

PROGRESSIVE AUTOMATION – THE SOLUTION OF CHOICE FOR IMPROVING LAB EFFICIENCY

PROGRESIVNA AUTOMATIZACIJA – IZBOR REŠENJA ZA POBOLJŠANJE LABORATORIJSKE EFIKASNOSTI

Jean-Michel Valid

Beckman Coulter International SA, Nyon, Switzerland

Summary: Today's hospital laboratory faces increasing pressure to improve turnaround time (TAT), while being required to handle an increasing number of test requests. At the same time, it must operate ever tighter cost controls. Using LEAN process improvement techniques is an effective way of identifying how to delivering greater efficiency and quality. LEAN focuses on identifying those processes that add value and on eliminating the 'waste' – those unnecessary, non value adding steps that cause bottlenecks and delay the delivery of results. Greater use of LEAN analysis also confirms that one of the most effective ways of achieving greater overall efficiency is by automating laboratory processes. With Beckman Coulter's progressive automation solution, a laboratory is likely to see a return on its investment within 18 to 36 months. Beckman Coulter uses a LEAN scorecard to enable the laboratory to easily assess its current testing processes and identify specific areas where improvement is needed. By doing this in advance, a laboratory can expect the implementation of its progressive automation solution to go smoothly. In addition, the average laboratory can automate its pre-analytic testing, using a high speed automated sorter, in as little as two weeks.

Keywords: lab automation, information systems, TAT, track, Lean, integrated systems, autovalidation

Introduction

The challenge facing today's hospital service is to treat more patients while keeping budgets under strict control. Introducing LEAN principles into the hospital

Kratak sadržaj: Primarni je cilj svake laboratorije da umanjí one procese koji su izvor grešaka. Ovo se postiže primenom različitih metoda, počev od tradicionalnih načina konsolidacije i funkcionalne integracije do potpune automatizacije. Zavisno od izbora načina automatizacije laboratorija će povećati kvalitet, umanjiti varijabilnosti i povećati konzistentnost rezultata. Potpuno automatizovani proces laboratorijskog ispitivanja dovešće do unapređenja proeca rada te će ovo podsticati bolnice da investiraju u laboratorije. Da bi se ovaj proces podsticao izrađena su uputstva koja će omogućiti laboratorijama da automatizuju svoj proces rada. Primenom LEAN metodologije postignut je jedan od najboljih načina automatizovanja laboratorijskog procesa. Laboratorijski rezultati se dobijaju mnogo brže, održava se konzistentno turnaround vreme (TAT) i poboljšava se celokupni proces rada. Pacijenti se dijagnostikuju i zbrinjavaju brže, što dovodi i do bržeg oporavka. Vreme provedeno u bolnici se smanjuje, a protok pacijenata je veći.

Ključne reči: laboratorijska automatizacija, informacijski sistemi, TAT, Lean, integrisani sistemi, autovalidacija

laboratory has been shown to increase speed, efficiency and quality. LEAN techniques focus on adding 'value' by automating processes, eliminating waste, reducing errors and improving safety (1). In pathology, that means the correct result at the right time for the patient.

Greater use of LEAN analysis has confirmed that one of the best ways of achieving this is by automating laboratory processes. Test results are delivered more quickly, maintaining a more consistent turnaround time (TAT) and improving the overall patient care process.

Patients are then diagnosed and admitted more quickly for timely treatment resulting in improved recovery. The time spent in hospital is reduced, with

Address for correspondence:

Jean-Michel Valid
Beckman Coulter International SA
Laboratory Automation Product Manager
Emerging Markets (Europe, Middle East, Africa, India)
22, Rue Juste-Olivier
Case Postal 1059
CH – 1260 Nyon 1, Switzerland
Tel. +41 22 365 0707
e-mail: jvalid@Beckman.com

the flow of patients to the wards managed more efficiently. This reduces patient bottlenecks and the need for transfers to other hospitals.

The primary goal of every laboratory should be to reduce those processes that present an opportunity for error. This can be achieved through a variety of methods, from traditional workstation menu consolidation and function integration to full automation. Regardless of the choice, automating processes will help the laboratory increase quality, decrease variability and increase consistency (2, 3).

Streamlining testing processes in this way provides a compelling argument for hospitals to invest in their laboratories so they can benefit from automation. To support this, there are independent guidelines for laboratories to use when taking the first steps towards deciding which processes to automate (4–6).

These prioritize the following:

- a) Recognize the importance of safety systems for workers and patients
- b) Promote safe design, standardization, and simplification of processes
- c) Support improved access to accurate, timely information
- d) Consider computerized laboratory data that quickly alerts clinicians to abnormal results
- e) Look for systems that accelerate turnaround time (TAT).

Automating the pre-analytic stage

Progressive automation describes a solution that not only standardizes and simplifies testing processes, but also speeds up turnaround time, notifies clinicians of abnormal results, and boosts laboratory safety by eliminating exposure to potential biohazards. Each of these benefits helps prevent medical errors and, in turn, improves patient safety (7).

Instrument automation has provided laboratory professionals with the tools they need to automate tasks and reduce errors while samples are actually being analysed. However, many delays are also caused during the pre- and post-analytic stages, with the pre-analytical process particularly vulnerable to error (8). Automation helps reduce staff errors caused by fatigue or lack of concentration, eliminating potential mix-ups of patient tubes and reducing labelling errors. Staff are more likely to appreciate the benefit of automation once they see that it also improves their safety, minimizing their exposure to biohazards and reducing the risk of injury.

Providing a consistent turnaround time is vital. Reporting of late test results is one of the most common reasons for delays in treatment. Laboratory automation systems address this by standardizing workflow and eliminating many manual steps. With

progressive automation solutions, laboratories can automate sample log-in, centrifugation, cap removal, aliquotting and sample sorting. This allows laboratory staff to focus on work that requires critical analysis, such as interpreting patient test results.

The role for autovalidation

The most efficient solution does not simply look at the pre-analytic or analytic sample processing. Automating the post-analytic sample verification process – autovalidation – is an important part of a progressive automation solution. It increases overall efficiency by enabling results produced by the instruments to be sent to the hospital LIS with little or no manual intervention.

All laboratories, regardless of their size, can benefit from some level of automation. However, implementing an automation system should not be done without careful thought. Laboratory heads are sometimes deterred by the belief that automation is a highly complex, high cost solution requiring extensive tracking and reengineering of laboratories. For many hospitals, this is neither feasible nor necessary. To determine the most appropriate level of automation, a laboratory first needs to carry out an assessment of its current and future testing requirements.

The experience of one hospital (managing 2.350 tubes per day mainly for chemistry, immunoassay, hematology and coagulation) showed that an initial process analysis identified more than 25.800 tasks performed daily in its laboratory. Some of these tasks involved waiting time, while others were linked directly to the safety of both patients and laboratory personnel (2).

Any problem in the flow of work through the laboratory can adversely affect a patient's test results. This is further compounded when the tasks are performed manually. By using a progressive automation solution, many manual, error-prone steps are no longer required. Indeed, as a result of this lab's analysis, the total number of sample-handling steps were reduced significantly from 25.800 (*Figure 1*) to up to 8.310 with a full automation solution (*Figure 2*), including tasks directly related to waiting time, patient safety, and laboratory safety (2).

LEAN scorecard simplifies process mapping

Laboratories interested in progressive automation, with an automated preanalytical sorter and middleware solutions, will find that a LEAN scorecard developed by Beckman Coulter's process mapping consultants enables them to carry out a simple but effective process analysis. This includes studying current performance, identifying specific processes that lead to potential errors and devising specific ways to reduce manual processes, decrease TAT and improve overall performance (*Figure 3a*).

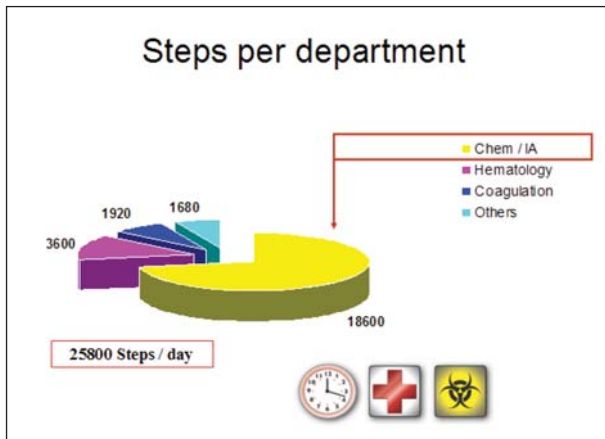


Figure 1 Laboratory processes per department, in lab handling 2.350 samples daily.

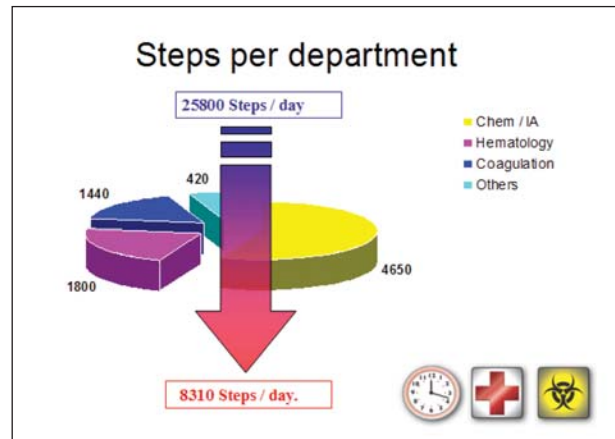


Figure 2 How automating the preanalytic stage can reduce manual processes from 25.800 to 8.310 steps per day.

27 Steps	Selections	Forms of Waste							
		Over Production	Movement of Materials	Correction or Defects	Extra Processing	Motion	Waiting	Inventory	
Log samples into laboratory	✓	Preanalytical							4
Verify collection at LIS	✓	Preanalytical							3
Prioritize STATs	✓	Preanalytical							4
Load individual tubes into centrifuge	✓	Preanalytical							3
Centrifuge samples	✓	Preanalytical							1
Unload each tube from centrifuge	✓	Preanalytical							4
Visualize serum indices	✓	Preanalytical							4
Decap	✓	Preanalytical							2
Identify aliquot needs	✓	Preanalytical							5
Label aliquot tubes	✓	Preanalytical							5
Make aliquot	✓	Preanalytical							5
Load tubes to analyzer racks	✓	Analytical							3
Place racks on chemistry analyzers	✓	Analytical							1
Place racks on immunoassay analyzers	✓	Analytical							3
Unload chemistry analyzers	✓	Analytical							3
Unload immunoassay analyzers	✓	Analytical							3
Chemistry rerun/reflex processes	✓	Analytical							2
Immunoassay rerun/reflex processes	✓	Analytical							2
Validate results and verify at LIS	✓	Post-analytical							3
Program tests not validated	✓	Post-analytical							2
Rerun tests not validated	✓	Post-analytical							4
Identify samples for reflex testing	✓	Post-analytical							3
Run reflex testing	✓	Post-analytical							2
Sort to additional workstations	✓	Post-analytical							4
Recap	✓	Post-analytical							3
Store samples	✓	Post-analytical							3
Locate tube for add-ons	✓	Post-analytical							4
Total Waste Steps Identified									85
									Score 0%

Figure 3a Lean Scorecard: Process mapping document highlights various forms of unnecessary steps in the laboratory.

Using this tool listing 27 possible manual processes, lab managers can quickly ‘visualize’ potential improvements – identifying up to seven unnecessary, time-wasting steps. Once these are identified, they can then look at other processes where waste and non value added steps can be eliminated. Using the scorecard would help them identify and reduce the total number of time-wasting steps from 85 to 27 (Figure 3b).

One of the prevailing myths in laboratory medicine is the complexity involved in implementing automation. Beckman Coulter, however, has the experience to show that the average laboratory can automate its pre-analytic testing process using a sorter (Figure 4) (including sample accessioning, pre-sorting, integrated or non-integrated centrifugation, selective decapping, aliquotting, sorting) in as little as two weeks.

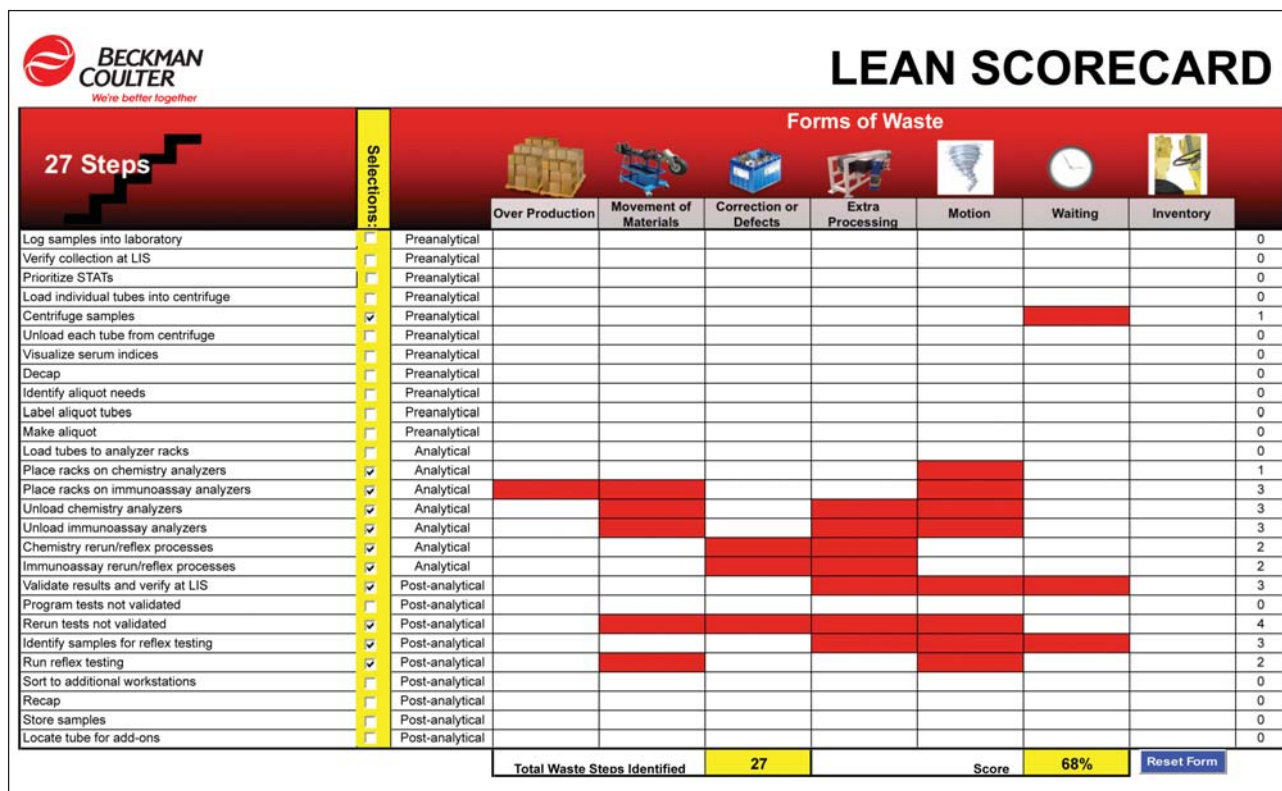


Figure 3b Example of lean scorecard: Lab implementing automated sorter and middleware software.

Progressive automation – tool for efficiency

It is wise for laboratories to seek the help of an experienced automation and process improvement partner to help maximize their reengineering plan. Laboratories should also look for a vendor able to provide instrument scalability. They need a partner with a successful track record of implementing automation solutions and being able to provide detailed outcome metrics. Finally, the partner needs to offer a strong service and support network.

With progressive automation, laboratories are likely to obtain a return on their investment within 18 to 36 months. If they have thoroughly mapped out their current testing processes in advance and identified specific areas of improvement, they can expect the implementation to go smoothly.

Laboratories will find they are able to handle an increase in their workload with the same number of staff. Turnaround time will be faster and more consistent with the potential for errors reduced. Patients therefore are likely to need less time in hospital.

Laboratories play a central role in safeguarding the well-being of patients. *In vitro* testing already represents less than five percent of a hospital’s total spending – and yet the information it generates plays a pivotal role in over 70% of healthcare decisions. Case studies show that up to 50% of direct hospital and



Figure 4 AutoMate 2550 high speed sorter with integrated aliquator.

outpatient charges can be reduced by making the most appropriate use of existing diagnostic information (9). Progressive automation is a tool that enables the lab to perform its role even more effectively.

Conflict of interest statement

The authors stated that there are no conflicts of interest regarding the publication of this article.

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