



DIAGNOSTIC TESTING & Emerging Technologies

New Trends, Applications, and IVD Industry Analysis

More Comprehensive View of Laboratory Automation Unfolding

When you ask most in the laboratory industry about automation, robots come to mind. But this is increasingly too narrow a view of the trends occurring in laboratory automation. Labs of all sizes are recognizing that task-focused, automated equipment must be integrated and coupled with information technology (IT) solutions in order to create a comprehensive automated system.

“Automation is an extremely narrow term for what we are doing. It’s an oversimplification. We are optimizing the entire laboratory workflow.”

—Franz Walt, CEO,
Chemistry, Immunoassay, Automation,
and Diagnostics IT business unit at
Siemens Healthcare Diagnostics

Cost constraints fueling demand for greater efficiency, shortages of qualified laboratory personnel, and quality improvement pressures including for more seamless transmission of laboratory results are all driving interest in lab automation. While system design will vary by laboratory, the “right” solution can better workflow, speed turn-around time (TAT), improve standardization and test quality, while accommodating future growth.

Total laboratory automation solutions can be a daunting and expensive prospect. So smaller labs, with space and budgetary constraints, often instead implement a piecemeal strategy of modular automation with flexible benchtop or stand-alone solutions. Task-focused automation (like barcoding systems, spectrophotometric technologies for sample inspection, and robotic-assisted sorting, racking, centrifuging, and aliquoting) can reduce clinical laboratory errors associated with preanalytical and postanalytical processing of specimens. Such task-oriented automated solutions are most common in traditional chemistry and immunochemistry areas, but are expected to move into areas that have never seen widespread automation like microbiology and histology. But experts tell *DTET* that to really take advantage of automation solutions, implementation must extend beyond individual tasks and empower the entire testing process—from sample ascension to delivery of results.

“Automation is an extremely narrow term for what we are doing,” says Franz Walt, CEO of the Chemistry, Immunoassay, Automation, and Diagnostics IT business unit at Siemens Healthcare Diagnostics (Tarrytown, N.Y.). “It’s an oversimplification. We are optimizing the entire laboratory workflow.”

Beyond Equipment

At its simplest form, lab automation is task oriented. But, experts say the real success of automation and favorable return on investment occurs when laboratories think of automation from a systems perspective.

“Laboratory automation is a transformational process. The transformation is not just a matter of technology but also our ability to use it,” explains Joe Liscouski,

executive director at the Institute for Laboratory Automation. “We have to broaden our view of what laboratory automation is about. It is more than just dealing with liquid handling systems and robotics but also the ability to apply them.”

Liscouski says that this shift in understanding automation requires acknowledgement that laboratory automation is a process. To embrace this shift from a task-level focus to a processes approach requires the recognition that software, robotics, and instrumentation are the tools needed to assist with tasks in order to achieve the ultimate goal of an automated system.

“The ROI calculation is not just a matter of dollars and cents, but also includes human factors, safety, data integrity, streamlining operations across the organization,” says Liscouski. “We have to take into account not just work that is done on the lab bench, but also how we work with the resulting data in lab wide applications such as laboratory information management systems, electronic laboratory notebooks, and the whole range of laboratory informatics.”

Lab automation and IT can no longer be viewed separately. “Process management” has been defined as integrating process control with data management to provide accurate, actionable, and timely diagnostic information as the centerpiece of high-quality care.

“A key issue is the need for integration, taking a comprehensive view of the entire process of data acquisition, data management and information delivery.”

—Emerging Trends in Laboratory
Process Management

The Impact of Siemens Automated Solutions

Siemens Healthcare Diagnostics (Tarrytown, N.Y.) is the current market leader in installations of automated laboratory systems. The company embraces the holistic view of automation in developing customized laboratory solutions, which leverage diagnostics IT to realize the comprehensive vision of every laboratory—to expeditiously and efficiently deliver highly accurate diagnostic information that impacts clinical care.

“A key issue is the need for integration, taking a comprehensive view of the entire process of data acquisition, data management and information delivery,” according to the Siemens Healthcare Diagnostics white paper *Emerging Trends in Laboratory Process Management*. “It includes all the steps required to acquire diagnostic data—from patient specimen collection to sample accessioning, measurement, analysis and quality control—and then to deliver actionable information to clinicians. If we think about this as a continuum rather than discrete steps, then we can begin to tear down the walls between instrument analytics, middleware and LIS. By the same token, data acquisition, data management, quality control and process control should be viewed as an integrated process.”

Siemens shared with *DTET* the implementation approaches of several recent laboratory automation clients to illustrate the impact of automated solutions on operations and to highlight lessons for laboratories considering future implementation.

In 2012, National Health Service Tayside (United Kingdom) became the first laboratory in northern Europe to deploy Siemens’ Aptio Automation system. The Ninewells Hospital Laboratory consolidated four laboratory disciplines (chemistry, immunology, hematology, and hemostasis) on a single 75-foot track that features multiple input routes and centrifuges; automates decapping/recapping, aliquoting, and sealing/unsealing functions; and allows for refrigerated storage of 15,000 tubes—all centrally managed by the CentralLink Data Management System.

NHS Tayside serves a population of 480,000 through a network of 22 hospitals and infirmaries and 69 general-practice sites that rely on two laboratories. With the automated system in place, the laboratory can process as many as 7,000 tubes a day on the track (1,700 tubes an hour at peak times), which is a 20 percent increase in workload with no additional staff. TAT improved across the board with a median TAT of 41 minutes and 95 percent of work completed in 67 minutes.

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—Bill Bartlett, Ph.D.

These efficiencies have directly impacted the business case at Ninewells Hospital Laboratory. Increased capacity allowed Ninewells Hospital laboratory to take on 73 percent of the testing historically performed at the smaller Perth Royal Infirmary (PRI) laboratory, allowing PRI to focus exclusively on acute admissions and inpatient testing, while Ninewells now handles 100 percent of the general-practice testing in the entire region. Additionally, the increased capacity has enabled Tayside to introduce new testing protocols.

"It's a common perception that laboratory automation is intended to reduce staff," says Bill Bartlett, Ph.D., joint clinical director of diagnostics at Tayside, in a statement. "Tayside's approach is different. We're redirecting knowledge and skills away from routine tasks and toward the value-added side of the business, toward quality and collaborative support of caregivers. We're delivering efficiencies in order to focus on effectiveness."

University Hospital Campus Bio-Medico (Italy) evaluated the positive impact that total laboratory automation had on TAT in the clinical pathology and microbiology lab. In a study published in the January issue of the *Journal of Laboratory Automation*, the laboratory reports automation had significant effects in reducing TAT and percentage of outlier tests. The laboratorians evaluated intra-laboratory TAT pre- and post- implementation of automation solutions (July 2012–May 2013 versus June 2013–June 2014).

The automation implementation included a modular system designed to automate preanalytical, analytical, and postanalytical processes. By combining multiple analysis tools into a single workstation, common management processes could be applied to tubes. This is achieved through an input/output module that loads and unloads tubes, identifies tube type, reads barcodes, and tracks operations in progress in the tubes; an automated centrifuge module; a decapper module; an aliquot module that can generate secondary tubes; a recapping module, for secondary aliquots; a sealer module for after the analytic process; and an automated storage module. Automation software enables staff to manage the workload orders from the hospital information system and monitor progression of operations of the associated analysis tools.

While there were significant reductions in all TAT, automation most strongly affected efficiency in the preanalytical phase including centrifugation of the sample, and thus TAT improvement was more evident for tests requiring a longer preanalytical process such as troponin I and PT.

PCL Alverno

PCL Alverno, a full service, community-based medical laboratory, unveiled in early March a fully automated laboratory solution at its Central laboratory facility in Hammond, Ind. The company says growth and expansion are "key priorities."

They have added seven new patient service center locations in the past 18 months, gaining 250 clients and significant volume. The lab turned to “state-of-the-art” laboratory technology and automation to accommodate this growth.

“We have not just overhauled our labs with new laboratory technology solutions; we have also worked very closely with Beckman Coulter to apply deep process advancements to ensure we are equipped to offer improved levels of service to patients and physician satisfaction,” says Sam Terese, the company’s CEO.

Siemens, Quest Partner for “Lab of the Future”

As part of what is being called the “most complex automation project undertaken,” the first analyzer, an ADVIA Centaur XP immunoassay analyzer, successfully aspirated from the automation track being installed at Quest Diagnostics’ new 200,000 square-foot clinical laboratory being built in Marlborough, Mass. This will be the first comprehensive automation solution—totally automated and traceable—that Quest Diagnostics (Madison, N.J.) has deployed in one of its regional mega-laboratories in the United States. This system is designed to achieve high efficiency and decrease testing TAT by optimizing the entire tube flow.

The automated solution will be able to process several thousand blood samples every hour. The technology-driven, 200-meter track combines automated technology and software from sample feed through to storage. Highlights of the “lab of the future” include automated processing of unsorted test tubes (blood, urine, or serum) using bar code labels, while robotic arms place the samples on multi-lane conveyor belts that transport them to the appropriate diagnostic stations (Prioritization of samples is possible with a “passing lane” to the front of the line). At the analysis stations, pipettes draw the volume of sample required at each analysis station, eliminating the need to split a sample between several test tubes. Each sample’s current position and all results can be called up at any time. Storage is also fully automated and can accommodate several hundred thousand refrigerated samples. The comprehensive automation system is being designed and installed by Siemens Healthcare Diagnostics and Inpeco.

“With our new ‘lab of the future’ in Marlborough, Quest Diagnostics will set a new standard in diagnostics services—not just for our company, but for our industry,” said Quest’s CEO Steve Rusckowski, in a statement. “These technologies will enhance quality and efficiencies so we can provide diagnostic services of the highest quality but at a low relative cost.”

Alverno, a joint venture of Presence Health and Franciscan Alliance Catholic health care systems, provides laboratory services for 26 hospitals in Indiana and Illinois and has a large reference lab for outreach work. The lab menu consists of 750 tests in both clinical and anatomic pathology and it processes more than 23 million tests per year, making it the largest microbiology lab in the Midwest.

By adding automated solutions in the microbiology area (digital imaging and matrix-assisted laser desorption/ionization-time of flight), Terese tells *DTET* that the lab can identify a causative organism for sepsis 24 to 36 hours sooner than it could just six to eight months ago.

“The goals of being more efficient at a lower cost are really only part of it,” Terese says. “In reality, automation is about a broader goal of quality, which is absolutely critical to improving care... In today’s health care environment, hospitals and laboratories are persistently under demands to reduce costs. While we cannot make decisions outside of that consideration, I would caution that you can’t let that be the only deciding factor either. The broader decision is how automation impacts the people we serve. How will it make a difference for the patients, clinicians, and hospital clients?”

Takeaway: The focus on task-oriented automated instruments is short-sighted in understanding current trends in laboratory automation. Laboratory automation requires a holistic, system-wide approach that encompasses all aspects of diagnostics from sample processing through delivery of results. 

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Kelly A. Briganti, JD, Editorial Director, Kelly@plainlanguagemedia.com; Barbara Manning Grimm, Managing Editor; Lori Solomon, Editor; Stephanie Murg, Managing Director; Kim Punter, Director of Conferences & Events; Randy Cochran, Corporate Licensing Manager; Jim Pearmain, General Manager, Pete Stowe, Managing Partner; Mark T. Ziebarth, Publisher.
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