying potential or actual bottlenecks as well as the opportunities for cost savings or other improvements, then applying those enhancements in the design of the process. Which workflows take the longest? Are there hidden bottlenecks in your lab procedures?
- **Re-engineering**—Done when the process becomes too complex or inefficient, and optimization is not reaching the desired output. Which steps are redundant and can be eliminated? Do we really need to purchase additional equipment or can we change the way we are using existing equipment to increase throughput and save money?

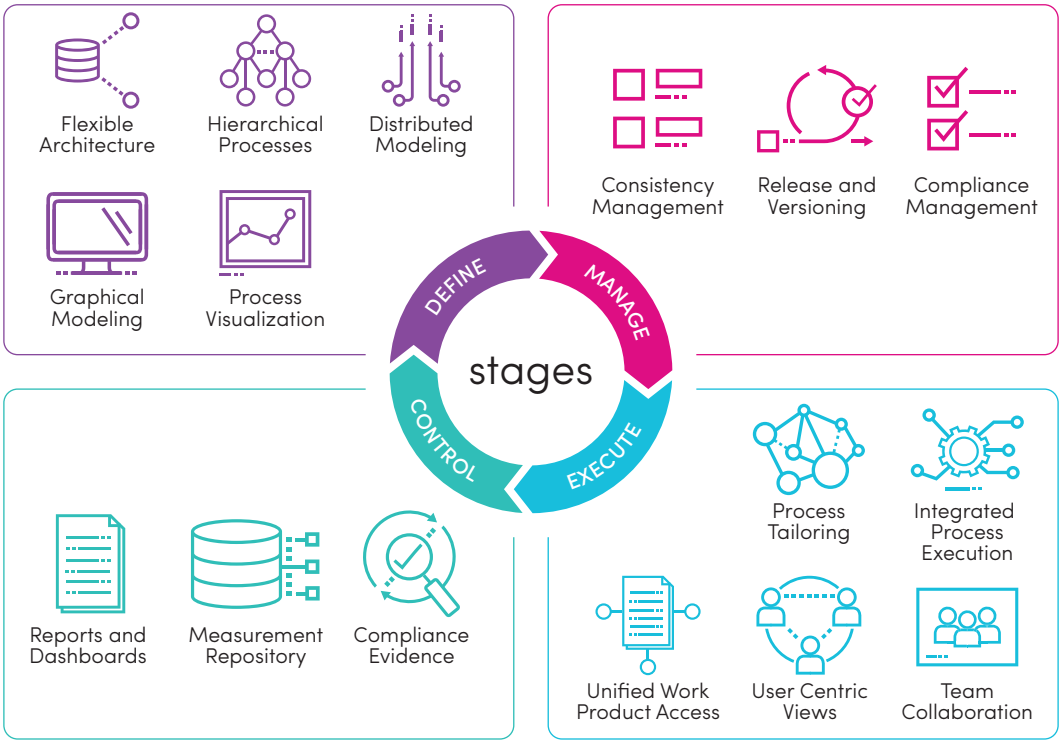


Figure 1. A depiction of the stages of business process optimization, with specific user-focused applications. Image courtesy of HP InfoSystem (www.hpinfosystem.com).

TRANSLATING BPM BENEFITS INTO SPDM BENEFITS

The real question in assessing how BPM principles can be applied is: how does this benefit my lab's operation? There is a host of literature available on the benefits of BPM, but without wading through all of it—feel free to search the Internet—we've co-opted a list of benefits published in *Business Analyst Learnings*.[2] Here we present a science twist on a few of the benefits of BPM:

1. Agility

Laboratory operations are ever-changing environments. While processes within the lab can often be routine and turnkey, there remains the need to be able to rapidly adopt new methods or technologies. With all processes in a lab managed with a single integrated software solution that enables BPM-like feedback, it becomes straightforward to design processes that are flexible. Rigorous SPDM enables organizations to make changes to processes with minimal costs, while still maintaining the flexibility to customize solutions to the requirements of the organization.

2. Productivity

Laboratories that process large numbers of samples in a production environment employ many routine workflows with repetitive protocols and analyses. SPDM can facilitate the automation of many of these routine tasks, such as running standard variant calling pipelines automatically upon the completion of a sequencing run without the need to involve the lab's bioinformatics team. These process improvements can free up technicians' and bioinformaticians' time to focus on processing more samples, developing new analysis pipelines, or other activities. Ultimately, this streamlines the lab's operations and makes them more productive.

3. Efficiency & Reduced Risks

Integrating all laboratory processes through SPDM enables the organization's management to easily identify areas of inefficiency. L7 has given laboratory inefficiency a lot of consideration in our white paper, *Five Strategies to Improve the Efficiency of Your Lab*[3], and the lessons from that paper are evident through the employment of SPDM. More efficient processes lead to the conservation of lab resources, enabling the resources to be better deployed. With well-designed, executed, and monitored processes, labs can effectively reduce risks associated with failures of the system.

4. Compliance & Transparency

As data-intensive technologies make their march towards routine clinical usage, it has become a necessity for labs using these technologies to make sure they are compliant with all industry and government regulations. SPDM ensures that laboratory organizations can implement regulatory requirements quickly, and labs using ESP as the backbone of their SPDM are assured of deep data provenance on all aspects of their workflows. This enables the labs to efficiently access audit trails that will satisfy regulatory requirements, effectively integrating compliance into their processes.

5. Employee Satisfaction

Below are some real questions that L7 has recently heard from customers and prospective users (no names to protect the identities of the guilty):

- "Where are my samples?"
- "I don't know if my analyses are done. I need to check with someone...Oh, they were completed two weeks ago?"
- "How do I find out what was done to this sample?"
- "How do I see what experiments are ongoing?"
- "Where can I find a full list of projects and PIs?"

With rigorous SPDM developed on the principles of BPM, a laboratory organization can illuminate answers to all these questions. The removal of traditional interfunctional silos relieves significant operational stress that is felt not only by the process itself, but also by the operators involved. In a data-intensive lab, this includes all of the stakeholders such as the lab techs, bioinformaticians, lab managers, IT support staff, and executive-level management. Ultimately, removal of silos and bottlenecks to create a more transparent operation makes for increased productivity and a more satisfied workforce.

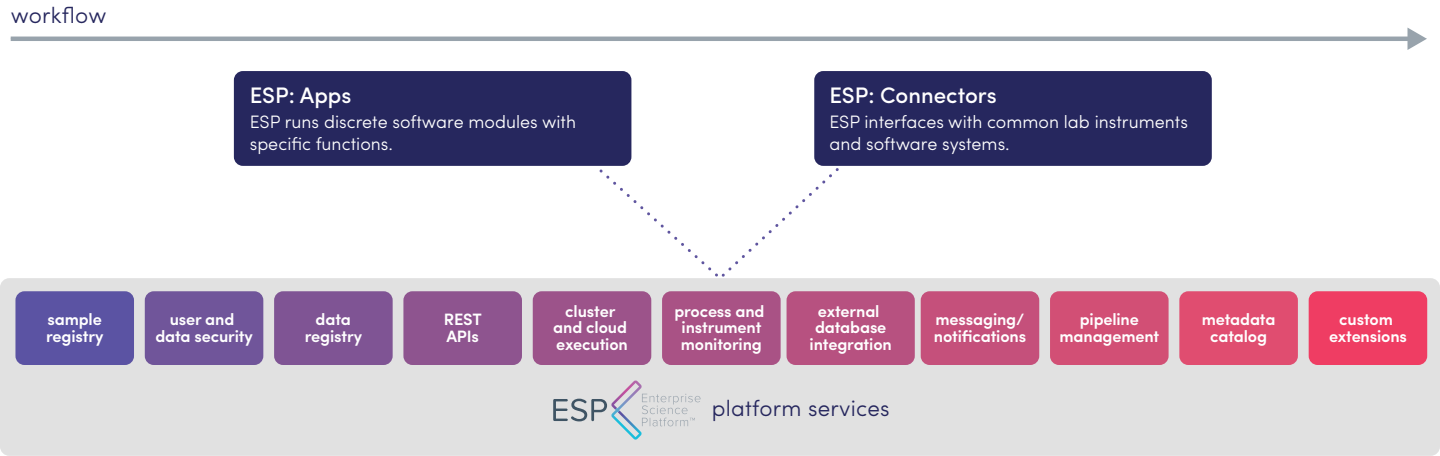


Figure 2. With L7's ESP, all functional components of data-intensive labs are managed together. With this level of management, organizations can be confident in their SPDM foundations.

6. Consistency, Repeatability, Transferability, & Sustainability

A recent survey published in the scientific journal *Nature*[4] found reproducibility rates to be as low as 10 percent to 40 percent. One respondent claimed that her lab's work became more reproducible and economical "by getting synchronized instead of troubleshooting failed experiments piecemeal." In other words, her lab made a long-term investment in improving its scientific outcomes by applying BPM principles. With SPDM, each step of a laboratory workflow is carefully planned and documented, then executed as designed. Problems arising in these workflows are all addressed the same way, regardless of the operator. Using these well-designed workflows, labs can significantly improve their output consistency. Furthermore, if everyone is performing the same well-designed processes, transfer of workflows to other labs becomes a much more straightforward endeavor. Finally, as a means of standardization of processes, the lab's workflows under SPDM become sustainable over longer periods of time, even with regular turnover of lab personnel.

7. Measurability

With the full operational process in a laboratory maintained through SPDM, organizations gain full insight into all aspects of their workflows. All processes can be measured and quantitatively analyzed for efficiency, productivity, and profitability. Now organizations can quickly determine what their lab's capacity currently is versus what it could be if their processes were streamlined. Plus, SPDM can provide reports and analytical tools to enable executive decisions.

8. Technology Integration

As data-intensive science democratizes and labs become more holistic in their approach to operational management, it is becoming increasingly important that the various technology platforms in a lab are well integrated. With the whole lab running in concert, the traditional communication silos (e.g., wet lab vs. bioinformatics) are broken down, all laboratory platforms can be monitored, and inefficiencies can be more easily pinpointed and remedied.

IMPLEMENTING L7 ESP AS YOUR SPDM PLATFORM

L7 ESP enables the unification of multiple technology platforms, from laboratory equipment to software tools for analysis and interpretation. ESP gives users detailed views into laboratory operations by tracking samples as they progress through all the steps of experimental workflows. The deep data provenance provided by the system ensures that the benefits of BPM systems can be translated into scientific operations.

Furthermore, ESP can integrate directly with operational platforms that are upstream and downstream from laboratory processes, and with the underlying IT infrastructure needed to run a data-intensive lab. By bridging the communication gap between various lab users, bioinformaticians, and IT, ESP enables labs to achieve many of the benefits discussed throughout this white paper.

1. http://searchcio.techtarget.com/definition/business-process-management
2. https://businessanalystlearnings.com/blog/2014/8/4/benefits-of-business-process-management
3. https://cdn2.hubspot.net/hubfs/3310565/Five%20Strategies%20to%20Improve%20your%20lab-%20White%20Paper_rev2.pdf
4. https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

For additional information on SPDM, or to learn how ESP can help you meet SPDM goals, please visit www.L7Informatics.com, or email L7 at info@L7Informatics.com. For further reading on BPM, we recommend *Fundamentals of Business Process Management* by Marlon Dumas, et al. (Springer, 2013).

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