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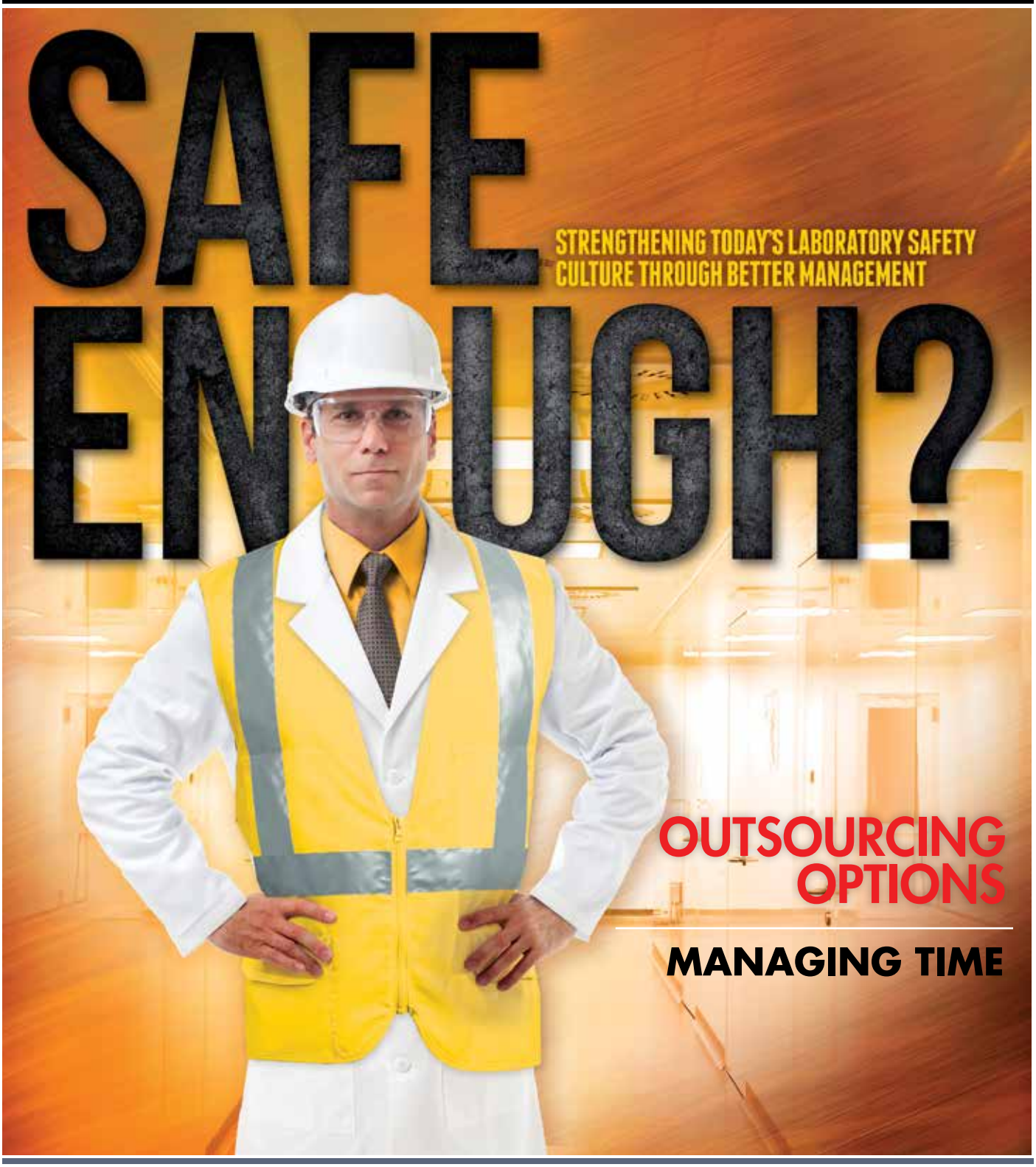

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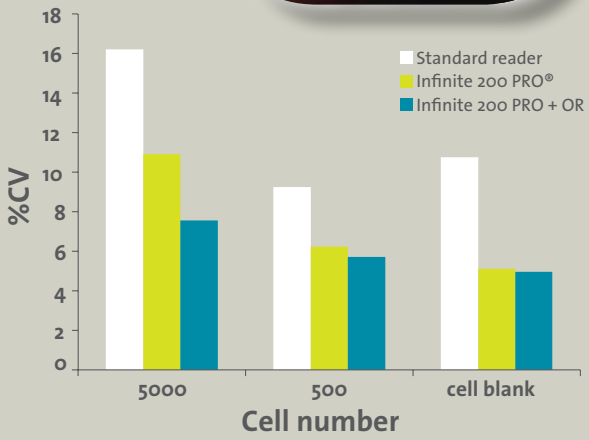

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SOME LIGHT SUMMER READING

Summer is just about here which means our annual August Product Resource Guide isn't too far off. This year's edition will see the return of the useful "Top Questions to Ask When Buying" lists to help you get started on the purchasing process for any product category in the guide. You'll also find a new list in the 2014-15 guide that focuses on interesting things you may not know about the featured product categories, such as how the earliest pipettes were constructed, and other factoids. As always, the guide will include the four latest product introductions within each category, along with updated manufacturer, distributer, and laboratory apps lists. Look for this great piece of summer reading to hit mailboxes and inboxes in mid-August!

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Time and Money

Running out of time or money is something most of us strive to avoid. In business, as in life, the goal is to save as much of both as you can. This month we look at a few ways to achieve that goal in your lab. Let's start with time.

"Keeping any lab on schedule requires vigilance in time management," says lab manager Michael Ogletree in this month's Leadership & Staffing article, "Managing Time." However, due to the workload ebb and flow that's inherent in laboratory operations, this is not always easy to do. It is up to lab managers to "come up with ways to continually equalize the load and increase a lab's efficiency using current best practices in time management," says author Sara Goudarzi. Turn to page 32 to find out how.

Speaking to another aspect of managing time, Mark Lanfear in this month's Science Matters column, talks about ranking priorities so that the most important tasks are taken care of before the trivial ones. "We hypnotize ourselves into believing that if we can keep all the urgencies of the day at bay, we'll be able to eventually tackle what's really important in our lives. But what I would argue is that in any situation, if you're managing your time effectively, you've been able to successfully 'rank' your priorities in a way in which the most important ones start to take precedence," he says.

Now for money.

This month's Business Management article, "Outsourcing Options," (page 20), examines the economic benefits of outsourcing certain laboratory operations. Sherri Basner, director, Intertek Chemicals and Pharmaceuticals, Americas, says "part of the compelling value proposition for companies outsourcing their in-house labs is that they have the potential to 'get much more output at reduced cost.'" She sees the relative instability in the economic environment as a big driver of outsourcing in the future. "If you can outsource and save time and money on areas that are not core, you will do it every time."

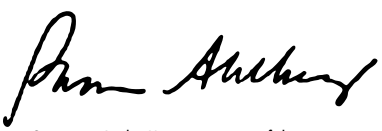
The business and economic advantages of another kind of outsourcing is discussed in "Managing Surplus Assets," (page 28). "In recent years, as companies have been discovering the hidden value in idle assets found throughout their enterprises, asset management best practice has been evolving," says author Ben Potenza.

Another potentially money-saving opportunity is discussed in this month's Ask the Expert column, in which Ike Harper, director for laboratory innovation at Johnson & Johnson, discusses the advantages of consolidating lab services with one provider. "Cost savings can be achieved in many ways, such as consolidating the number of contracts with one vendor, reducing the options on supplies ordered, and getting volume discounts," says Harper.

But our lead story this month has nothing to do with time or money, but something equally or more important – the safety of your lab. Please take a look at our cover story, "Safe Enough?" to find out what management steps you can take to further ensure the safety and health of your staff. "The need for a better safety culture, especially in academia but also in general industry, cannot be denied. How do we do this?" says Vince McLeod. Turn to page 10 to find out. And if you want to know how your lab compares with those who participated in our Fifth Annual Lab Safety survey, turn to page 16.

Time and money are one thing, health and safety are everything.

Best,



Pamela Ahlberg
Editor-in-Chief

Correction: In the May issue, some of the quotes in our LIMS product focus article were misattributed. We have corrected that and the revised article appears this month on page 48.

Lab Manager
Run Your Lab Like a Business

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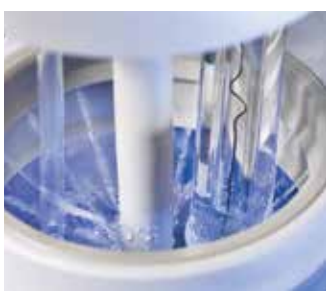

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According to a recent OSHA publication, there are more than 500,000 workers employed in laboratories in the United States.[1] And as lab managers, you know that laboratories can be potentially dangerous places to work. Because the Safety Guys write about this stuff all the time, you know that laboratory workers are exposed to numerous hazards spanning biological, chemical, physical, and radioactive risks. Repetitive tasks of production labs and high-volume analytical labs as well as the challenges of handling research animals can also lead to musculoskeletal disorders. The diverse and serious potential hazards faced daily by laboratory workers begs two questions: Are our labs safe enough? Are we doing our best to protect our laboratory workers? Sadly, given some examples below, the answer is definitely not.

> "Laboratory workers are exposed to numerous hazards spanning biological, chemical, physical, and radioactive risks."

Research laboratories conduct work on the forefront of technology and innovation. This often entails working with dangerous materials and unknown reactions. Progress demands that this research continue and thrive. However, it must be done with effective safety management in place and within a strong safety culture at the institution. This is not always the case, particularly in academic settings. A rash of recent serious accidents sheds light on the fact that we could and should be doing better. Granted, these are taken primarily from academic labs, but that is only because that is where we Safety Guys practice in our day jobs. We are sure that if we looked long and hard enough, we could find similar incidents in nonacademic settings.

Making the case for stronger safety culture and management programs

During the past few years there have been a number of very serious laboratory accidents that have resulted in severe injuries, extensive facility damage, and even fatalities. Given the facts, the labs may have been lucky that damages and injuries were not worse. We present a brief summary of a few recent events and findings by the Chemical Safety Board (CSB) to make our case for needing a stronger safety culture and better management programs.

2010, Texas Tech University[2]

Two graduate students were conducting research for the Department of Homeland Security on explosive compounds. They were given the task of synthesizing and testing a new compound, a nickel hydrazine perchlorate (NHP) derivative. The faculty principal investigators believed they had verbally established a limit of 100 milligrams for production of the material. Through interviews of graduate students on the project, the CSB found that initially the compound was made in small batches of 300 milligrams. The two graduate students decided to scale up the production to 10 grams to make one batch of material for all their testing. The senior member of the team noted the large batch contained clumps, which he thought needed breaking up prior to conducting their testing. The students believed that keeping the compound wet with a solvent would prevent it from exploding. As the project lead graduate student started to break up the clumps, the material detonated. The student was severely injured, losing three fin-

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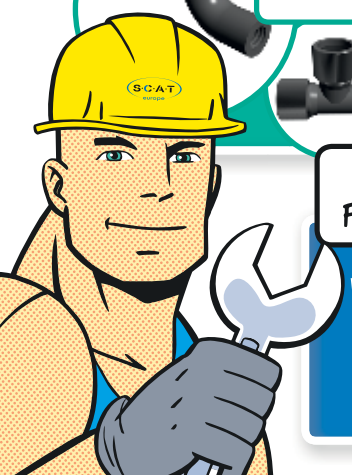

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gers of his left hand, having his eye perforated, and sustaining cuts and burns on the rest of his body.

The CSB investigation following the incident found that there was no formal system for communicating or documenting the limit on compound synthesis. Nor was there any auditing by the principal investigators to verify compliance. Further, the CSB discovered there had been two near misses with similar causes in the laboratories of the same principal investigators since 2007. However, due to the lack of a reporting system for auditing, documenting, and reviewing incidents, these important lessons were not passed on to project members.

June 2010, University of Missouri[3]

The biochemistry lab involved in this incident conducted research on anaerobic bacteria, organisms that cannot live in the presence of oxygen. The bacteria were cultured in a microbiologic anaerobic growth chamber that was about two cubic meters in size. During routine setup of the growth chamber, the standard operating procedures called for initially purging the chamber with nitrogen. Then small amounts of pure hydrogen were introduced to remove any remaining oxygen by combining to form water. The source of the hydrogen was a standard 55- inch-tall K-size cylinder. Apparently, the student researchers were not very familiar with the setup and operation of the gas delivery system. Following a check for leaks in the hydrogen gas lines, the valve for the hydrogen cylinder was inadvertently left open. Hydrogen introduced into the chamber reached an explosive level and was ignited by a source in the chamber, according to investigators. Four researchers were injured, and the lab was destroyed.

"The need for a better safety culture, especially in academia but also in general industry, cannot be denied."

Fortunately, none of the injuries in this incident were serious. One student who was admitted to the hospital was released the following day after treatment for burns. The lab was a total loss, but the building's sprinkler system put out the resulting fire, limiting damage to adjacent areas. The hydrogen cylinder did not explode, and secondary impacts were minimal. Even so, building repairs ran to several hundred thousand dollars, and the cost to repair and replace equipment will probably double that figure.

December 2008, University of California, Los Angeles[4]

This widely publicized incident occurred in an organic chemistry lab in the UCLA Molecular Science Building. A newly hired but experienced research associate was planning to scale up a reaction using tert-butyllithium (t-BuLi), a pyrophoric material, meaning it ignites spontaneously on contact with air. The research associate intended to add three 54-milliliter aliquots of t-BuLi in pentane to a reaction flask placed in a dry ice/acetone bath, and then combine them with vinyl bromide to create vinyllithium, the first part of a multistage process.

Handling pyrophorics is tricky. Normally it is done using inert gas, such as nitrogen or argon, and prepared glass syringes with one-to-two-foot-long needles. For reasons unknown, the research associate was using a plastic syringe with a two-inch needle, requiring tipping the reagent bottle up in order to fill the syringe. In addition, she was wearing only nitrile gloves, safety glasses, and street clothes, including a synthetic sweater. No lab coat was used. The syringe and plunger separated during the first attempt at filling the syringe, and the t-BuLi and pentane spilled on her hands and sweater, immediately bursting into flames. In the ensuing panic the associate ran from the area, although a safety shower was just six feet from the hood where she was working. A fellow postdoc working in the same lab was able to smother the flames with his lab coat—but not before the research associate sustained third-degree burns on her hands and second-degree burns on her arms and abdomen, covering about 40 percent of her body. After she spent 18 days in a specialized burn center, her organs began to fail and she succumbed.

This horrific fatal accident has garnered much media attention. UCLA was fined about $32,000. But most of the attention is due to the fact the local district attorney has filed felony labor code violations against the principal investigator, the first criminal prosecution of an American academic for a lab accident. Was the principal investigator grossly negligent, or was he following standard protocol for academic research? The trial is under way and should help answer these and other questions.

Moving toward a better safety culture

"The most difficult thing to do is change a culture." That quote is from Bill Tolman, the chair of the chemistry department at the University of Minnesota.[4] Looking at the examples presented above, the need for a better safety culture, especially in academia but also in general industry, cannot be

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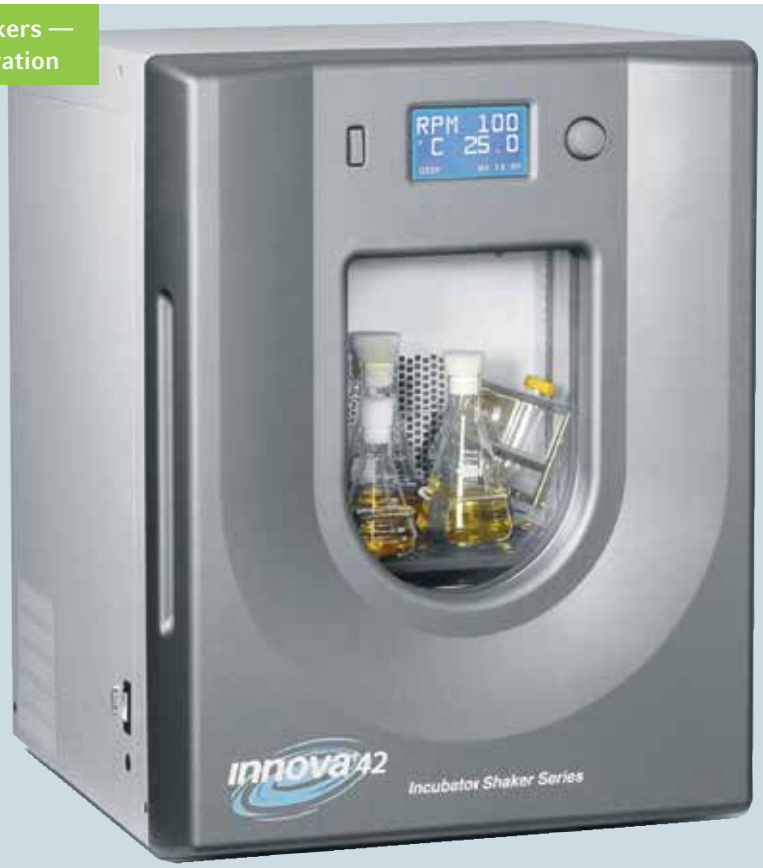

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denied. How do we do this? What steps are necessary to move us closer to safe and healthy research laboratories and workplaces? Below are our answer, opinion, and plan.

Prevention = Training

As Safety Guys, we believe prevention is the best medicine and that it starts with training. However, we would venture to say that most of us consider training just another item to check off, a small headache that we have to deal with and perform in order to comply with regulations. Granted, many regulations do address training, and a few go as far as to make it mandatory. The Safety Guys have covered (and will continue to write about) these mainstays of safety: the OSHA Lab Standard and Hazard Communication Standard and specific chemical standards that are common to research laboratories. Add OSHA respiratory protection and hearing conservation standards plus EPA hazardous wastes regulations and you have a very full complement of routine or annual training requirements.

If we truly want to move training away from the mundane and advance toward real prevention, we need to make good training a priority and put most of our effort into ensuring that it is done well and that employees take it to heart. To do this, incorporate a wide variety of training methods and use everything at your disposal. Online, computer-based training can reach large numbers of employees with computer access. Videos are very helpful, especially if well done, but should be updated or replaced every so often or they will become stale. In-person training is still probably the most effective, but don't let those PowerPoint presentations go too long without updating and tailoring them to your specific audience or topic. Try inserting short video clips (YouTube videos) to make important points and maintain interest. We Safety Guys are also big fans of short tests administered immediately following the training session to demonstrate understanding and comprehension. Consider the use of even briefer pop quizzes given unannounced to see whether employees are retaining the most critical information. And finally, retrain whenever the need arises, such as when a breach in protocol, a near miss or close call, or, heaven forbid, an accident or injury occurs.

Prevention = Observing

What do we mean by this, you ask? Think about it. How busy are you in your day-to-day activities? Dealing with all the little things that come up while trying to finish your must-do list, maybe you feel overwhelmed. When did you last take the time to observe your employees performing their work?

By observing we mean conducting regular inspections of the lab, chemical storage room, and other areas under your supervision. And performing occasional audits. Checking the chemical inventory, safety data sheets, training records, and standard operation procedures, sure. But mostly we would ask that you simply watch. Are the proper procedures being followed? Does it look and feel right? Is there anything that could be done differently or changed to flow better, be more efficient, or, most important, performed more safely? In addition to watching, ask employees for feedback. Perhaps they have ideas on improving certain procedures or operations. They perform the tasks daily; what better source is there for positive change? Finally, we want to stress documentation. Record your observations, employee input, training needs, and anything else that you feel needs attention. Set definite dates for follow-up and completion of corrective actions.

Prevention = What if … ?

Statistics on the differences between academic and industrial safety are sparse, to say the least. But nobody seems to dispute that safety culture at universities is widely divergent from safety culture in private, industrial, and production facilities. The reasons for this are far-ranging and complex and beyond the scope of this article yet perhaps the topic of a future one. However, one reason may be a program referred to as Process Safety Management.

Process Safety Management, or PSM, is an OSHA regulation that applies only to certain facilities that handle specific chemicals classed as highly hazardous and in large quantities above the standard's published thresholds.[5] The emphasis of this OSHA standard is management of the hazards associated with these very dangerous chemicals to prevent unexpected releases that create the real possibility of disaster if not properly controlled. The relatively substantial threshold quantities mean that the standard generally applies only to large production facilities. However, we feel that PSM and especially the major components have much wider applicability and should be considered for all laboratories handling hazardous materials.

The purpose of PSM is succinctly summarized as preventing or minimizing the consequences of catastrophic releases that may result in toxic, fire, or explosion hazards. Given that catastrophic is defined as "a major uncontrolled release that presents serious danger to employees in the workplace," we can all agree this is easily applied to most research labs handling hazardous materials.

The main component is the process hazard analysis (PHA); all hazards involved in the process are identified, evaluated,

and (hopefully) controlled. In industry the PHA is performed using a number of different methodologies such as hazard and operability studies, failure mode and effects analysis, fault tree analysis, or simple checklist/what-if scenarios as appropriate to the complexity of the process. We think the latter what-if method is a perfect one to use in most laboratory situations. In developing your standard operating procedures, take the time to ask "What if?" for each step of the operation. As you work through each "deviation"—considering the worst-case scenario and its causes, consequences, possible safeguards, and recommendations—you very likely will uncover appropriate controls, both engineering and administrative, that will greatly improve safety. We challenge you to play "What if?" and see whether your safety culture is stronger for it.

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Vince McLeod *is the founder and senior member of the Safety Guys and an industrial hygienist certified by the American Board of Industrial Hygiene. He currently serves as the senior industrial hygienist in the University of Florida's Environmental Health and Safety Division. He has 27 years of occupational health and safety experience at the University of Florida, and he specializes in conducting exposure assessments and health hazard evaluations for the university's 3,000-plus research laboratories.*

THE FIFTH ANNUAL LABORATORY SAFETY SURVEY

NO SIGNIFICANT IMPROVEMENT IN LAB SAFETY PRACTICES REPORTED

by Pam Ahlberg

Last year we reported a distressing decline in nearly every area of laboratory safety practices among the nearly 600 respondents who participated in the survey. This year, with almost 800 lab professionals weighing in, we were pleased to learn that the dramatic drop-off in safety protocols had leveled off somewhat—though what we see this year can hardly be called a turnaround. In fact, despite encouraging improvement regarding laboratory equipment safety, by and large the numbers trended downward again. See for yourself.

Demographics

This year 35 percent of respondents identified themselves as laboratory supervisors, directors, or managers, compared with 43 percent last year. Areas of work were distributed fairly evenly among environmental, chemical, microbiology, biotechnology, cell biology, cancer/oncology, clinical, and neuroscience. Slightly smaller percentages of respondents this year were involved in energy, pharmaceutical, plastics/polymers, drug discovery, food and beverage, forensics, genetics, immunology, and "other." This indicates that this year's respondents were slightly more involved in the life sciences than last year.

As for the types of research organizations respondents worked in, university or college remained the majority, up 11 points from last year (36% vs. 25%). Industry remained the same at 14 percent, but the percentage of those working in clinical or medical labs dropped eight points from last year (13% vs. 21%). Combined, these three categories remained the majority at 63 percent. The balance of respondents, at considerably smaller percentages, was distributed among government, contract, manufacturing, private research, and "other."

Significantly different from last year was the number of respondents working in labs with one to 10 people (50% vs. 41%). Those working in labs with 11 to 50 people remained similar to last year at roughly 35 percent. But the number of respondents working in labs with more than 50 people was down 11 percentage points from last year (14% vs. 25%). This suggests that the head count in smaller labs is growing while it is shrinking in larger ones. This same shift from larger to smaller labs was indicated in the overall size of organizations, with 22 percent of respondents working for companies with fewer than 100 people, compared with 17 percent last year.

Safety and hygiene

Compared with last year, the decline in laboratory safety and hygiene practices was negligible. For example, this year 56 percent of respondents said that their labs have designated chemical hygiene officers compared with 59 percent last year. And only 1 percent fewer respondents said that their labs had a designated safety officer (76% vs. 77%). When it came to the question of whether these labs had standard operating procedures written for each task, the numbers were identical to last year with 78 percent yes, 20 percent no, and 2 percent not knowing.

> "What we see this year can hardly be called a turnaround."

The relatively good news this year is that, regarding laboratory record-keeping practices, the improved numbers far outweighed the declines. This year's survey reports an 11 percent increase in the number of labs that have a current biological safety manual (66% vs. 55%) and a 4 percent increase in respondents that are current in their annual chemical and hygiene planning and training (75% vs. 71%). A 1 percent increase was reported for laboratory safety manuals available to lab personnel (81% vs. 80%). Even taking into consideration the insignificant 1 percent decrease in those having material safety data sheets (96% vs. 97%) and complete chemical inventories (82% vs. 83%), overall improvements were encouraging.

Health and safety

While declines in basic laboratory health and safety management practices were smaller than last year, they continued nonetheless. Three percent fewer labs reported that current chemical and lab safety manuals were accessible to every worker (88% vs. 91%). There was a 2 percent drop in labs reporting that hazards identified by previous safety audits had been abated (78% vs. 80%) and a 1 percent drop in the number of labs that had workers trained in how to respond to an accident (89% vs. 90%). Two percent fewer respondents said that standard operating procedures had been written for each laboratory task (74% vs. 76%). Similar percentage declines were reported for workers being instructed in laboratory emergency action/fire prevention plan procedures; workers being properly trained in chemical safety, physical hazards, and laboratory safety; and labs performing periodic laboratory safety inspections, at 1, 2, and 3 percent respectively. Most alarming, however, was the whopping 14 percent fewer respondents who said that workers using biohazards, toxins, and regulated carcinogens had received special training (66% vs. 80%).

Inspections

When it came to laboratory safety inspections, 30 percent said that their labs conducted those annually, 6 percent every two years or more, and 14 percent semiannually. A drop in the number of labs with the most frequent inspection interval was reported by those who perform inspections monthly (22% vs. 27%), but an increase was reported by those who perform inspections quarterly (16% vs. 14%).

General safety practices

When labs were asked 18 questions concerning general safety management practices, such as labeling, clutter, lighting, first-aid kits, and protective clothing, their answers indicated a continued drop-off. While most of the reported declines were relatively insignificant, a few were notable. For example, the largest drop in compliance was associated with the statement, "All shelves have lips, wires, or other restraints to prevent items from falling," with yes answers down four points (49% vs. 53%). Two-point drops were also reported for adequate ventilation; location and accessibility of first-aid kits; food and beverages in labs; and eye protection. Additional one-point declines were reported for adequate lighting, fire extinguishers, noise control, physical safety, emergency call lists, and chemical spill control materials. Of the four instances of improvement over last year, the greatest—at 73 percent versus 70 percent—had to do with

ergonomic furnishings. The three others, with only one-point improvements, concerned unobstructed work areas, properly labeled sinks, and protective gloves.

Hazardous materials

Of the 12 statements concerning hazardous materials management, declines compared with 2013 numbered six, no change was indicated for three, and three indicated improvement. The statement with the largest jump in yes answers was, "Waste accumulation point signs are posted at designated collection points," moving up seven points from 48 percent to 55 percent. A three-point improvement was also reported concerning proper segregation and storage of chemical waste containers (90% vs. 87%). The other improvement, by only one point, had to do with the storage and labeling of sharp objects (93% vs. 92%). The largest drop in yeses, at 3 percent, was seen in responses to statements concerning safe handling of regulated carcinogens (87% vs. 92%) and separation and storage of chemicals by hazard class (90% vs. 93%). There were three other declines in the one-point range, with the balance the same year over year.

Fire and electrical

In the category of fire and electrical safety, we saw the same downward trend, which in a few cases was fairly significant. Of the eight fire and electrical statements, the three that gave rise to declines were labeling for circuit breakers (65% vs. 71%), proper containers for flammable liquids (83% vs. 88%), and proper storage cabinets for flammable liquids (85% vs. 88%). However, these drops occurred in conjunction with some minor improvements, namely a one-point improvement each for plugs, cords, and receptacles in good condition (96% vs. 95%), proper grounding of equipment (93% vs. 92%), and power cabinets, etc., free of obstructions (91% vs. 90%). The remaining two categories did not change year over year.

Laboratory equipment

And now for something completely unexpected. Of all the categories, laboratory equipment safety represented the greatest improvement in safety practices across the board, with not a single decline among responses to the 12 statements. As you can see from the facing chart, every statement showed improvement, with the greatest leaps concerning properly labeled refrigerators/freezers for flammables (89% vs. 83%) and properly guarded moveable parts and belts (83% vs. 79%). The difference between equipment safety and almost all other aspects of laboratory safety is a head scratcher, but improvement is improvement and we'll take it.

▼ *Changes in Laboratory Equipment Safety Practices from 2012 to 2014*

Please respond to the following Laboratory Equipment safety statements.	2014 Yes	2013 Yes	2012 Yes
All biological safety cabinets and chemical fume hoods have been tested within the past year.	85%	82%	92%
Test labels are properly affixed to the fume hoods and biological fume cabinets tested.	85%	83%	93%
Storage in fume hoods and biological safety cabinets is kept to a minimum and is placed so as to not impede proper airflow.	90%	89%	93%
All rotating or movable parts and belts are properly guarded with screens.	83%	79%	90%
All refrigerators/freezers used for storage of flammables (non-sparking/laboratory safe) are properly labeled.	89%	83%	90%
Non-spark-proof refrigerators (household types) are labeled "Unsafe for Flammable Storage."	56%	52%	72%
All gas cylinders are chained to an immovable object to prevent tipping or falling.	93%	91%	93%
Valves of gas cylinders are capped when not in use.	90%	87%	91%
Gas cylinders are stored with other compatible gases.	91%	87%	93%
Gas cylinders are not emptied completely, but left with 25 psi to prevent backflow.	61%	59%	73%
Empty cylinders are marked "MT" or "EMPTY" and stored separately.	79%	77%	86%
Rooms containing compressed gases have a sign outside the room stating COMPRESSED GAS and the name of the gas and hazard class.	57%	57%	69%

Notable this year was the increase in the number of respondents from academic and smaller labs as compared with large and industrial labs, which might have had some bearing on the results. Based on a comparison between academic and industrial labs, we did see a trend among academic labs to have better bookwork, labeling signage, and so forth, while industrial labs seem to be better at employing engineered solutions and had better compliance. We will be watching this closely in next year's survey results.

OUTSOURCING OPTIONS

EVALUATING THE MOVE FROM IN-HOUSE LABORATORIES TO INDEPENDENT PROVIDERS

by Bernard Tulsi

As they sort out where their in-house laboratories fit within the enterprise, technology-driven businesses, many with requirements far exceeding the typical fee-for-service testing, have been adopting outsourcing models aimed at keeping control, retaining proprietary knowledge, and tapping into the broad technical and administrative expertise of contract lab services providers —all at a steep discount relative to their own in-house lab operations.

"The option of outsourcing laboratory services is an intelligent win-win approach," says Andrew Swift, EVP, Intertek Chemicals and Pharmaceuticals (Abu Dhabi, United Arab Emirates).

At its core, laboratory outsourcing consists of the transfer of research and development, quality control, and related analytical functions from in-house laboratories to independent providers of test and measurement services. A recession-afflicted global economy, together with industry-specific game changers, such as the $100-billion-plus patent precipice in the pharmaceutical industry, have made staff and budget cutting almost routine occurrences in technology-driven businesses. As a result, an array of inventive approaches have sprouted to help technology companies cope with lost talent and a surfeit of underused lab instrumentation and facilities.

Outsourcing refers to a broad spectrum of service models and contractual arrangements for laboratory services, according to Phil Heaton, general manager, Oil Sands & Upgrading at Maxxam Analytics (Alberta, Canada). He says that at one end of the spectrum, simply sending out a proportion of a lab's samples to a third party for testing—anything outside a facility's own walls—could be referred to as outsourcing. The other end of the spectrum could include the full turnkey operation of laboratories, including the operation of onsite facilities, says Heaton. In practice, both globally and within industries, there are hybrids of all those forms—a blend of models and arrangements in which most industries participate today, according to Heaton. He says there is an overall propensity for outsourcing globally, and "laboratories are not immune to that."

Sherri Basner, director, Intertek Chemicals and Pharmaceuticals, Americas, explains that while outsourcing entails laboratory-wide shifts from an in-house setting to provision of testing services, the scope is much broader. "It runs the range of outsourcing certain high-volume routine tests to portions of the work flow, or just outsourcing access to certain capabilities that can't be afforded in-house."

Basner believes that while there is almost always a good business case to support outsourcing in any business climate, it will be most popular in a dynamic economic environment. "When the economy is growing fast and companies can't keep up with internal needs, they will look for outsourcing partners. When it is weak and declining, outsourcing is driven more by the need to save costs internally or at least to transition from fixed costs to variable costs."

Swift joined Intertek, the global provider of testing and measurement services, as it was embarking upon a large-scale laboratory outsourcing program with British Petroleum (BP) for its global refinery support services laboratories. "BP was quite a pioneer in the oil and chemicals industry for contemplating laboratory outsourcing models, and this one certainly broke some new ground."

"Over 12 years later we continue to run this laboratory in Intertek as an outsourced facility, serving BP with a wider scope of advanced analytical measurement services while being hot wired into the global BP organization. Under the same model and location, a few years later we successfully expanded the scope from downstream refining services into upstream exploration and production support services as well," says Swift.

At the same time, under the Intertek model, this facility was being projected to international third-party markets through a portal that globally networked orga-

nizations like Intertek can provide—so it became a highly valued asset in partnership with BP, according to Swift. "Fueled by further innovative facility outsourcing contracts, over the next 10 years Intertek assembled one of the strongest knowledge centers and global expert measurement capabilities of the time," says Swift.

A number of other global organizations in related industries saw the success of this partnership and approached Intertek about similar or related models in their spheres, according to Swift. "In the following five to six years, over 10 other global majors successfully outsourced significant laboratory testing and measurement assets, and expert scientists and engineers. Intellectual property was guarded with transparent and innovative approaches to confidentiality and security in each contract," says Swift. Among them were organizations like Rolls Royce, Kodak, Unilever, Shell in Australia, Dow in the US, DSM and Sabic in The Netherlands, and ICI in the UK, according to Swift.

Heaton says that the management of one of Maxxam's clients, a multinational petrochemical company that operated its own in-house laboratories globally, concluded more than a decade ago and that the laboratory function was not a core competency. Management recognized that a service provider whose core competency was laboratory testing would be a good partner, according to Heaton. "That was an early example of how Maxxam became focused on laboratory outsourcing, and that relationship goes back more than 15 years," he says.

Many of Maxxam's customers, including several of the major global oil and gas producers now operating in the Canadian oil sands, maintained their own in-house exclusive laboratories in the past. "That is no longer the case, and the shift is part of a global trend," he says. Companies that outsource their laboratory testing reason that a dedicated test services provider focused on laboratory operations will almost certainly be more innovative while pursuing improvements in the field, according to Heaton.

"The acceleration toward large-scale laboratory outsourcing has really picked up in the last 10 years—and will continue to accelerate and become even more commonplace—and certainly for new facilities, it will become first choice," says Heaton. He noted that it will be more challenging for legacy in-house laboratories.

Swift also believes that the value perception of such outsourcing by the major corporations changed dramatically in the course of the past ten years. He says that various factors influence and drive outsourcing from the corporate perspective and he considers what was 'core' and 'what was not' to the execution of a company's strategy, was the original primary consideration. "In the 70s, 80s and 90s in the chemicals, defense, pharmaceutical, and oil and gas industries, to be a technical leader in the market there was a need to have the best equipped laboratory available; having the best laboratory testing capability 'in-house' was a key differentiator," says Swift.

He says that industry recession before the turn of the millennium changed this view considerably and organizations were forced to consider an alternative 'asset light' approach to laboratory support while preserving the same technical capability—in the commodities, defense, and chemicals industries, for economic reasons; and in the oil and gas exploration and pharmaceutical industries for strategic reasons. Companies in all these

industries realized that the maintenance of in-house laboratories was a very capital and operationally expensive proposition, and that they were building up assets that were only partly used (underutilized) and which were very costly to implement and sustain.

As a result, there was considerable interest in partnering with Intertek's platform of measurement laboratories which it had built to support its customer base around the world. "These companies were very keen to look at alternative models for retaining access to their instrumentation power and use them on a 'pay on demand' basis with a capable partner," says Swift.

"They secured those arrangements with long term contracts that guaranteed access, on a privileged basis, and which guarded their intellectual property," he says. As a result of these outsourcing ventures, companies were still able to participate in the strategic development of laboratory capabilities but via a partnership model with organizations like Intertek, which had compatible agendas for developing the resource, according to Swift.

Describing an added dimension, Swift says in many companies with multiple divisions or categories, the 'high end' labs serve everyone but are not comfortably owned by any one, and so no single division is willing to take on the liabilities and bear the full cost of an expensive overhead benefitting others. "So the in-house laboratory in the new economy is a bit of a misfit for the legacy corporation," says Swift.

Benefits such as more streamlined costs have led to substantial growth in the outsourcing of laboratory operations during the past decade. To be sure, different industries have climbed aboard at different rates. Rob Weibe, vice president and general manager, Maxxam Analytics, Food Science and Safety, says outsourcing is a newer trend in the food industry, which may be five or six years behind the oil and gas industry in this area.

"There are three real reasons why food companies are pursuing outsourcing. Food companies are realizing that laboratory analysis is not a core function. They do not have the training and the systems, and technology moves very quickly in this area.

"The second piece is that the real cost of running a food lab is much higher than many food companies expect—the capital spend and operational costs are increasing constantly, and the cost of data management, which is critical for regulatory purposes, is going up."

Weibe says the third reason is that outsourcing companies provide food companies with real opportunities for cost savings. He says they offer advantages in identifying better practices, help resolve problems more quickly, tend to invest more heavily in newer and better test and measurement instrumentation, and provide faster and more reliable results than in-house labs. "We have customers who are decreasing their warehouse space because of their switch to outsourcing and away from their in-house labs."

Basner says that part of the compelling value proposition for companies outsourcing their in-house labs is that they have the potential to "get much more output at reduced cost." Prior to transitioning to Intertek, Basner managed the analytical sciences department of an international industrial chemicals and gases company, and she had an integral role in the outsourcing of in-house lab operations to Intertek.

"My experience in this has been in participating in the outsourcing field and transitioning from a parent company into Intertek. I spent the bulk of my career as a product development chemist with a global chemical company where I managed the analytical sciences department. The company closed an outsourcing deal in 2010 to transition the analytical sciences group to Intertek.

"I have been through the outsourcing process, and it has been a very successful venture from the perspective of both companies thus far.

The parent company has publicly stated that success was first and foremost cost reduction—analytical services was a high cost area, very capital and space intensive—especially since the company was in a field that required a very broad range of analytical testing. "The only way to save money and economize was for the company to trim down on people, so they had a lot of underutilized assets, the use of which they needed to optimize," says Basner.

So they wanted to reduce their total costs, transition their variable costs, and reduce capital investments. "Even if you are not making investments in expansion capital, there is a need to make investments in replacement capital," says Basner.

"So maintaining analytical services was a constant source of expenditures for them. They wanted to balance that with very high-quality analytical science; they wanted to have access to the scientists who already understood their chemistry and technologies, which was important for maintaining timely service delivery and keeping costs down.

"Also, there was the added advantage of accessing broader Intertek capabilities, which was a big attraction for them, and honestly, they were also anxious to provide career options for their analytical scientists," Basner says.

To be sure, this process is not devoid of pitfalls and struggles, according to Basner. She says there was a necessity to reeducate people who worked seamlessly at one time so they could work together following the transition of her parent company's laboratory operation to Intertek. Still, there were lingering feelings of separation, as well as cultural and administrative challenges typically associated with transition.

Basner says tools must be developed and put in place to deal with the issues of transition. In addition, the streamlining of operational steps such as an appealing web-based sample submission system developed by Intertek was enormously helpful, she says.

She sees the relative instability in the economic environment as a big driver of outsourcing in the future. "If you can outsource and save time and money on areas that are not core, you will do it every time. This will no doubt continue over the next several years, and it is also not industry-specific."

Swift also expects to see expansion over the next several years. As long as companies like Intertek invest in the required technologies, there will be opportunities to provide value to small and medium companies that cannot justify the expense of establishing their own 'high end' labs, and to help the larger players pursue large scale growth on a truly 'asset light' agenda.

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RANK YOUR PRIORITIES

By Mark A. Lanfear

Human behavior is difficult to figure out.

For example, take the way we all tend to treat "priorities." We all have them, and we instinctively know that some of them are much more important than others.

Such as our families. The people we love. That novel we'd like to write. That project we'd like to tackle that could lead to a cure for cancer.

These are the types of priorities that can be life-changing. The ones that, if we can accomplish them, can make us feel alive and purposeful. And yet, what do we typically do with the most important priorities in our lives? We put them in a separate pile for later. We adopt the attitude that we'll get around to them because there will always be plenty of time to do so.

In the meantime, there are the "urgent" and "recurring" priorities of our everyday lives constantly lurking at the forefront. Answering all our emails. Checking social media. Scheduling those meetings. Responding to requests for our time and expertise.

What do we do with these types of priorities—the ones that may indeed be urgent but have little to do with our long-term success?

We put them first. We hypnotize ourselves into believing that if we can keep all the urgencies of the day at bay, we'll be able to eventually tackle what's really important in our lives.

But this is a recipe for an endless cycle that has the ability to go around and around in the same circle unless we are able to "shift" the dynamic. The familiar term "tomorrow never comes" comes to mind when I think about this cycle of missed opportunities—where our priorities are not necessarily being dealt with in the correct order.

Continually evaluating your time management is the key. We hear this term all the time—but what does it really mean? And how can you truly get your own time management practices under control?

> "Getting time management right does indeed—and should—involve saying 'no' when necessary."

There's no easy answer, and the solutions will always be different for every individual circumstance. But what I would argue is that in any situation, if you're managing your time effectively, you've been able to successfully "rank" your priorities in a way in which the most important ones start to take precedence.

This isn't to say that the daily tasks of life can be ignored. We all must meet personal and professional urgencies on a regular basis. We all must answer those emails eventually—and we can't always say no when someone asks us to do something.

But getting time management right does indeed—and should—involve saying "no" when necessary. No to the constant distractions of email. No to managing personal social media. No to texting when there is a much more important priority staring you in the face, such as that critical professional project that you could start right now in order to take your career to the next level.

In lab management, all these issues exist, as they do in practically every work environment. Time management will always be a challenge. It's particularly critical in an environment where the work you do could have consequences for thousands or millions of people. Not prioritizing your critical work on the job could jeopardize not only your own well-being and personal growth but also that of others.

Rise to the challenge this year of putting your most important, long-term priorities at the starting line each and every day.

Make that a priority, and you may see your time management skills soar.

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WHY DOES GREAT COLLABORATION REQUIRE GOOD CONFLICT?

By Lynda McDermott

When did the term "conflict" get such a bad name? In my work with teams over the past 25 years all around the world, I have never found a high-performing *team* that did not have moments when team members disagreed, debated, or argued. These teams all had a healthy respect for the value of not only having differences of opinions or perspectives but also for having learned how to manage themselves as they worked through the discord or tensions precipitated by their disputes. Rather than being an enemy of collaboration, *c*onflict is, in fact, a necessary requirement for productive and successful collaboration.

When people work together as a high-performing team—sharing information, looking at alternative courses of action, and making decisions together—they learn to give others on the team the benefit of the doubt when conflicts arise. Leaders can foster this by making sure they keep all team members in the "information loop." They can seek all team members' input when developing approaches for resolving issues. When people feel others are working for the benefit of the team more than for their own personal interests, then they will be more willing to give others the benefit of the doubt and find out what is happening before getting angry and shutting down communication.

Once the right climate is established, team members need to use constructive communication techniques to keep their conflict conversations moving in a way that facilitates collaboration. Several particularly effective communication techniques include reaching out, perspective taking, listening for understanding, sharing thoughts and feelings, and creating solutions.

Conflict communication consists of talking and listening. In many ways, listening is the more important of the two. A couple of behaviors typify good listening. The first is perspective taking, which involves trying to see things from the other person's point of view. By trying to do this, you can learn new things about a conflict that may prove helpful in resolving it.

The second technique is called listening for understanding. This involves hearing what the other person has to say whether or not you agree with it. Most of us listen in order to respond. We hear the other person's words but at the same time are judging whether they are right or wrong so we can correct the other person when we get the chance to speak. This type of listening causes us to miss many important points, and it generally causes the other person to get defensive. When you listen carefully, the other person will usually calm down and you will pick up ideas that can help resolve the conflict and improve the quality of your collaboration. When you have listened carefully to the other person, he or she also becomes more open to listening to you, which can make it easier to make your own points.

Once this sharing has occurred, you are well positioned to be able to explore new options for creating solutions to the problem you face. This search for options can take into account a variety of perspectives so that solutions will not be one-sided. Rather, they can be crafted in ways that meet all parties' needs and generate sustainable solutions.

Conflict is a natural part of life. People recognize this but are often afraid to address it. When that happens, collaboration is hampered because communication withers. To achieve optimal collaboration, people need to be able to explore issues and debate points in a constructive manner. By managing conflict effectively, collaboration can be enhanced and its promise fulfilled.

*For further information about **Lynda McDermott**'s work with teams and team leadership, contact Lynda McDermott at lmcdermott@equiproint.com. Please visit her at www.equiproint.com or follow Linda on LinkedIn, Facebook, or Twitter.*

LABCAST Be sure to attend Lynda McDermott's Lab Manager Academy webinar "Why Does Great Collaboration Require Good Conflict?" on Wednesday, July 9, or afterward at **www.labmanager.com/greatcollaboration** to watch the archived video.

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MANAGING SURPLUS ASSETS

A HOLISTIC APPROACH BALANCES NEEDS ACROSS AN ENTIRE GLOBAL ENTERPRISE

by Ben Potenza

Much has been written about the business benefits of outsourcing "noncore" activities, and this approach is now well-established in most chemical, pharmaceutical, and biotech companies. By concentrating on core areas and working with specialists for other tasks, costs are better managed, efficiency is boosted, and ROI (return on investment) is increased.

This principle continues to drive a focus on process simplification and maximizing efficiency in the R&D and production environments. Such strategies have become vital for day-to-day operations in most sectors. Now, business leaders targeting the very highest levels of excellence are extending this rigor to the proactive management of idle and surplus analytical, laboratory, and other equipment, recognizing the often dormant value in these assets.

A whole-business approach

There have always been equipment dealers buying up surplus assets for pennies on the dollar and selling them. But in recent years, as companies have been discovering the hidden value in idle assets found throughout their enterprises, asset management best practice has been evolving. Specialist service companies, staffed by industry experts and proven project management professionals, offer an approach and services that are different from the traditional equipment dealer or auctioneer.

One vendor in this field, EquipNet, provides a holistic approach to surplus asset management that balances needs across an entire global enterprise. This is effectively illustrated using its proprietary 'Value Control Model.' The figure below shows how a managed program can be customized based on time and can involve various disposition channels, including redeployment, negotiated sales with managed pricing through an online marketplace, competitive auction events, and clearance programs.

▲ *Total clarity of process and a whole-company approach characterize the Value Control Model. Individual company circumstances inform asset management decisions.*

A central tracking platform

After making a significant investment in evaluating, selecting, and purchasing a piece of equipment, redeploying that asset to another part of the business when its initial use is over delivers the highest ongoing value for the asset. However, redeployment cannot be successfully and consistently achieved unless there is a central tracking platform installed within all company locations. Users should be able to post, track, identify, and internally redeploy equipment that is not being used in its

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present location, ahead of moving to external sale. Features to look for in an asset redeployment management system include a robust platform that sits behind a company's firewall, a simple user interface that allows workflow management, multiple access levels for managers and executives across the business, and in-depth search functionality. Comprehensive listing specifications that provide information that lets the company know what it has and where the equipment is located are important too.

> "Companies have been discovering the hidden value in idle assets found throughout their enterprises."

If a company chooses not to redeploy an asset, a sale or disposal is the next logical step. The rise of the Internet has seen the development of online marketplace packages to meet this need. When considering an online transaction, however, particularly for a high-value and complex piece of equipment, the human touch is perhaps still the most important factor. Using a vendor with specific industry experience is crucial to success.

A desire to recoup as much money as possible on surplus assets may, in certain circumstances, be superseded by time constraints. In this case, liquidity becomes the highest priority. Auctions are another dependable channel for achieving this goal. Designing and managing a successful auction event depends on many factors. A specialist partner should advise on the right approach in each case; your options might include online auctions, live/webcast auction events, and sealed bid and private treaty sales. Innovation should be at work here too; look for active marketing by the auction provider, expert knowledge of the equipment being offered for sale, and a flexible approach to managing bids close to, but under, any reserve set.

Assets that hold very little value are best dealt with through clearance, by donations, or by scrap and environmental recycling. Working with your chosen expert, you should expect to be advised of the scrap value of your idle equipment and presented with a comparison of that amount against the market value to sell it, together with a recommended strategy that will generate the highest rate of return.

In conclusion

Understanding what equipment you have, and where in the business it is located, provides solid information for laboratory managers to plan effectively. But a proactive approach is not without its challenges, requiring formalized processes, specialist knowledge of the industry and its equipment, dedicated resources, and a concerted effort to change asset management practices. Many businesses lack the time or resources necessary to establish a successful program themselves. For this reason, many companies are relying on partnerships with specialist service providers for cash release, reduced costs, and increased efficiency.

***Ben Potenza**, VP Marketing, EquipNet Inc., can be reached at 44-118-901-6161 or sales@equipnet.com.*

CASE STUDY: Maximum return on the closure of an R&D department

The Challenge:
In March 2013, a major pharmaceutical company approached EquipNet for help with closing a section of its R&D laboratory facility in northern Germany.

A six-month timeframe was available to complete the project.

The Scope:
The company wished to expose an inventory of redundant assets from this site to the histology and vivarium departments throughout its enterprise, with the intent of redeploying as many assets as possible. In addition, all remaining items were to be sold within the six-month project time frame.

The Approach:
All assets were catalogued and photographed, and fair market valuations were established for each item. Assets were then listed on a secure, company-specific software platform so that the organization's 170 facilities across the globe had full exposure to the items available.

Due to tight time restraints, the equipment was simultaneously advertised online. Items that didn't redeploy or sell through the managed price approach were put in a web-based auction.

The Result:
The company was able to redeploy 10 percent of the items. More important, by relocating this equipment, purchase of new equipment was avoided, which equated to a cost saving of more than $200,000. Sixty-four percent of the items were sold. A further 20 percent of the items held no resale value and were scrapped.

The location was cleared within the allotted time frame, and the company maximized the return on its original investment in those assets—all without interrupting ongoing operations.

MANAGING TIME

EFFECTIVE TIME MANAGEMENT STRATEGIES TAILORED TO THE TASK AND THE TEAM

by Sara Goudarzi

In order to increase efficiency, many companies today are under pressure to improve their time management practices. This is not an easy task, however, due to the workload ebb and flow that's inherent in laboratory operations. For that reason, upper administration must come up with ways to continually equalize the load and increase a lab's efficiency using current best practices in time management.

For many managers this means preplanning, effective scheduling, having contingency strategies and gathering regularly to meet the current needs of the lab.

"Keeping any lab on schedule requires vigilance in time management," says Michael Ogletree, laboratory manager at Airtech Environmental Services Inc. in Denver. "Any time wasted or not used efficiently will inevitably lead to increases in turnaround time."

> "Being adaptable allows for the variability that comes with different projects and deadlines."

Ogletree's laboratory specializes in analysis for stationary source emissions testing. Between the Denver lab's one primary analyst and one part-time tech and the field lab's four primary test leaders, the team conducts more than 25 standard Environmental Protection Agency (EPA) test methods along with multiple others conducted on site using continuous emissions monitors. The team also performs nonstandard testing for a variety of compounds.

"In our Denver lab, we analyzed over 1,200 samples in 2013, and over 200 typically week-long, on-site sampling projects," Ogletree says. "In addition, we provided analytical support to our field labs through preparation of various reagents, sampling media and standards prep."

With such high throughput, time management can be tough, especially during busy seasons.

"Keeping track of samples coming in and [deciding] how to prioritize them has been very important," explains Ogletree. "We have several project managers (PMs) that manage the field test leaders, with whom I work closely to keep track of which samples will be coming back on a weekly basis. I send out weekly updates to the PMs, with estimated dates as to when each set of samples will be completed. This gives them a chance to communicate with our clients as to when they will be receiving project reports."

Flexibility in time management

Each manager finds his or her own methods to optimize keeping track of the ongoing and anticipated jobs and of the time necessary to complete corresponding lab work.

"I meet with my team weekly to determine work for the next week," says Amie Sluiter, research scientist and research section supervisor at the National Renewable Energy Laboratory's (NREL) National Bioenergy Center in Golden, CO. "This allows me to prioritize samples and ensure that everyone has a balanced workload every week."

Sluiter's lab staff analyzes materials for biofuels production. Much of their investigation is aimed at improving methods or research to characterize new products or processes. They use NREL laboratory analytical procedures, industry standard methods utilized worldwide in the biofuels industry.

Her team characterizes everything, from the starting material to intermediates to final products, and provides feedback to the process engineers to let them know if their experiments were successful.

"Rotating tasks can also be beneficial in keeping the staff engaged and interested, which in turn can increase productivity."

"With the data we produce, they can often tell exactly where in the process something went wrong," she says. "We also contract with outside clients in industry and academia to develop new methods for novel feedstock and optimize biofuels production. We develop and validate rapid methods for in-line and at-line characterization as well."

Sluiter and her team of 12 scientists and technicians perform hundreds of analyses each year. The team is housed in two buildings and works on at least 20 projects at a time. Sluiter's method of time management is to allow each team member to evaluate their own schedule and abilities and to work within that frame.

"I encourage them to stay comfortably busy, and if they find that they are overwhelmed or underworked, they come and let me know and I find work for them," she says.

"As long as folks are getting deadlines met, working with colleagues pleasantly, and producing high-quality data, I leave them alone," Sluiter adds. "However, it is critical that you have an open-door policy if they get overwhelmed or something goes awry."

Julie Hill, vice president, chemistry, of the National Food Lab (NFL) in Livermore, CA, also believes in flexibility when it comes to time management. As a consulting and testing firm providing creative, practical and science-based insights to solve food safety, quality and product and process development challenges for food and beverage companies, being adaptable allows for the variability that comes with different projects and deadlines.

"We don't have specific practices employed across the laboratory," she says. "We set safety, quality and client service goals including efficiency objectives."

"Each individual develops their own practices that work for them," Hill adds. "Many of our staff can work on several projects at one time, and others work more efficiently completing one task and then moving on to the next."

Flexibility within her lab, however, does not mean that Hill forgoes best practices in time management. She uses Lean Lab and Six Sigma—both practices used for improving processes and increasing efficiency.

"Like many companies today, the pressure is on to increase our efficiency and practice effective time management," Hill says. "One of the unique characteristics of our chemistry team is they are a very cohesive group. Many of our chemists have worked at the NFL for 10-plus years, and a few of our staff have been with us for over 20 years. With that kind of longevity and experience comes an innate ability to mentor our junior staff as well as help direct work flow and quickly manage problems that might crop up in a day."

"It works for us to allow each individual to develop his or her own time management best practices to meet the end goal," she adds. "Our chemistry supervisors and managers do coach our staff and offer techniques such as preplanning your day, prioritizing your 'to do' list, and eliminating wasteful activities."

Time management tools

Even within the most flexible of frameworks, managers use different tools to track work, progress and schedules. Although the tools might be different, the idea is generally the same.

Airtech's Ogletree uses Excel spreadsheets as a primary means of scheduling.

"We have one master Excel spreadsheet with field jobs; [this] is used to communicate jobs going—which week, assigned personnel, test methods, location, etc.," he says. "In addition, we have a lab-specific spreadsheet that tracks which samples we have in house, the scheduled turnaround time, [and things like] when they were received."

"I refer to both the master field spreadsheet as well as the internal lab spreadsheet constantly," Ogletree adds.

This management method is especially helpful as his lab has grown significantly in the past few years and the workload has more than doubled.

"It hasn't had a significant impact on how we manage our time, but rather, we have had to become much more diligent about keeping our spreadsheets up to date and simultaneously working on multiple projects at once to be able to maximize our analytical time," Ogletree says.

> "The most important tip in the management of time is to complete tasks as soon as possible even when things are not busy."

Others, like Hill at the NFL, use a laboratory information management system (LIMS)—software specifically designed to support a lab's functions and workflow. Using LIMS, she and others in management positions assign due dates to each project. However, in keeping with her philosophy of flexibility and autonomy when it comes to scheduling, she allows each staff member to set their schedule and to work as a team and meet these deadlines.

"This may seem like an idealistic strategy, but it works for us," she says. "Our team knows what the project deadlines are, and they schedule their work flow appropriately to get their work done."

NREL's Sluiter, on the other hand, uses two systems to manage workloads. The first is a time tracker, which the staff fills out weekly for the upcoming week. This allows Sluiter to be aware of how much time each staff member has available and if they're working on high-priority samples. It also allows her to know if anyone is available for overtime in the case of unexpected incoming work.

"In trying to get everyone to fill out the workload sheet for the next week, I first tried candy," she says. "Anyone who did not fill it out got a 'Snickers of Shame.' That didn't work—they offered to go back and erase their week just to get some candy—so I finally told them that whoever did not fill out the sheet would get the worst dirty, boring work I could come up with. That worked like a charm."

She and her team also have a system that tracks every analysis for every sample set. The analyses are assigned a tracking number. Once an analysis is finished, the technician sends it in for quality assurance/quality control and records in the system the date it was submitted. After the data is approved and sent to the client, the reviewer records the date delivered. To ensure excellent customer service, the review takes a maximum of five working days.

Additionally, Sluiter and her staff schedule time on their heavily used instruments online, so that multiple groups can easily share equipment.

Uninterrupted time and task rotation

When organizations experience a high volume of work, uninterrupted time becomes an important asset. This allows staff members to familiarize themselves with a task and continue working on it without stopping and repeatedly having to spend extra time becoming reacquainted with procedures.

"Many of the tests are time sensitive, and I have found that constant shifting or interruptions make people in the lab less efficient and [more] unhappy," says Sluiter. "They like to be able to anticipate their day."

Additionally, many test methods require sample prep prior to analyses, which can be performed only when there's uninterrupted time available.

"There are samples, however, that have an involved prep followed by an extended evaporation time, such as EPA Method 202 for condensable particulate matter," says Ogletree.

In such cases, staff members can take that time and start another task, instead of waiting. For that reason, it's good to have lab staff rotate tasks when necessary.

Once the techs are well versed in the methods, says Ogletree, "running multiple instruments or analyzers at once leads to the most productivity. Frequently there is some instrumental run time that allows for some other activity, such as running a second instrument, prepping for outgoing instruments or reagents, etc."

Rotating tasks can also be beneficial in keeping the staff engaged and interested, which in turn can increase productivity.

"My team is in a research environment because they like research," Sluiter says. "I find that if they get stuck with one task all the time… they get bored, and their work slows, and they do not get to connect to the projects like I would like them to. The more they understand about a project, the more they are primed to offer important ideas or make observations in the lab."

No matter the method, managers believe that everyone needs a way of organizing tasks to stay on track.

"I feel like the most important tip in the management of time is to complete tasks as soon as possible even when things are not busy," says Ogletree. "It can be difficult at times to predict what will be coming in, and getting behind on analysis is the last thing you want."

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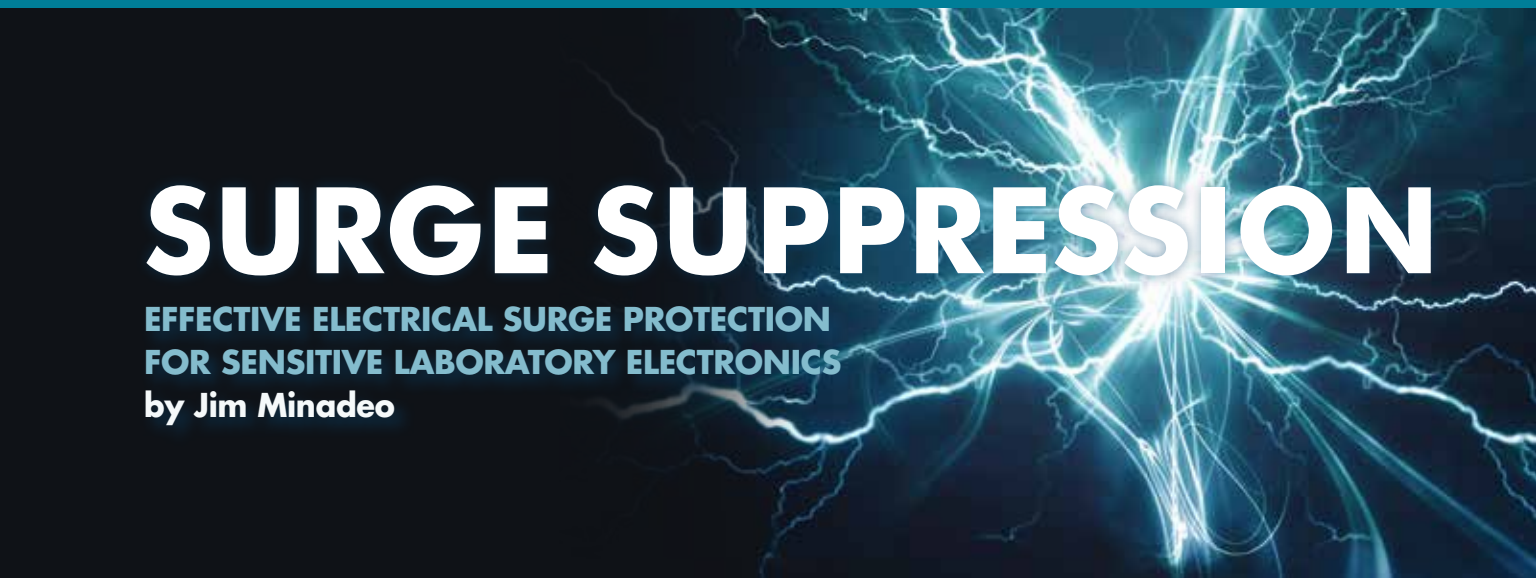


SURGE SUPPRESSION

EFFECTIVE ELECTRICAL SURGE PROTECTION FOR SENSITIVE LABORATORY ELECTRONICS

by Jim Minadeo

It is a summer afternoon and dark clouds are rolling in. You notice that outside your laboratory windows the lightning strikes are getting closer. Your first thought is to back up your data. Your second thought is to shut down your $50,000 spectrometer so electrical surges from lightning strikes don't kill the sensitive electronics. After the storm leaves the area, you pat yourself on the back for protecting your data and equipment. The worry is over. Or is it?

> "According to IEEE/ANSI C62.41, 80 percent of surges originate from within a building."

Where do surges come from?

Ask most people and they will say that electrical surges come from lightning strikes or are due to poor electric service. They are only 20 percent correct. According to IEEE/ANSI C62.41, 80 percent of surges originate from within a building. You could have perfect power coming into the building and still have a wide range of surges affecting your sensitive electronics. The surges originate from many sources within a laboratory:

- Laboratory mixers
- Refrigerators
- Heaters and hot plates
- Power tools
- Fume hood motors
- Light switches

Basically any piece of lab equipment can cause a surge. If your equipment is on the same branch circuit as these surge sources, then you will need protection.

What are surges?

Normal power in a building (120 VAC) in North America is delivered via a hot leg and a neutral return leg. The power line is grounded at the entrance of a building, serving as the zero reference point and providing a safe alternate path for electricity. Without a protective device, the surge travels over the hot lead into your equipment and back through the neutral. During normal operation, no current goes to the ground line. Data communication also uses the ground line as the reference point for communication. Electric power is cycled at 60 hertz, so the power wave period is 1/60 of a second. A surge occurs when the voltage rises for less than 1 percent of the power wave period. Therefore, surges last on the order of 50 µs.

The IEEE describes the most destructive surge a unipolar combination pulse containing 6,000 volts and 3,000 amps for 20 µs. On average, 100 of these surges could affect your equipment each year. This equates to about 4.5 million watts, for a 20 µs surge duration!

Surges are high-frequency random noise on a power line. They have a waveform that is described by a rise in voltage but also, as important, as a rise in current. It is important to stick with UL terminology when comparing protective devices.

How surges affect equipment?

Your computer and laboratory test equipment have semiconductor components such as diodes and transistors that are rated for various voltage/current combinations, but most need to operate below 330 volts. Above 330 volts, pinholes and melt spots occur within the component, which over time leads to failure. This process is analogous to an erosion process that is caused by a small but potent force over time. Again, because a surge is both a rise in voltage and a rise in current, it is important to protect your equipment from both the sudden change in voltage (dV/dt) and current (di/dt).

▲ *This fire started with the MOV-based surge suppressor. Fires such as this prompted a 15 million-unit recall in the fall of 2013.*

The flood analogy

Think of surges as an oncoming flood in a river. Flood warnings are based on the height of the oncoming water. One may say that when the river is 20 feet deep, the river is considered at "flood stage." But what would you say if the river is 20 feet 3 inches deep. Is it dangerous? That depends on the speed of the water flowing. If the water is flowing very slowly, one can swim through it. If the water is rushing at you, it can knock you over and carry you away. Therefore when characterizing the danger of a flood, one should measure the height of the water as well as the speed of the flowing water. The same holds for electrical surges. Just acting on a voltage rise alone may not be enough. The inrush of current is just as damaging to electronic components. There are two main methods of protecting equipment from surges—parallel shunting using metal oxide varistors (MOVs) and series mode filtering.

Typical metal oxide varistor technology

The MOV is a component that diverts current after a trigger voltage is reached. Most surge suppressors on the market use this component as the heart of their surge protection. It sits in parallel with your power line waiting for the voltage to rise. When the voltage level is reached, the MOV diverts the surge energy to ground.

According to UL1449 3rd edition, there are only two properties that define suppressors—the voltage protection rating (VPR) and the maximum continuous operating voltage (MCOV). The VPR is the voltage range above which the surges are diverted. Typical MOVs are

"A surge occurs when the voltage rises for less than 1 percent of the power wave period."

rated for VPR in ranges from 330 volts to 1000 volts. The MCOV is the maximum voltage environment in which the MOV can be used safely. If you look at the MCOV ratings for MOVs, you will see that they fall in two general ranges—127 volts and 175 volts. Plug in type suppressors will typically have a VPR of 330 volt (ideal) but will have a 127 volt MCOV (not ideal—too close to line voltage). Suppressors installed at the service panel will generally have a safer MCOV (175 volts) but a much higher VPR of 600 to 1,000 volts (also not ideal—damaging to sensitive electronics).

If you look at the specifications of an MOV-based protector, you will see terms such as "joule rating," "clamp level," "max surge amp," "voltage level," "response time," and many more. By far, the "joule rating" is the most quoted and misunderstood specification. The "joule rating" is based on the amount of surge energy an MOV can withstand one time.

The joule rating drops as the MOV receives subsequent surges. Because the worst-case surges can happen 100 times each year, a yearly replacement schedule is required in order to ensure that the suppressor is still protecting your equipment. An MOV will fail either by dropping out of the circuit (leaving you unprotected) or by overheating. Last fall 15 million MOV suppressors were recalled because of fires caused by overheated suppressors.

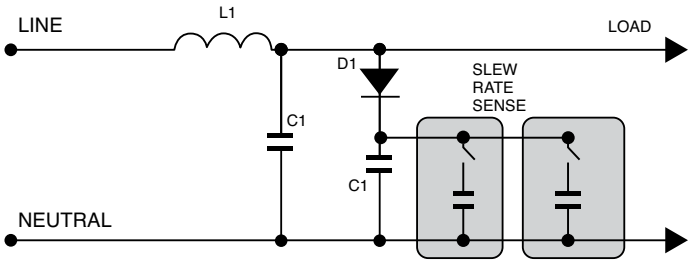
Some companies advocate using a "cascading approach," where two different devices are used—one at the service entrance and one at the point of use. But the service entrance MOV will let high voltages through that will degrade the device at the point of use. Other companies use additional components designed to protect the MOV, not your equipment.

Finally, as stated before, the MOVs divert the surge energy to the ground line. The safety of the ground line is compromised as well as the data communications lines. Some companies offer data line surge suppression through a separate device because they know the MOV sends surges to the ground line. They are protecting you from their other products!

Series mode filter technology (real-time suppression)

Another approach is to first consider what a surge really is—a high-frequency noise comprising a rise in voltage and a rise in current that occurs over a period of time. Surges are an unwanted component of the electricity you do want to reach your equipment. Instead of diverting the surge energy, let us consider a method that filters the unwanted surge.

Filtering the surge requires a device that is placed in series with the electric power. Because the filter has to be good enough to limit the voltage rise as well as the inrush of current, there have to be several stages of filtration. The first stage is an inductor coil. A properly designed inductor can choke the higher-frequency noise (i.e., the surge), letting the lower-frequency AC power wave pass through. The second stage is a series of components (mostly capacitors) to keep the voltage to a desired level. By combining these two stages, one could effectively stop the voltage rise and the inrush of current. The surge energy ends up being converted to useful energy and some negligible heat.



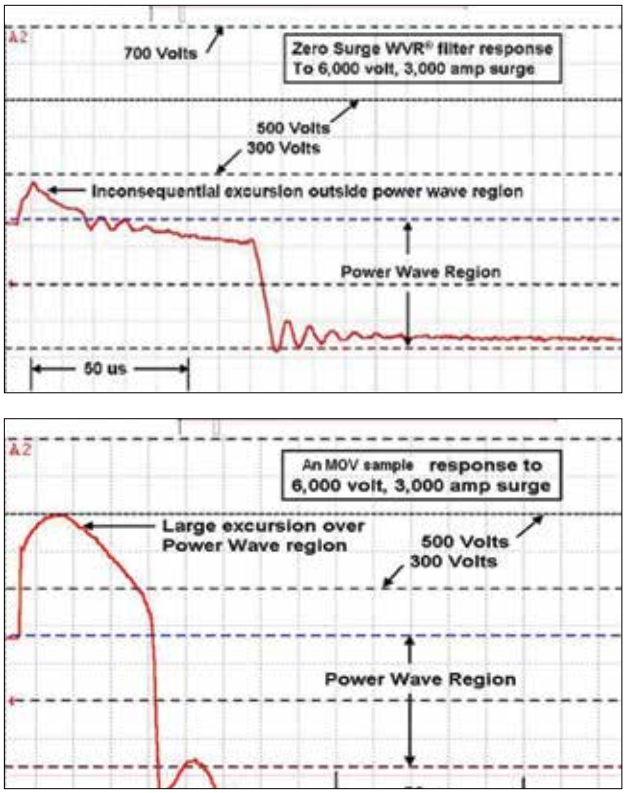
▲ *Simplified schematic of a series mode filter. There are no sacrificial components, so the filter does not wear down with use, and it repeatedly eliminates surges.*

Learning from our MOV discussion, we ask about the MCOV and VPR for series mode filters. Do they have the same issues? The answer is no! The VPR for a series mode filter is tested to the lowest 330-volt rating but also has a high MCOV at 175 volts. A series mode filter does not have a joule rating because it does not have a sacrificial component as an MOV does. In fact, a properly designed series mode filter can withstand 1,000 of the worst-case surges (6,000 volts / 3,000 amps) applied in 30-second pulses.

There are many advantages to using this approach. A series mode filter responds in a real-time, continuous manner, so there is no delay in response. A series mode filter can more effectively suppress the rise in current, which is the more critical part of surge suppression. It is possible to achieve a 25+ year life with a series mode filter. No surge energy is sent to the ground line. Another benefit is that EMI interference is also filtered from the power line.

What is the total cost of surge suppression?

The simple answer is that an MOV product can cost anywhere from $15 to over $200, depending on the accessories and number of outlets. A series mode product generally costs between $140 and $200 for a plug-in model. When one sees surge suppressors for as low as $15 at a big-box retail store, why spend the significantly higher price for a series mode filter? Also, many MOV surge suppressor companies claim long warranties and thousands of dollars in insurance. First, if you read the fine print of an MOV warranty, you will usually find that it is almost impossible to claim the insurance. The terms



▲ *Two oscillographs of surge suppressors reacting to an incoming surge of 6000 volts and 3000 amps. Note the total time outside the power wave is high for the MOV.*

and conditions and stipulations usually do not cover the normal mode of failure. They also remind you that the MOV suppressors last only a year or less, so they have to be replaced at least once a year. Because MOVs divert surge onto the ground line, you can expect connected equipment to fail earlier than normal. And finally, do you want to worry about unplugging all the surge suppressors in your building every night? Paying a low price for a product with a high voltage let-through and a low operating voltage rating is not cost-effective or safe.

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Ike Harper

ASK THE EXPERT

CHOOSING THE RIGHT OPTION FOR LABORATORY SERVICES

by Tanuja Koppal, PhD

Ike Harper, director for laboratory innovation at Johnson & Johnson, talks to contributing editor Tanuja Koppal, PhD, about the advantages of consolidating lab services with one provider. He explains in great detail the steps taken at J&J to ensure that the right process and vendor were put in place in order to give the program the time and opportunity it needed to succeed. He emphasizes the need for external validation as well as internal communication and collaboration to get the necessary buy-in and support from the key people involved.

Q: When and how did you go about consolidating your lab services at J&J?

A: I lead the newly formed Laboratory Services Center of Excellence at J&J's corporate headquarters. At J&J we have been looking to consolidate lab services for the past five years. J&J has three business sectors—pharmaceutical, consumer, and medical device and diagnostics. Each of our sectors has independent lab services, but the programs that we had in place never really tied together. We have a very diverse culture, one that focuses on decentralization. So how do you put a consolidated services program into a decentralized organization? For that we had to look at the organization as a whole to put the right program in place that worked enterprise-wide, while still being able to focus on local needs and customization. We now have a program in place that has been able to deliver a custom solution that provides significant value on the enterprise level.

Q: Can you explain how the consolidation took place and the steps that led to it?

A: It started as an idea to save time for scientists by bringing in outside services that have proven expertise in this area. It started as small pockets of activity across sectors, and then we realized that they were not aligned with each other. A few years ago, we started to redefine all our programs, particularly our lab instrumentation services program, since it offered the most benefit and required the most attention. We started to collaborate with the scientists from the quality manufacturing side and the R&D side across all three sectors and asked them what they felt were the key deliverables for a lab instrumentation service. We captured their thoughts, put together a model to deliver the desired service, and then went back to the scientists to validate the model. Next, we went to our finance and procurement partners to help us define some of the business details and to help us identify the right global supplier to put in place a program called "Enterprise Laboratory Instrumentation Services," or ELIS. We always emphasize the enterprise aspect, since it is something that stretches across all our sectors and our businesses globally but still [is] very flexible at the local level.

We defined what the ELIS program looked like with three pillars of support: the first pillar is the administrative function that mans the help desk, helps with paperwork, and enters information into the various databases; next we have a high-level engineer who is certified to repair certain equipment that we have in-house; and the third pillar is a technician who can service the basic, low-level equipment. This helps in the distribution of work so that the administrative staff can focus on their job functions while the service engineer and technician can handle their responsibilities based on the level of complexity. We went to our teams in finance and procurement to work out some details to identify the right supplier. Once we got acceptance from the organization through collaboration and careful consideration, then we were able to visualize and verbalize the program to bring in the right supplier.

Q: What did the supplier evaluation process look like?

A: We defined our request for proposals (RFP) based on the fact that we needed a global supplier. We had five different sections in our RFP, for quality, organization, finance, process, and innovation. We brought together a group of about 35 representatives from quality, R&D, finance, and procurement, from all our business sectors, to review the RFP and the bids that were submitted. We used scorecards for each section of the bid, and we split the team up into five groups, each focusing on a particular section. These groups then ranked that particular section in each of the bids, and that's how we evaluated the bids against each other. We also tested each of the suppliers through

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Ike Harper is the director for laboratory innovation in Johnson & Johnson's Worldwide Engineering & Technical Operations. He has bachelor's degrees in chemistry and business administration and a master's degree in finance and high technology. Ike has 21 years of experience in the areas of pharmaceuticals, consumer products, medical devices, and combination products. In his current role, he leads the global programs for laboratory services, such as lab instrumentation, lab supplies, lab scientific support, and asset redeployment. Ike has a unique perspective on laboratory operations, having spent time in various roles, including research & development, operations, and quality/regulatory affairs. Ike has also been a leader in several national and international standard-setting organizations for a wide range of requirements and many types of health care products.

a series of interviews with the team. Once we had identified the top three or four suppliers, we brought them in for more meetings just so that they truly understood what they were delivering to us. We also looked at where their service engineers were located globally. We asked for a map of how many engineers they had in the field globally and where they were located. We concluded with one more in-depth comparison of all the suppliers who bid, who was really the key to delivering good service, and we made our decision.

We now have two global suppliers—one for lab supplies and scientific services and one for lab equipment services—who work closely together. We have very detailed master service agreements, statements of work, and quality agreements with these suppliers. So from a global perspective we have covered what is expected to be delivered and how it is expected to be delivered. If a site wants to enhance the agreements at the local level, it has a site-level agreement to do that.

Q: How long did this whole process take, from defining what you wanted to getting all the services consolidated with one supplier?

A: That whole process took about 10 months. It was a very deliberate process that coincided with a contract-renewal process for some contracts that were ending. Although the needs of the three sectors were different, the basic service platform is consistent. We now have a provider that can manage all the service contracts, the preventive maintenance (PM), and the instrument calibrations and repairs for us. This takes a significant load off the scientists and the procurement teams, and we can consolidate all our service contracts through one supplier. This supplier will look at all the hundreds of contracts we have, with all different vendors, and get us better terms for those contracts. This is one way that the program brings value to us. There are also cost and the time savings gained by allowing researchers to focus on the science that supports our businesses and [spend] less time on support functions to repair or troubleshoot various instruments. The majority of the non-value-added activities are managed by experienced suppliers with expertise in their respective areas: equipment PM, calibration, vendor management, ordering supplies and managing inventory, chemical management, etc. This demonstrates the value of the program.

Q: So how did you determine return on investment?

A: We determine return on investment by building the business case in collaboration with finance. One of the most difficult things to do is to get a baseline measure of how things would perform with and without this program in place. In doing this, we had to determine the costs of the current state, which can be hard to uncover, as details are sometimes buried in the budgets. We looked at all the costs and the time put in by the scientists on non-value-added work. We worked with the supplier to get a before-and-after picture to see what we will be spending and saving in terms of time and costs. Cost savings can be achieved in many ways, such as consolidating the number of contracts with one vendor, reducing the options on supplies ordered, and getting volume discounts. The other value of the program is in harmonization and standardization. For instance, calibrations can be performed using a standardized approach across all sites with the same basic protocol; services can be provided consistently across all our sites, and we don't have to make significant time or capital investments to do that. The supplier provides a means of delivering the standardized processes we develop to the entire organization.

Our supplier also has a global inventory management system, so we now have global visibility of our lab instrumentation, which adds benefits in many ways, such as a scientist who can now search for a specific instrument and find the owner to collaborate on testing samples or troubleshooting a problem. These types of added benefits bring us together as an enterprise. We are expanding this

database to include many things, such as instrument PM that further enhances our abilities as an organization to better plan for future events, such as capital and resource investments. We also have reporting on standard performance measures across all our sites. We also leverage our suppliers' experience and expertise in the industry to standardize, leverage knowledge, and improve our operations around the globe.

Q: What are some of the challenges that you have encountered?

A: So far things have gone pretty well. Finding the right resources has sometimes been a challenge. When we implement the program at a site, we have to make sure we have the right people in place for that site, and sometimes that can take a little longer than expected, depending on where that site is located. At some sites, there is a lot of competition in the area, and we may lose some good people now and then. The challenge has really been finding the right people and retaining them. Once we get the right people in place, the programs have run very well. As far as the processes go, we have defined them very well, so we know what to do when we get there. We have created a playbook for implementing the programs, which describes project management, communication, building support, and more. When we go to a site, the project manager there knows how to set up a steering committee and how to get internal buy-in from the scientists and the executive team. We have town hall meetings to inform the scientists about the changes that are coming, so they feel comfortable with the program before, during, and after implementation. We also encourage them to participate in the program and provide feedback to help define how it's going to work at that site. So we don't go in thinking it's going to work one way and the scientists think it's another.

Q: When you selected a vendor, did you set up a trial period to see how things would work?

A: We did external benchmarking as a part of our supplier evaluation process. We went to companies where these programs were in place and talked to the leaders and scientists there. We tried to do as much due diligence as we could when evaluating the suppliers. When we brought the supplier in, we didn't waste any time implementing the program immediately. So far everything has been going pretty well. My one regret is that we did not start with a longer-term contract. We did include a clause to end the agreement if something does go wrong.

Q: What would your advice be to lab managers with smaller labs and budgets? Is consolidation a worthwhile option for them?

A: I think it's worth looking into the option of consolidating services with one vendor. If these labs try to manage it all internally, they are going to be paying a resource to do that anyway. If they pay a temporary resource, there is always a possibility that it will leave at some point. If you work with a supplier, then it becomes the supplier's responsibility to maintain and train that person to handle the equipment specific to that lab. You also get the expertise and the investment that the supplier puts into this multi-vendor service management. You can access the comprehensive database that the supplier owns. Sometimes our internal databases don't talk to each other, but with the supplier's database we can analyze our inventory and track assets across the enterprise. Also, rather than managing all the individual vendors, the supplier will manage them for you. When a new vendor comes in, the supplier will make sure that vendor has the right credentials and certifications before performing the work. With regard to managing sites remotely, the supplier manages the people on-site, and we have a list of contacts for escalating issues if they come up. These services are affordable, and they are good at what they do and really help alleviate the pressure on the scientists.

Before putting any program in place, my advice is to collaborate with scientists and external companies to talk about what works and what doesn't. You also need to build executive support, which requires understanding of what is important to the business and being able to convey the value to the business. With acceptance from the bench level and the executive level, you can organize your program such that it's transparent and people can see the value that it is bringing. In addition, the program needs time and effort to work. You need at least six months for people to get used to the process, for new people to settle in, and for getting a lot of feedback. I would recommend frequent meetings in the first six months and then determine if the frequency can be scaled back over time. But initially you need to focus a lot of attention to make sure the program gets off the ground successfully.

WATCH YOUR STEP!

STAY AWARE OF YOUR SURROUNDINGS TO AVOID PHYSICAL HAZARDS

by Vince McLeod

Research facilities, especially laboratories, are challenging places to work safely. This month, the Safety Guys alert you to potentially significant physical hazards present in the workplace. What do we mean when we say "physical hazards?" Commonly, they include conditions and situations that might lead to slips, trips and falls. But if you are handling animals, they also cover the potential for bites, scratches and contact injuries. However, in addition to these common issues we want you to start thinking about the not-so-obvious hazards such as electrical safety hazards and high noise areas.

Let's start with the easy stuff

Many injuries arise from poor housekeeping. Slips, trips, and falls are too common and easily avoided. Begin with organizing the storage areas, and avoid creating hazards with your material storage. Stack and interlock bags, containers and boxes that are stored in tiers; limit the height so that the tiers are stable, and secure against tipping, sliding or collapse. Minimize chaotic accumulation of materials that could cause tripping, hinder access, or present a fire risk.

Next, perform a general facility inspection, concentrating on walking/working surfaces, lighting and egress pathways. It is imperative that emergency exit routes remain clear and unobstructed at all times. Make sure floors are smooth and free of cracks or lips that could catch or trip. Inspect storage racks, hand trucks, and other equipment to ensure good mechanical condition. Pay special attention to the casters. Note the lighting conditions, and measure illumination in those areas that seem dim. Compare results with those recommended by IES and ANSI.[1] Ensure that all lights within seven feet of the floor are protected against accidental breakage. Slip plastic protective tubes over florescent bulbs prior to mounting, or install screens onto the fixtures. Finally, note areas of special lighting requirements, and train employees to allow for eye adjustment before working in those areas.

"It is imperative that emergency exit routes remain clear and unobstructed at all times."

You might be in for a shock

While performing your facility inspection, keep an eye out for electrical hazards. Frequently found problems include improper use of extension cords or cords with cut, torn or frayed insulation, exposed wiring, missing grounding plugs, open electrical panels and overloaded circuits. Less obvious hazards are present on electrophoresis equipment, biosafety cabinets and wet vacuum systems. Pay very close attention to wet areas: Equip all electrical power outlets in wet locations with ground fault circuit interrupters (GFCIs) to prevent accidental electrocutions. GFCIs are designed to "trip" and break the circuit when a small amount of current begins flowing to ground. Wet locations include outlets within six feet of a sink, faucet or other water source, and outlets located outdoors or in areas that get washed down routinely. Specific GFCI outlets can be used individually, or GFCI may be installed in the electrical panel to protect entire circuits.

Improper use of flexible extension cords is one of the most common electrical hazards. Extension cords should never substitute for permanent wiring. Check the insulation

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SAFETY TIP

DO NOT ALLOW FOOD TO BE STORED IN CHEMICAL REFRIGERATORS

By James. A. Kaufman

Prohibiting the storage of food in chemical refrigerators is another one of the basic rules of good practice. It is intended to prevent the ingestion of toxic or infectious materials. The food will absorb the vapors from the chemicals in the refrigerator and then they'll be consumed.

Post a clear warning sign on any chemical refrigerator: "Chemicals Only; Do Not Store Your Food Here."

Assign one person the responsibility for each refrigerator. They can check it periodically to be sure there's no food and no unlabeled containers. They can also see that the inventory list is up to date, the refrigerator is functioning properly and does not need to be defrosted.

A related problem is caused by carrying a pack of cigarettes in your pocket while working in laboratories. The tobacco adsorbs chemicals from the air (like a dosimeter). Then when you go outside to "clean air," the adsorbed chemicals are burned and inhaled. Illnesses have been traced to the inhalation of these chemical combustion products.

The storage of food and beverages where they may be exposed to hazardous substances is specifically prohibited in the OSHA sanitation standard, 29CFR1910.141(g)2/4.

Source: Kaufman, James A., Laboratory Safety Guidelines - Expanded Edition, The Laboratory Safety Institute, www.labsafetyinstitute.org.

and make sure it is in good condition and that it inserts into the plug ends. Never repair cracks, breaks, cuts, or tears with tape. Either discard the extension cord or shorten it by installing a new plug end. Take care not to run extension cords through doors or windows, where they can be pinched or cut. Use only grounded equipment and tools, and never remove the grounding pin from the plug end. Do not hook multiple extension cords together to reach your work; just get the right length cord for the job.

Another thing to check is the electrical panel. Ensure a three-foot clear space is kept in front of these at all times. Also, clearly label each circuit breaker. Finally, use of hanging lights or electrical outlets is becoming widespread and can help keep cords off floors and out of the way. Check electrical pendants for proper strain relief, type of box and guarding, if needed. In a recently visited facility there was an accident from an unguarded hanging outlet shorting out when it was "caught" by a forklift passing under it. Fortunately, the forklift driver was not electrocuted.

Can you hear me now?

Many areas within research facilities are inherently noisy. Excessive noise can result from the equipment in use, such as sonicators, high-pressure air cleaning equipment and wet vacuum systems. Exposure to loud noise can result in loss of hearing. Noise-induced hearing loss is permanent and cannot be treated medically. This type of hearing loss is usually noticed by a reduced response to frequencies above 2,000 hertz (Hz). Since normal human speech is in the 2,000Hz to 4,000Hz range, noise-induced hearing loss is debilitating at work and in daily life.

OSHA limits employee noise exposure to 90 decibels (dB) averaged over an eight-hour work shift measured on the A-scale and slow response with a standard sound level meter.[2] If noise levels exceed 85dB, then the employer must implement a hearing conservation program (HCP) for exposed employees. The American Conference of Governmental Industrial Hygienists

recommends a more conservative threshold of 85dB as an eight-hour time-weighted average.[3] Monitoring, annual audiometric testing, hearing protection, training and record keeping are required under the HCP.

A quick and useful method of checking areas for excessive noise is the "conversation test." Standing one to three feet from another person, attempt a normal conversation in the noisy area. If conversation is difficult or impossible, then the noise might be excessive. Have the areas evaluated by a qualified person knowledgeable in occupational noise, measuring techniques, data analysis, and control alternatives.

Control of excessive noise falls into three categories: engineering controls, administrative controls and personal protective equipment. Under the OSHA standard, engineering controls are used first to control the hazard. This can include purchase of newer, quieter equipment, shielding or installation of acoustical sound-deadening treatments on walls and ceilings. Administrative controls entail limiting the time an employee spends in the noise hazard area or assigning more than one employee to split the time needed to complete the task. The last line of defense for preventing excessive noise exposure is personal protective equipment such as earplugs or ear muffs.

We're just getting warmed up

In this issue, we have touched on a few physical hazards that you can look into and make an immediate impact on your facility's safety. In coming issues we will delve into additional ones, such as mechanical equipment hazards and ergonomic hazards associated with material and equipment use, lifting, pushing and pulling. Until next issue remember – SAFETY FIRST!

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LIMS

CENTRAL DATA REPOSITORIES REINVENT THEMSELVES

by Angelo DePalma, PhD

Despite having been available for close to 30 years, laboratory information management systems (LIMS) are about to undergo a metamorphosis characterized by greater utility, accessibility, and availability—at lower cost.

The first LIMS implementations resided on mainframe computers at large companies, a situation that permeated the product platform for several decades, even after personal computers became ubiquitous.

"LIMS technology has lagged behind other software at several levels," says Aubree Hoover, senior product manager at GenoLogics Life Sciences Software (Victoria, BC,). GenoLogics specializes in LIMS for proteomics and genomics, particularly next-generation gene sequencing.

Overcoming deployment difficulties

LIMS's reputation for difficulty of use, high cost, a steep learning curve, and spotty accessibility is about to change, as GenoLogics and other firms are offering web-based LIMS and expanding accessibility to portable devices such as smartphones and tablets.

GenoLogics released a cloud-based product in 2013 and now supports tablets as well.

Which raises the question of accessibility versus feature set. "To some degree the software must be simplified for use on mobile devices," Hoover admits. Applications requiring significant keyboard input, for example, are inappropriate for tablets. GenoLogics has instead focused on a level of utility for which handhelds excel, such as sample tracking, and other uses that make sense for tablets.

Many LIMS vendors now provide some level of service "in the cloud"—known as "software as a service" (SaaS). The idea makes sense for many industries, particularly those that are highly science-based, such as GenoLogics' next-gen sequencing customer base. "Many start-up diagnostics companies have no interest in managing their IT in-house," Hoover tells *Lab Manager*. "They want a LIMS, they need one, but they don't want the overhead."

Luckily for them, their data is much more secure at a data center than on-site, and the service is less expensive than an in-house installation. Downtime is also significantly reduced, as the LIMS company does not need to travel to the customer for troubleshooting.

GenoLogics services its cloud customers through Amazon Web Services, whose commercial tagline, "Launch virtual machines and apps in minutes," illustrates another significant benefit for cloud-based LIMS customers: virtually no start-up time. "Deploying a LIMS used to be like starting a major construction project," Hoover says.

These benefits have contributed not only to lower prices for functionality equivalent to the most sophisticated systems of a few years ago but also to a "democratization" of LIMS.

One repository

That is not to say that high-end LIMS installed at the customer's brick-and-mortar facility are going away any time soon. Tom Dolan, chief operating officer at Ruro (Frederick, MD), notes that over the years many organizations have added layer upon layer of LIMS. One of Ruro's potential pharmaceutical customers already had seven separate LIMSs installed.

Having many LIMS or other systems can cause a data "silo" effect and it is a common issue, especially among larger institutions. "The idea that many LIMS are needed flies in the face of one of LIMS' most important purposes: to create a central, singular data repository for a lab organization's data," Dolan says.

Today's life sciences organizations, however, are beginning to recognize the benefits of collaboration across research, development, diagnostics, and patient care. "Creating a single log-in, integrating as much data as possible with the same accuracy checks on all data, and having standardized nomenclature, facilitates collaboration," Dolan adds. "You can't merge seven tasks into one when the LIMS can't see five or six of those tasks."

The importance of "one LIMS, one log-in, one organization" to highly integrated teams is exemplified by some hospitals and programs that conduct translational medicine. These collaborative organizations house diagnostics labs, clinicians, patient records, and laboratories that conduct basic research. Making sense of projects that flow from the research bench to the bedside is impossible with any number of separate LIMS, but is enabled by one over-arching, all-encompassing solution. "The advantage that translational science institutions have is that, from an early stage, many realized that they would need this level of data unity," Dolan says..

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FUME HOODS

AERODYNAMICS AND ACCESSORIES ADD EFFICIENCY, SAFETY, AND EASE OF USE

by Mike May, PhD

I've worked in hoods where a little piece of tissue paper attached to the bottom of the sash served as an indicator that it was exhausting the air. Somehow, that sounds like a prehistoric lab by today's standards. Granted, it was a while ago, but I wasn't using a dinosaur-era device.

Moving far beyond tissue flags, modern fume hoods can be ducted, ductless, or filtered. Ductless hoods, invented by Erlab (Rowley, MA) in the late 1960s, use an application-specific molecular carbon filter. Filtered fume hoods, also invented by Erlab, are modern research-grade ductless hoods and use one universal filter that adsorbs acids, bases, and solvents simultaneously. Although AirClean Systems (Raleigh, NC) makes various types, Brandon Howell, vice president and technical director, says, "There's a continued trend to more acceptance of ductless hoods in the marketplace—from labs and industry to education and forensics."

Using a ductless hood requires an application review to make sure that it's a safe option. Howell says, "Almost any chemical is suitable for a ductless hood, but you need to know the volume, evaporation rates, and so on for the particular application." He adds, "In the rare instances when an application is deemed unsuitable for a ductless solution, a ducted hood would be recommended."

User safety is guaranteed by the manufacturer providing a chemical listing that shows the retention capacity of their filter for each chemical, by the approval of an application-specific chemical evaluation, and by the support of a safety specialist to monitor filter lifetime or changes to the application. Filtered fume hoods have more advanced sensing, a secondary "safety filter," and these hoods handle a much broader range of applications so that the filter type does not require changing when there is a modification in work practices.

Howell says that some lab architects now include ductless hoods from the beginning. Some teaching labs already do that, but "the instructors know exactly what they'll teach, and it's very repeatable," says Kenneth Crooks, director of North American sales for GreenFumeHood Technology from Erlab. "So they are more comfortable taking the leap into filtered fume hoods instead of ducted, and they are not working with a large quantity of really dangerous chemicals."

Fine-tuning features

In some cases, the desirable features in a fume hood might not seem as obvious. As an example, Crooks says, "Instructors want to be able to see from anyplace in the lab to all students." That can require hoods with windows so the instructor can see down a long line of students at work.

"There's a continued trend to more acceptance of ductless hoods in the marketplace—from labs and industry to education and forensics."

At Butler University in Indianapolis, Indiana, professor of chemistry Stacy O'Reilly knows those special teaching needs. She says that her department's hoods are used primarily in organic chemistry teaching labs, where each semester about 250 students—typically sophomores majoring in biology, chemistry, or pharmacy, plus those training to be physician assistants—put those hoods to work for more than 20 hours a week. When asked what features matter most in her hoods, O'Reilly points out efficiency and ease of use for beginning lab students. She adds, "The hoods need to pull well enough to ensure containment of volatile organic compounds, and they need to be quiet so you can talk in a room with 12 of them going at the same time."

O'Reilly uses Erlab's filtered hoods, which she says don't require much work. "The sensors on the hoods have to be replaced every two years," she says. "Other than that, the hoods take very little day-to-day maintenance."

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> "With a relatively small hood, [energy] savings could pay for the hood in less than two years."

A new hood can also provide updated features, like sashes controlled with sensors, which can be added on later or ordered with a new hood. "You can program the sash to go up when you step up to the hood," says Beth Mettlach, sales engineer at Labconco (Kansas City, MO). It will automatically go down based on a programmed time after you step away. "This automatic opening and closing can be really handy when you are carrying something heavy or bulky," says Mettlach. A hood can also reduce its air supply when closed, and that improves efficiency, which you will see is a key trend.

Traditionally, fume hoods consisted of metal like stainless steel. Some researchers still want that, but other options exist. For example, AirClean makes its fume hoods from polypropylene.

Improving the ROI

To get more of a return from a fume hood, energy often comes up as a fundamental concern. In general, today's ducted hoods are more efficient, and they reduce the overall turnover of conditioned air. Even more energy can be saved in heating and air conditioning with a ductless hood.

Some situations work with a mix—going with ducted hoods where applications create a high volume of fumes or unknown compounds, and using ductless ones in other places. "You can mix and match to keep costs down," says Howell. Overall, deploying such a mix and using modern fume hoods can provide the airflow velocities that your safety officer requires, while using less air.

The key to building improved fume hoods depends on aerodynamics. "The design engineers take into account the properties of the air when it hits the sash handle at working height or hits the sides of the fume hood," Mettlach explains. "They also try to limit turbulence to make sure that the air passes directly through the baffle."

Any vendor can perform an analysis to see how long it would take to get back the cost of a new hood based on energy savings. "The energy savings from going to a new, ducted hood can be around $4,000 a year if you currently have a constant-volume hood running all the time," says Mettlach. "With a relatively small hood, that savings could pay for the hood in less than two years."

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CHROMATOGRAPHY DATA SYSTEMS

ONE PIECE OF SOFTWARE CAN MANAGE MANY INSTRUMENTS AND LARGE DATA STREAMS

by Mike May, PhD

Many labs use chromatography-based devices. Plus, different labs face different needs in handling chromatography data. Nearly any situation, though, benefits from a chromatography data system (CDS). Many applications require extreme ease of use. "In many labs, someone must set up the method behind the scenes, but the daily operation must be as simple as possible," says Terry Sheehan, director of gas chromatography and mass spectrometry marketing at Agilent (Santa Clara, CA).

In some situations, users have very specific data needs. "Somebody in the military or an emergency responder might use a chromatograph or mass spectrometer to analyze an explosive sample," says Sheehan, "and they just want the results in fundamental parameters."

For scientists developing methods for a specific application, though, a CDS needs more flexibility and accessibility. "Then you need a certain level of complexity," Sheehan says. "People doing R&D, trying to do something novel, need a lot of additional tools."

Drive for diversity

In addition to diverse applications, some users want diverse capabilities from a single CDS. As an example, Jade Byrd, Empower product manager at Waters (Milford, MA) says, "Customers ask us to control more technology in our CDS—multiple types of separation technologies and detection modes." She adds, "We work with business partners to offer solutions to support even other vendors' hardware."

Beyond just collecting data and helping users analyze it, a CDS can do even more. Byrd says, "Customers have asked that we incorporate tools in our CDS to understand where the bottlenecks are in a lab: for example, a dashboard showing system uptime."

To make a system even more diverse, Byrd suggests one that provides a remote client server environment. "The alternative is a computer next to every piece of lab equipment, which is a waste of bench space and then only one person at a time can interact with the data," she says.

A modern CDS can handle large amounts of data. In addition, most any CDS today lets a researcher look at more data simultaneously. "That provides more efficient processing," says Sheehan. Despite the growth in CDS power, they keep getting easier to use. "Someone can work with a CDS as easily as with an iPhone," says Sheehan.

Finding your features

At Parallel Dimension Consulting in San Francisco, California, research scientist and founder Daniel Prudhomme has used a CDS for R&D and for clinical and commercial work in the drug industry. "For R&D work," he says, "many experiments are performed and data grow quickly. A well-organized, searchable database will help to keep things from getting out of hand." He adds, "For the drug-supply support, it's critical that the CDS have password protection for each operator, full audit trails for all work conducted, and permanent lockdown on the data generated."

For someone in the market for a CDS, Prudhomme suggests several approaches. "For the R&D testing, a flexible system is important. Not all functions are needed by all operators," he says. "Also the interface for instrument control is something to consider. How easily can users access their systems from various locations, such as the lab or the office?" For the drug-supply side, he points to other considerations, saying, "The ability to capture all of the critical QC testing operations in an electronic format is a major benefit."

The right CDS balances many needs.

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PARTICLE SIZING AND CHARACTERIZATION

DIVERSE, COMPLIMENTARY TECHNOLOGIES

by Angelo DePalma, PhD

Particle sizing methodologies range from straightforward sieving and sedimentation analysis to advanced laser-based light-scattering techniques, microscopy/imaging, nanoparticle tracking analysis, and others.

Dozens of techniques have emerged for analyzing particles. A particle sizing lab may use optical microscopy, scanning electron microscopy, diffraction, dynamic light scattering, and particle counting. "It depends on what you're trying to accomplish and the materials you're analyzing," says Philip Plantz, PhD, who manages advanced applications at Microtrac (Largo, FL). "Each technique provides a piece of information to enable characterization."

Particle sizing is critical for almost every manufacturing segment. But growth in such key industries as biotechnology, pharmaceuticals, nanotechnology, and energy exploration will propel the global market for particle size analyzers by an annual growth rate of 4.9 percent, according to a report, *Particle Size Analysis Market by Technology, Industry & End User—Global Forecasts to 2018*, sold by report aggregator RnR Market Research (Dallas, TX). Growing demand for particle-sizing instruments will be most robust in the Asia-Pacific region, where growth will approach 6 percent per year due to increases in the outsourcing of pharmaceutical manufacturing and R&D to China and India.

Overall, the report estimates 2018 instrumentation sales at $290 million. North America holds 33 percent of the global market, with Europe right behind at 32 percent. Top instrumentation players are Malvern Instruments, Horiba, Beckman Coulter, and Microtrac.

Dynamic imaging analysis

Several companies advertise particle characterization based on dynamic imaging particle analysis (DIPA), for example Microtrac, Micromeritics, Horiba, Retsch, and Fluid Imaging Technologies. Microtrac's system uses sieve analysis and a strobe LED light source to illuminate particles, while Horiba and Micromeritics collect images of silhouettes produced by particles flowing in a stream.

Fluid Imaging (Scarborough, ME) is unique in its reliance on light microscopy and fast imaging methods, which in addition to accurate sizing acquires data on more than 30 additional parameters. Lew Brown, Fluid Imaging technical director, has written extensively on DIPA as it applies to the characterization of materials, biologics, minerals, powders, and other substances in the size domain with a lower limit of approximately one micrometer.

Static microscope-based imaging is a labor-intensive technique that acquires one frame at a time. Today computers and lasers have automated sizing and allow collection of an unprecedented amount of information in a short time. "These tools take the burden off the user," says Plantz. But conventional microscopy is still slow.

Fluid Imaging's FlowCAM system images particles flowing past the microscope optics in real time. A high-speed flash "freezes" particles within the image field and is synchronized with the camera shutter.

Advanced laser-based methods such as Coulter counting and dynamic light scattering (DLS) are faster, but they provide little information other than nominal size or "equivalent spherical diameter." DLS analysis, for example, assumes that particles are perfectly spherical, which they most often are not, and cannot accurately characterize particles.

Another drawback of systems that provide simple size distributions is they cannot distinguish, at the high end of the distribution, very large particles from aggregates of two or more smaller particles.

By providing size, shape, and other properties, imaging-based microscope analysis resembles true particle characterization rather than simple sizing, "They're particle sizers, not analyzers," Brown observes. "By operating at thirty frames per second, microscope-based techniques can gather

enormous quantities of data very quickly. Plus, we have a real image of each particle, so we can do filtering and pattern recognition."

The main drawback of DIPA is that it doesn't work with particles smaller than one micrometer—not terribly small by today's standards for nanomaterials. This is a consequence of the diffraction limit of visible light.

It is possible to analyze images from electron and atomic force microscopy with DIPA software, but the drawback is throughput: It can take hours to acquire images of just a few particles with those techniques. "Users would not be able to characterize statistically relevant numbers of particles in a reasonable time frame," Brown explains.

Microscope-based DIPA shares one inherent limitation with laser-based methods, namely the orientation of particles as they travel through the imaging field. Depending on the speed of image (or signal) acquisition, a rod-like particle may appear as a large or a small circle, and flakes may appear as rods. By using a dimensionally constrained flow cell that provides particles with less freedom to rotate, this problem is mostly eliminated.

Single particle analysis

According to Kerry Hasapidis, president of Particle Sizing Systems (Port Richey, FL), the hottest trend in particle sizing today is the move toward single-particle analysis. "Labs are returning to single-particle methods, like microscopy, that incorporate some aspect of image analysis."

The scientific impetus behind the change is the real-world problem of particle outliers. Almost any laser-based technique gives mean particle size distributions, but critical quality attributes are rarely based on shifts in particle size amounting to plus or minus two to three microns. "The key is outliers—very fine particles that change viscosity, or very large particles," Hasapidis says. Large outliers clog pens and inkjet print heads, or in drugs may cause strokes by blocking blood vessels.

Single-particle techniques are particularly useful at very low concentrations, such as contamination measurements. "That's where you are looking for a needle in a haystack," explains Philip Plantz. "Its drawback is the lower measurement limit of about one micron. Diffraction methods get down to ten nanometers, and dynamic light scattering down to one nanometer."

Particle Sizing Systems has been riding the wave toward single-particle analysis, which combines the speed of laser-based particle characterization with the ability to characterize not averages, but actual particle-size distributions for samples consisting of hundreds of thousands of particles in minutes.

The basic technique grew from laser systems that counted contamination particles on the basis of how much light individual particles block, not on an aggregate measurement transformed into particle size distributions through mathematical manipulation.

"Think of a very fast microscope, but instead of having someone view, count, and measure particles, we use a detector based on the amount of light a particle obscures," Hasapidis says. "It combines the speed of a laser and the ability to discriminate a lot of particles in a short time."

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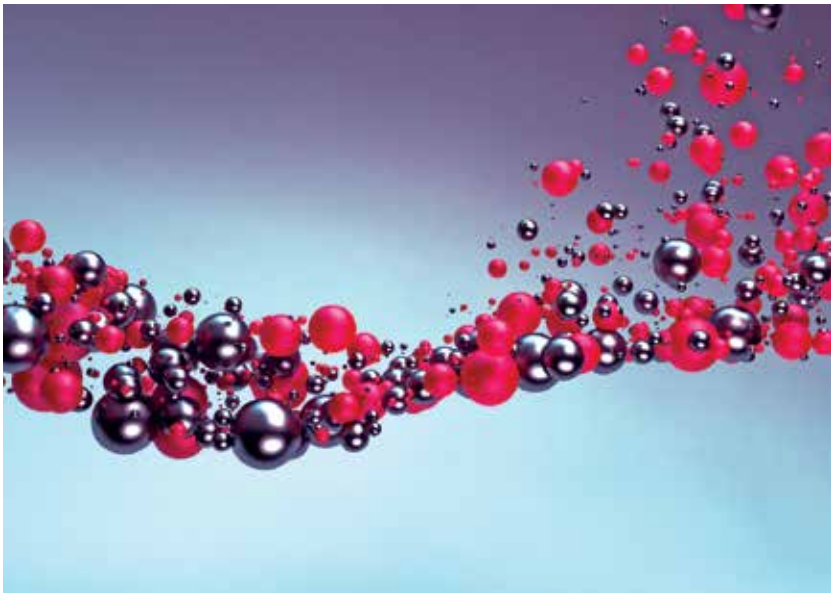

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HPLC SYSTEMS

HAPPY BIRTHDAY, UHPLC

by Angelo DePalma, PhD

This year marks the tenth anniversary of Waters' (Milford, MA) debut of the ACQUITY UPLC®, the trademarked original on which all modern UHPLC systems, to various degrees, are modeled. Early adoption of high-pressure systems and sub-two-micron columns was what one would expect from a "disruptive" analysis platform. Finding doubters was not too difficult, particularly among Waters' competitors. But eventually even the most vociferous critics joined the bandwagon with their own versions of high-pressure, low-particle-size stationary-phase liquid chromatography systems.

"We'd like to think that UPLC was one of the more innovative developments in laboratory analytics," says Bill Foley, senior director of separations product management for Waters. "The label disruptive was fairly accurate. UPLC changed how customers process samples; it improved productivity and provided more and better information about samples than conventional HPLC."

After more than ten years of continuous investment and improvement, UPLC and UHPLC have branched out to include supercritical fluid chromatography (e.g., Waters' UPC²® or convergence chromatography platform), polymer analysis and nanoscale and microscale LC analysis. Column chemistries suitable for ultra-high-pressure LC have broadened to include size exclusion and gel permeation. Detector options, including Waters' innovative ACQUITY QDa detector, have similarly multiplied.

"After more than ten years of continuous investment and improvement, UPLC and UHPLC have branched out."

Waters took significant risks in rolling out UPLC. "We placed a big bet on the technology," Foley says. "Its adoption in key industries strongly suggests that this is the current state-of-the-art, and the future, of liquid chromatography."

For Waters UPLC has grown into a family of products and a multiplicity of applications and settings. For example, the UPLC-based PATrol™ process analyzer duplicates in real time the capabilities of hours-long sampling and analysis of bioprocesses, to allow real-time decision-making during cell cultures.

Hardware and process choices

Many choices in LC, for example balancing column life against the time and costs of sample preparation, come down to economics. Estimating the costs of sample prep at 50 cents per sample, and of columns at $500, the break-even is at approximately 1,000 injections (preparation time not included). Trap columns shift the economics slightly in favor of trap and elute, as a trap column costs about $200. Clearly each lab must calculate relative economic benefits and costs for its own workflows, according to Phillip DeLand, global LC business manager at Bruker Daltonics (Freemont, CA).

For example, in environmental and food testing, which consist of "difficult" matrices, operators load the matrix onto a trap column, retain analytes of interest, wash away the background, and elute target analytes onto a separation column to reduce background and with it limits of MS detection.

One Bruker customer has been able to shoot human bodily fluids directly into the LC without sample prep or even a trap column. "You wouldn't even think of doing that several years ago," DeLand says. "But today, with the robustness of columns, you can perform that kind of analysis with no loss of resolution, even after one thousand injections."

SFC update

Despite years of experience from the vendor and user perspectives, no go-to column yet exists for SFC that approaches the utility of C18 columns in reverse-phase HPLC and UHPLC. "Even for chiral separations, there still isn't one SFC column users can rely on as a first choice. A lot of research has gone into finding one or two columns with comparable selectivity to C18," says D.J. Tognarelli, chromatography product specialist at JASCO (Easton, MD).

This drawback becomes even more acute as pharmaceutical industry chromatographers look to SFC for non-chiral separations to augment the technique's superiority for separating chiral compounds. "Achiral separations are where SFC is really trying to catch up with conventional LC," Tognarelli adds.

"A lot of research has gone into finding one or two columns with comparable selectivity to C18."

Since SFC most closely resembles normal phase separations, analysts usually begin their search for an appropriate separation medium with a silica column, but as Tognarelli notes, silica is nowhere nearly as selective, or as capable of modification to suit particular situations, as C18 is. It is therefore not unusual for analysts to have as many as six columns each for chiral and achiral SFC separations and to have to run through several to optimize their separations.

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EXPLORING AN UNSEEN WORLD

SENSE OF DISCOVERY AND THE ABILITY TO MELD INTERESTS WITH WORK ARE THE DRIVING FORCES IN THIS LAB

BY RACHEL MUENZ

Photos courtesy of Gregory Dick

All around us is an invisible world that, while most people don't often think about it, has big effects on our own. As principal investigator (PI) of the Michigan Geomicrobiology Lab in the University of Michigan's Department of Earth and Environmental Sciences, Gregory Dick and his staff get to explore that world each day, studying how microorganisms influence larger Earth processes.

"I'm just fascinated with the notion that tiny, unseen microorganisms can have a big effect on biological communities and on environmental and geological processes," said Dick about why he got into microbiology. "I'm not exactly sure when I first put my finger on that, but I've been interested in that for a long time."

He adds that when he first started doing research in microbiology as an undergrad 16 years ago, he was more interested in the role of microbes in disease but soon realized he was more interested in the microbes themselves than in the health and medical side of things. The aspect of life in extreme environments was also a big reason that Dick decided to pursue a career in microbiology.

"There's a wide range of different conditions that life on this planet can thrive under, and that also extends to our concepts of life potentially beyond Earth, so that is a field called astrobiology that also drew me into this science," he says.

Because the world of microorganisms is so diverse, there's a lot of variety in the research Dick's lab does, with their main projects focusing on microorganisms in deep-sea hydrothermal vent systems, cyanobacterial mats, and cyanobacteria responsible for harmful algal blooms, which is a major water quality issue in the Great Lakes.

"We study how microorganisms grow and reproduce based on chemosynthetic energy that's found at the deep-sea vents," Dick explains about the work his lab does deep in the ocean. "Another side of that is we're interested in how microorganisms influence the chemistry of deep-sea hydrothermal vent fluids and how those vents affect ocean chemistry."

▲ *Arti Tyagi at the biosafety cabinet.*

▲ *The Geomicrobiology Lab in the CC Little Building at the University of Michigan, Ann Arbor.*

Dick adds that his lab's research involving cyanobacterial mats gives the 1,400-square-foot lab a look into the past, since the mats "are living analogs of the types of microbial mats that covered Earth for large periods of its early history."

Like those main research projects, the backgrounds of the lab's 12 staff members are also varied.

"A lot of people are entering my lab with just their undergraduate degrees, and because my work is pretty interdisciplinary—we do microbiology but we also do oceanography and more environmental chemistry-type stuff—I take on students with various backgrounds, from biology to environmental science to even engineering," Dick explains.

Depending on the position, staff have anywhere from undergraduate degrees up to the PhD level in education. While staff fluctuates as students graduate, on average the lab has three PhD students, three postdoc students, three undergrads, and three regular staff members. The training that students and staff get when they start in the lab, most of which is taken care of by two full-time staff members, depends on their position and experience level.

"Some of the people in my lab do only computer work, so obviously the type of training they get is quite different than what someone who [does lab work] might get," Dick says. "We don't have a standardized training protocol or regimen—it's based on the employees and what they'll be working on, so it's customized."

Employees are kept busy with anywhere from a few dozen samples to a hundred each month—that number changes due to the variety of work in the lab, Dick says.

"We have a variety of different extents to which we characterize samples," he explains. "In some cases we're just quickly screening samples, and in other cases we might spend years on the same samples."

A day in the life and staying organized

Many of the students, postdocs, and other lab members spend most of their days working on computers in the lab. Dick explains that because most microorganisms in nature don't grow in culture, in order to study those organisms lab staff must extract DNA directly from natural samples—either from soils, lake water, or seawater. The lab then sequences DNA directly in those samples—a process called metagenomics that allows lab staff to understand those organisms through their DNA and RNA sequences without growing them in the lab.

"[Metagenomics] involves high-throughput, next-generation sequencing, really massive datasets that are complex and take a long time to analyze on the computer in terms of bioinformatics," Dick says. "A lot of my lab members spend a decent amount of time on the computer connecting these bioinformatics analyses."

However, that's not the only way staff spend their time.

"Other days, the whole day will consist of performing DNA extractions or extracting RNA and converting it to cDNA [complementary DNA]," Dick says. "Another day on the job may be spent out on a boat on the Great Lakes or on the ocean—so there's a variety of different ways we spend our days here."

With all that variability, weekly lab meetings are essential to keeping things organized and everyone updated on each other's work. In addition, Dick also holds weekly one-on-one meetings with staff members in order to keep track of progress, and the lab uses a Google calendar for scheduling and to inform staff of when Dick is in the office.

As PI, Dick is in charge of mentoring the students and postdocs as well as giving them advice on their projects and the next phase of their careers.

"I see myself largely as a facilitator—facilitating communication, facilitating research, providing an environment where productive and cutting-edge research can take place," he says. "I think peer mentoring is really important. I can't solve every issue in the lab, but if we all put our heads together, we're often much more efficient. I think that's where communication really pays off."

He adds that the mentoring aspect of his job is one of the things he enjoys most.

"I just recently had my first couple of PhD students finish, and that was very satisfying, to see students and to think about how much progress they've made through their PhDs," Dick says, adding he also likes discovering new things. "I think that's what gets a lot of us into science—the process of discovery, of uncovering new processes and new concepts. We also do a variety of fieldwork, including going on oceanographic expeditions or day trips on lakes to collect samples and conduct our science, so I really enjoy that as well."

▲ *Chemical storage and balance area.*

▲ *Petri dishes for the cultivation of bacteria from the environment.*

Finding out what his staff like to do best and helping them combine those passions with their work is the main way Dick motivates his staff. "My main strategy is to allow them to pursue their own interests, to be flexible," he says. "I think that's when staff are most productive—when they're happy. Treating them well, with respect, and in a professional way [is also important]."

So much data

While there are many fun aspects to working in the Michigan Geomicrobiology Lab, the work isn't without its challenges, a main one being the massive datasets lab staff have to work with on a regular basis.

"That presents both conceptual challenges as well as just having computers that are big enough to crunch through some of this data to process it," Dick says, adding that the extraordinary diversity and novelty of microbial life in nature are other things that can make the lab's work difficult. "A lot of the organisms we study have never been brought into culture in the lab and are very, very different than anything that's been brought into culture in a lab, so the biggest challenge is to infer their biology based on DNA- or RNA-sequenced information, especially when they're very different from laboratory model organisms where we usually do our genetics and biochemistry and so on."

To handle those challenges, the lab has a full-time bioinformatics specialist on staff to help Dick and the rest of the lab members keep up with all of the new technologies and programs in the bioinformatics field and to help train the rest of the staff in those newest approaches.

Dick adds that, without a doubt, the biggest change in the microbiology field over the past few years has been the improvement in DNA sequencing technologies.

"When I was a graduate student, DNA sequencing was much more expensive and we could generate much less data," he says. "In the last ten years, the throughput has gone up and the cost has gone down, and this relates to some of the data challenges that we talked about earlier. It's fundamentally changed the way that we do our science."

As far as the lab's future goes, lab members' work with cyanobacteria is a new direction that will involve some construction.

"When I built my lab, we weren't really set up to do that [cyanobacteria research], so a big part of my lab's plans for the next few years is to build a photosynthetic cultivation facility where we can grow cyanobacteria," Dick says.

In addition, the lab's harmful algal bloom research, which they were just funded to do by the new University of Michigan Water Center, will get under way soon, as lab staff will be taking samples from Lake Erie each week this summer as part of the project.

"They [harmful algal blooms] really affect water quality and the quality of these lakes in terms of recreational value," Dick says about the importance of the research. "We're going to be applying some new genome and transcriptome techniques to these harmful algal blooms. To me, what's cool about that is we're studying interactions between bacteria and viruses and environmental chemistry and trying to understand how all that translates into this big societally relevant environmental issue."

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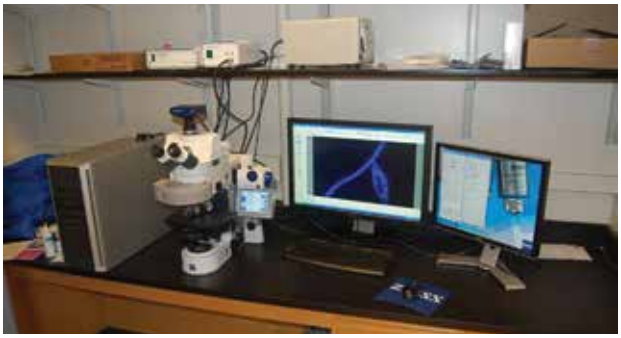

▲ *Microscope room with Zeiss epifluorescence microscope.*

TOP 5 INSTRUMENTS IN THE LAB:

1. Thermal cycler for polymerase chain reaction
2. Biosafety cabinet
3. Autoclave
4. Zeiss epifluorescence microscope
5. UV-VIS spec plate reader

INSIGHTS ON LIQUID HANDLING SYSTEMS

PIPETTES TO ROBOTS

by Angelo DePalma, PhD

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Pipette Automation Device
VIAFLO ASSIST / INTEGRA
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Equipment for dispensing and aspirating liquids runs the gamut from handheld pipettes that cost less than $100 to mid-range benchtop units to complex, fully robotic systems that cost $1 million or more. Systems exist for nearly every lab, workflow, and throughput level, even for many labs that believe automation is too complex or too expensive.

High-end liquid handlers serve high-throughput workflows at large companies, but all automated systems share one characteristic. "They all replace tedious manual operations, which is where most errors occur," says Ian Shuttler, head of strategy and portfolio management at Tecan (Männedorf, Switzerland).

Full-blown robotic liquid handling systems are formidable, integrated systems with steep learning curves, but complexity is somewhat mitigated through improved interfaces. Tecan, for example, has introduced a simple touch-screen interface for working through methods with the help of graphics, text, and application wizards.

At the mid-range level of complexity, vendors are taking advantage of their entry- or mid-level automation products to create application-specific systems that may be reconfigured down the road as workflow demands change. This product development strategy requires balancing immediate needs with future-focused flexibility. "As customers gain experience, the systems should grow with them, so robotics-enabled liquid handing systems remain relevant," Shuttler adds.

What's unique compared with ten years ago is that the market is addressing users who lack the automation and coding experience demanded by larger automation systems. "Everyone needs some way to move liquids around, so the key is to make liquid handling more accessible and easier to integrate with hardware," says Tara Jones-Roe, marketing manager at Beckman Coulter (Indianapolis, IN). Most labs that purchase the company's entry-level Biomek 4000 liquid handler, for example, are first-time automation buyers.

The original, big-money driver for lab automation was high-throughput screening of drug candidates. While that market still exists, the "numbers game" has reduced from millions or hundreds of thousands of compounds to just hundreds or thousands.

Paradoxically, the market for liquid handling systems has increased as screening numbers dropped and labs increasingly look for greater consistency, says Michael Beier, product manager at Integra Biosciences (Zizers, Switzerland), which specializes in liquid handlers that straddle the complexity continuum between handheld pipettes and fully automated systems. "Less hands-on time allows workers to concentrate on other tasks, but also improves ergonomics, especially for veteran lab workers who are prone to repetitive stress injuries," he explains.

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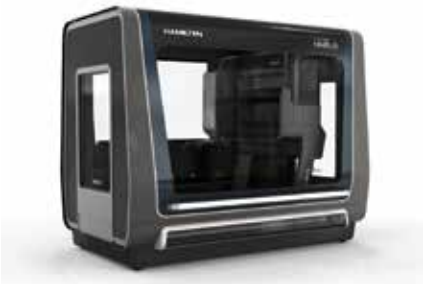
One result of the automation "craze" is that labs that would not have considered automation a few years ago are now buying into it, particularly for benchtop, semi-automated liquid handling systems. "People are looking for instruments that are affordable, that they can operate easily, and whose operation doesn't require dedicated personal," Beier says. The Viaflo 96 handheld 96-channel pipette, for example, represents an interesting crossover product between handheld and low-level automated liquid handlers. "Anyone can use it, and it's affordable," Beier adds.



▲ *Compact Pipetting Workstation / NIMBUS384 Hamilton Robotics / www.hamiltonrobotics.com*

▲ *PCR Software Wizard / TouchTools™ PCR Wizard / Tecan / www.tecan.com*

The question of application specificity versus flexibility is one that customers and vendors continue to grapple with. "There are two sides to that coin for sure," says Jason Greene, senior product manager at BioTek Instruments (Winooski, VT). BioTek's modular approach, based on components of automation as opposed to large robotic systems, works well for labs whose needs change frequently—provided they possess the expertise to take advantage of that flexibility, or the funds to call someone in to make the adjustments.

In other situations, well-funded customers who do not anticipate significant assay changes might consider large, high-end automated workstations. "While that's a fine option for other people who need more flexibility, the big liquid handlers are perhaps a bit too rigid for them in terms of capabilities. That's where the smaller, modular approach may be more appropriate," Greene adds.

Beckman Coulter is in a similar position technologically. As a member of the Danaher family of life science companies, Beckman is able to exploit sample preparation expertise from its sister companies that extends into cellular, genomic, and proteomic applications. And like many automation companies, it regularly collaborates with other automation companies to deliver customized products. Lab automation in general, and liquid handling in particular, could not progress as far as it has without these partnerships.

ROLE OF MID-RANGE SYSTEMS

The trend toward miniaturization and personalization has fueled demand for mid-range liquid handlers that are more sophisticated than automated manual pipettors but lack the complexity and capabilities of large robotic systems.

Joby Jenkins, product manager for liquid handling products at TTP Labtech (Cambridge, UK), calls such systems "dedicated benchtop, low-volume pipetting instruments."

TTP Labtech's mosquito line of liquid handlers, for example, lacks many of the attributes of full-scale robotics from Tecan or Hamilton. As the name implies, these liquid handlers are smaller and deliver volumes in the low to mid-range, from 25 nanoliters up to 5 microliters.

> "Today's scientists are looking for their own personal benchtop pipetting systems that do one thing very well."

Compared with many large robotic systems, mosquito is viewed as low to medium throughput. "However, for certain applications, such as protein crystallography, being able to set up nanoliter volumes in a ninety-six-well plate in less than two minutes represents a significant degree of miniaturization and increase in throughput," Jenkins says.

Moreover, the systems integrate well with robotics. Users can employ a plate handler and stacker, or can aim for even bigger things. TTP Labtech has partnered with Tecan, for example, to integrate a mosquito with Tecan robotics and software, which extends the capabilities of both systems. "The user's experience is of using a large Tecan system that now can pipette lower volumes. The whole integration is controlled by the one software," Jenkins says.

Two related trends in automated liquid handling have emerged from customers' desire for personalization. The first involves less reliance on core automation facilities;

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the second is the need for systems dedicated to one task.

"Today's scientists are looking for their own personal benchtop pipetting systems that do one thing very well," explains Bobby Chavli, associate director of marketing for Hamilton Robotics (Reno, NV). "This represents a big change."

One driver for benchtop robotics is the realization that automation's benefits transcend high-throughput capabilities. Laboratories increasingly appreciate reproducibility, consistency across operators and labs, error reduction, and walkaway time.

Related to personalization is the desire for off-the-shelf "solutions"—systems customized for specific assays using kits from a single reagent vendor. For example, Hamilton's Nimbus next-gen sequencing workstation works specifically with Roche kits, whereas the NGS workstation is configured for the New England Biolab and Illumina chemistries.

Hamilton still sells general-purpose robotics platforms such as Star, Vantage, and Nimbus, whose prices range from about $100,000 to $2 million. Application-specific modules are built on these to a high degree of specificity. And core automation facilities still operate for complex workflows and high-throughput projects, but the benchtop norm has been redefined toward greater capability and, simultaneously, user-friendliness.

Whereas five or ten years ago customers may have spent weeks or months developing automated methods for these assays, today's user is more focused on the application itself and on hands-free time that may be spent more productively. "Now, if they use Illumina reagents, they expect an automated workstation for those experiments," Chavli says.

CARE AND MAINTENANCE

Calibration and maintenance have always been sticking points with instrument users. This is true with liquid handlers as well, whether dealing with single-channel manual pipettes or dispensing heads for large systems. "Many customers would be happy never to calibrate their pipettes," says Melinda Sheehan, product manager for liquid handling at Eppendorf (Hauppauge, NY).

Labs have many convenient options for pipette calibration. Kits are available for in-house gravimetric calibration by technicians or end users. For example, Artel (Westbrook, ME) sells a calibration workstation, the PCS®, for do-it-yourselfers.

Lab managers often turn for calibration to original vendors, who provide on-site calibration services for large groups or departments or service via standard delivery services. Some manufacturers even provide loaner pipettes when turnaround is expected to be lengthy. Numerous third-party service organizations will service pipettes at their shops or at the customer's site as well.

▲ *Pipette Calibration System / PCS® / Artel / www.artel-usa.com*

Despite these choices, many users simply will not part with their favorite pipette for a week or have a liquid handler sit idle for a similar length of time.

"Many customers come up to us at trade shows and ask about pipette calibration," Sheehan says. "By the time they're asking that question, they probably have a drawer full of broken or out-of-spec pipettes."

Eppendorf has eliminated some of the burden of calibration record-keeping by installing radiofrequency identification (RFID) chips into all its manual and electronic pipettes. RFID stores more information than most pipette operators require to remain in compliance—for example, serial number, date and type of service, and usage. Eppendorf has used the chips "since before we even had a plan regarding what we would do with them," according to Sheehan.

▲ *Liquid Handling Tracking System / TrackIT / Eppendorf www.eppendorfna.com*

Electronic tagging practically eliminates the need to collect and store paper calibration certificates, which Sheehan describes as passé, saying, "Certificates get lost. In some cases the upper and lower parts of instruments get mixed up, and nobody knows which reassembled pipette the certificate belongs to."

Eppendorf has recently introduced TrackIT software, which uses a USB-style scanner to read and store calibration information. TrackIT allows users to enter additional information as per company policy or regulations. Eppendorf has similar tracking systems for single- or multichannel pipetting heads used in automated liquid handlers.

Similarly benchtop systems, like Integra's Viaflo 96, demand little upkeep. "The only part that requires service is the pipetting head," Beier says. "The mechanics are maintenance-free."

Calibration interval depends on the user's established standard operating procedures, but usually involve six- or 12-month cycles. Robotic systems, by contrast, require service contracts under greater control of vendors, Beier explains, saying, "Mechanical parts need service."

The final word on maintenance involves not instrumentation, but lab workers. "Users must continually be trained on how to use the latest good laboratory pipetting techniques, use pipetting products that offer the best ergonomics and performance, and regularly maintain their instruments with a certified service provider," says Raymond Mercier, business director of liquid transfer at Thermo Fisher Scientific (Waltham, MA).

PURCHASE CONSIDERATIONS

Pre-purchase considerations are as varied as liquid handlers themselves. Purchasing a handheld pipette, for example, is a low-budget personal choice, while a fully robotic liquid handling system is a capital expenditure.

For pipettes, Mercier suggests:

- Find a comfortable, ergonomic fit to prevent poor pipetting technique, which affects accuracy and precision.
- Look for pipettes and tips that were designed together.
- Don't skimp on consumables: consistency in pipette tips reduces fit variability and benefits overall performance.

"And be sure to select a vendor with robust global manufacturing capabilities to ensure uninterrupted pipette tip supply," Mercier adds.

Semi-automated systems are simpler than robotics and spare end users from extensive training. Integra's Viaflo and Assist semi-automated systems, for example, are true walk-up instruments. "If you can operate a pipette, you can operate these instruments," Beier says. "Lab managers typically believe that if manual pipettes are not enough, they have to splurge on a robotic system. That's untrue. They should consider options in between, which may be more economical and, for many workflows, more efficient."

It all comes down to understanding workflows, Beier adds. "Do they want to ramp up a little or a lot? Without fully automating, a ninety-six-channel pipette improves throughput significantly compared with a conventional handheld pipette."

Managers need also to consider how many people will be using the instrument. If it's a dedicated system, with a single task, with preprogrammed methods, and if walk-away time is valued, then a robotic system is appropriate.

WORKFLOW REQUIREMENTS

"It sounds obvious, but the most considerations when purchasing automation are the requirements of your day-to-day workflow," Greene says. Workflow includes individual process steps as well as specific liquid handling steps and bottlenecks based on anticipated throughput. Some processes or steps might work well with existing equipment, while it may make sense to automate other operations. Anticipated benefits range from increased walkaway time, accuracy, and precision to the ability to introduce uniformity to operations prone to human error. Lab managers might, for example, notice variations from technician to technician or at certain times of day when other things are occurring in the laboratory.

Other common considerations are the throughputs, batch sizes, and types or viscosities of reagents a lab works with. Purchasers should consider whether they purchase reagents or make them up in the lab, in what quantities, and the value of consistency.

Greene believes that dedicated, application-specific customization is a smart business strategy from the perspective of product differentiation. "If [customization is] done right, vendors can rest assured that they've done their homework," Greene tells *Lab Manager*. "But we know from experience that few individuals purchase automation in that manner because they know that colleagues will want to use it. And if it goes into a core facility, a lot of people will be sharing it. As soon as the system enters the lab, they'll forget the needs that were enunciated during the demo and sales process. That's why you need, at least at some level, an open design."

In other environments, when budgets allow, throughput

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is high, and/or assay requirements are relatively fixed, a large automated workstation can make sense. While this is a suitable choice for labs that don't need total flexibility, higher-end, fully automated liquid handlers can be too rigid for many. This is where smaller, modular approaches can be more appropriate.

For Jones-Roe of Beckman Coulter, purchase decisions should be based on trusted partnerships with vendors, scientific expertise, product knowledge, and a high level of support in hardware, software, and applications writing. "Whether you're spending $50,000 or $1 million, can an automation platform grow with your lab? Is it versatile or locked down? Can you add or remove components?" she asks.

AVOID THE CUL-DE-SAC

Despite the trend toward application-specific automation, users should be wary of entering an automation cul-de-sac. For example, Tecan has learned through customer surveys that many closed, dedicated liquid handling systems eventually go idle. Determining the most appropriate mix of current utility and future flexibility is therefore a critical part of early discussions with automation vendors.

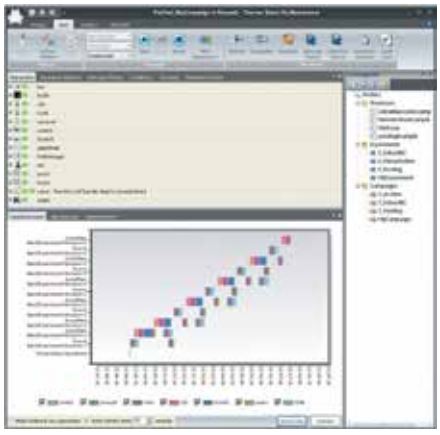
Shuttler refers to system acquisition as a "consultative sale, where the salesman acts as an automation consultant; they know the systems' capabilities and can recommend one based on current and anticipated future needs."

Chavli notes that while customers are looking for "solutions," liquid handlers can easily become expensive paperweights if they do not possess the versatility demanded by changing workflows. "Perhaps you purchased a liquid handler for PCR. Great. What happens when your lab is no longer performing PCR? Obviously, you want built-in flexibility, even though specific tasks are the reason for purchasing the system," he says.

At some level, purchasers should seek systems that, with the assistance of the vendor or in-house automation experts, may be reconfigured for future projects. "In addition to the performance, precision, and accuracy required by current workflows, customers need to take a long-term view," Chavli advises. "These are expensive systems that most users hold on to for many years."

Related are the anticipation and realization of value across an automated system's lifetime: the enhancements in throughput, quality, and time savings the system adds to your laboratory and results. Vendors of some systems claim, for example, to dispense 1 microliter volumes that are common in modern low-volume assays. Chavli questions such assertions unless the vendor can demonstrate that dispensers compensate for a fluid's viscosity and density: Think concentrated buffer versus glycerol or oil.

Lab managers considering the purchase of an automated liquid handler must consider current needs while remaining open to future workflow demands. Labs should question vendors about upgradability and interoperability (particularly with respect to components already in the lab), assess available literature, and whenever possible put systems through their paces.



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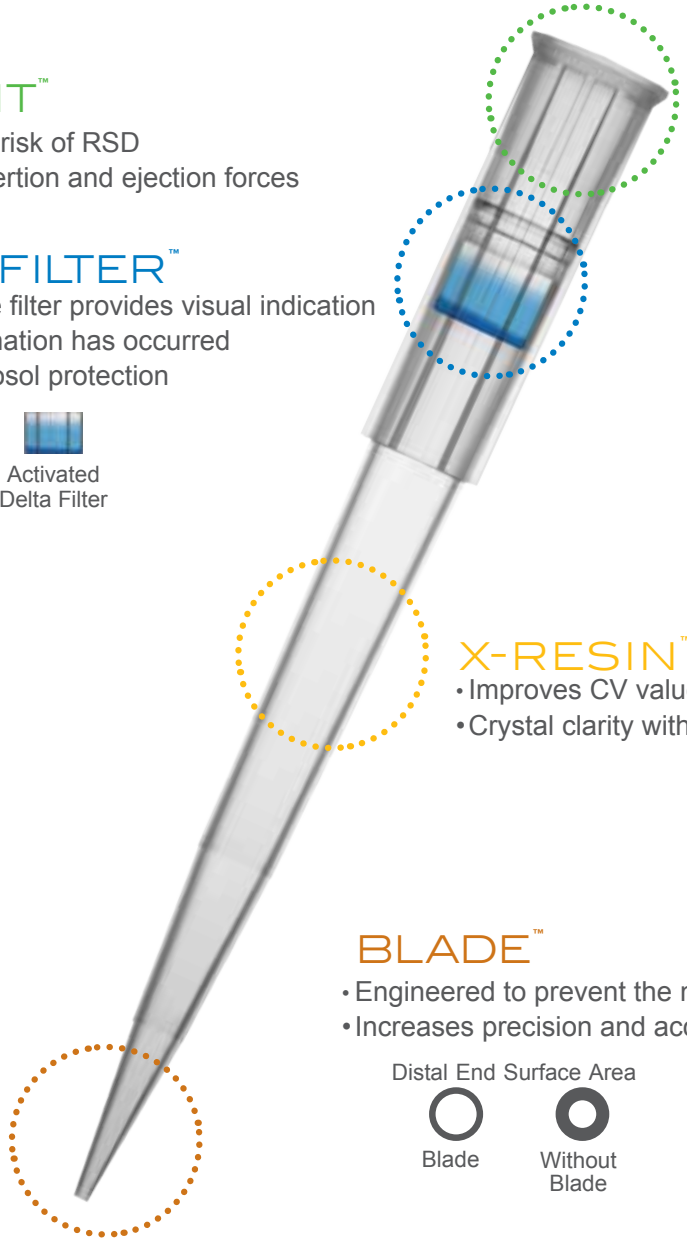

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However, in the new era of big science and high-throughput sample processing, the manual work required for electrophoresis is becoming harder to sustain. The associated errors have forced labs with high-throughput pipelines to use new approaches.

Today's modest labs are conducting at least 3,000 sequencing reactions per year for translational medicine studies, and rerun rates spurred by manual errors can cost millions of dollars.

As a result, upfront sample quality control tests that rely on rapid characterization are crucial for many applications, including miRNA-seq, RNA-seq, ChIP-seq, long-fragment sequencing, gene synthesis and cloning. Reliable size selection for these samples is also critical in maximizing the value of downstream processes.

The manual process for gel-based size selection can cause sample-to-sample result deviation. The processes of gel casting, target identification, and gel-dissolution recovery of nucleic acids are all subject to variability. Furthermore, manual size selection is an involved process that can add a full day or more to genomics workflows.

Automated, high-throughput agarose gel size selection and electrophoretic sample characterization are important steps toward improving results and speeding clinical research.

Solution: Hamilton Robotics' recently launched automated solution on Microlab® NIMBUS® Select workstation using Coastal Genomics' Ranger Technology is one example of how the process is being improved.

Coastal Genomics' Ranger Technology updates both the agarose gel size selection and analytics processes to meet the needs of genomics laboratories. Combined with the Hamilton Robotics workstation, this automated solution removes operator variability, reduces sample preparation time by collapsing the analytical processes of the assay into the size selection process and secures sample integrity for downstream processes.

The NIMBUS Select workstation is a small-footprint liquid handler that can size-select as few as one or as many as 96 samples in a single run. In addition, inexpensive, high-resolution analytics cassettes can be used to characterize up to 192 samples in a run without size selection. The NIMBUS has validated protocols for the downstream library prep for most major NGS manufacturers.

Unlike traditional agarose gel band selection, Ranger Technology does not need UV light to illuminate the bands. Throughout the electrophoretic process, DNA bands are illuminated by exposure to visible light. Ranger Technology images these bands to identify and recover target fractions, thereby avoiding DNA damage from UV exposure and preventing any potential impact on downstream applications.

The workstation can size-select 96 samples in two hours, shaving six hours off of other gel extraction protocols. Users define the base pair range of their target fragment and the workstation automatically loads the samples from a 96-well source plate into the Ranger agarose gel cassettes. The gantry-mounted camera records multiple images of the electrophoretic process. These images are analyzed to identify the target, which is recovered by the workstation when it arrives at an extraction well in the agarose gel cassette. Electropherograms before and after the size-selection event are reported for all samples.

Ranger Technology offers improvements over bead-based approaches. Additional QC analytical processes required for beads are consolidated into the size-selection run. The system typically improves recovery yields and is capable of size selection on targets exceeding 20 kbp. Users can expect to eliminate undesirable off-target fragments, increase read lengths and improve normalization of libraries prior to sequencing.

Ranger Technology's analytics capability is ideal for groups faced with the requirements to assess fragment length distributions. Up to 192 high-resolution electropherograms can be developed in less than one hour. The system flexibly accommodates runs in which only a fraction of the capacity are loaded, thereby saving consumable costs. Coastal Genomics is also developing a low-resolution analytics solution that will accommodate up to 384 analyses per run.

This new and affordable method for size selection and analytics leverages automation to eliminate labor-intensive protocols. As the workload for gene synthesis and NGS increases, this system promises to save researchers valuable time and money.

For more information, please contact Hamilton Robotics Product Inquiries at 800-648-5950 or marketingrequest@hamiltoncompany.com.

▲ *The interior of the Microlab® NIMBUS® Select workstation using Coastal Genomics' Ranger Technology.*

because knowledge is power

SmartCapture — Business Intelligence for Smarter Decisions

SmartCapture™ technology empowers you to make smart laboratory decisions based on real instrument and equipment usage information. Finally, a solution that provides data across all makes and models.

The Power to Do More

Unity Lab Services' proven expertise combined with SmartCapture automatic data collection provides knowledge to:

- Balance instrument workload
- Identify redeployment opportunities
- Optimize instrument and equipment service levels

Enabling you to reduce downtime risk, cut capital expenditures and decrease equipment maintenance costs.

Ask how SmartCapture can drive cost savings, improve lab productivity and power smart lab decisions.

Contact us today
www.unitylabservices.com/smartcapture

Unity Lab Services
A Thermo Fisher Scientific Brand

BETTER RESEARCH DATA MANAGEMENT

Problem: Researchers and scientists generate and collect vast amounts of data in their work, whether they are running experiments in the lab or surveying and interviewing people on the street. Researchers typically don't deal with their research outputs until towards the end of the research cycle, when poor organization and data management can be difficult to manage and address, but causes the most problems. Poor data management results in experiments that are harder to replicate and findings that may be called into question. Papers can be retracted, careers impacted and ultimately science can suffer. When researchers move on they may pass their work to others in their research group, where poor data management results in the group inheriting indecipherable written notes they cannot use.

Solution: A Mac desktop application such as Projects allows researchers to organize and manage their research data while they are collecting and working on research projects. Projects has several features aimed at helping resolve reproducibility problems and generally allowing the organization of research data to be an effortless part of the research workflow.

Researchers can annotate their data files and star important files while they are collecting and working on those files on their Mac. Projects then tracks events such as added files, annotations and stars added to research data in a chronological timeline. Over time the visual timeline becomes a useful history of work done by the researcher. It tells a story of how the project evolved, including when files were added to the project, which files were marked as important with a star and when and what annotations were made about the data. The timeline can be used to perform searches too—an especially useful feature when researchers are looking for a particular note linked to a file, or data they have collected at a particular time, but cannot remember the file name or location. By clicking on the event in the timeline, the researcher is taken directly to the data file on their Mac.

Projects keeps backups, called Snapshots, across the entire research project. Snapshots can be created by the researcher at important times during their research workflow such as when they have finished a paper and submitted it to a journal. Snapshots taken at particular points in the research workflow become useful especially when, for example, a journal asks for all the data corresponding to the paper. This paper may have been submitted months before, and the data or analyses may have been changed since for other purposes, such as presentations or posters. Snapshots are also taken as a precaution automatically every hour, day and week in a rolling manner.

The application links with figshare, a cloud storage and data sharing platform. Raw data, negative data and analyses can all be pushed up to figshare and stored in the cloud privately as another backup. Files can then be shared in collaborative spaces on figshare, so research groups can work on shared files using the cloud resource. Researchers can then publish their research data or outputs openly on figshare and get credit for all their research.

For more information, visit https://projects.ac/

▲ *The Projects timeline tracks when files or folders are added to a project, when notes are created and when important files are starred, making it easier to manage research projects.*

TECHNOLOGYNEWS

ANALYTICAL

Ultraviolet-Visible Diode Array Spectrophotometer

Cary 8454

- Includes a new version of UV-Vis ChemStation software that integrates with OpenLAB Enterprise Content Manager (ECM)
- Provides the secure data management needed in pharmaceutical and other highly regulated industries
- Compact, easy-to-maintain system can collect a complete spectrum in less than one second
- Transitioning from existing earlier models to the Cary 8454 UV-Vis is seamless

Agilent www.agilent.com

GC Column Connection Supplies

- Easy-to-use, leak-free supplies improve GC flow-path integrity and allow users to experience longer periods of unattended operation
- New supplies include a self-tightening column nut, UltiMetal Plus-treated metal tubing and parts, UltiMetal Plus stainless steel capillary guard columns, UltiMetal Plus stainless steel transfer lines and capillary tubing, the Ultra Inert deactivated press, column installation swaging tools for graphite and metal ferrules, and the UltiMetal Plus flexible metal ferrule

Agilent www.agilent.com

Continuous Flow Analyzer

Futura Duo

- Can run simultaneously multiple parameters in parallel for combined analyses, with its integrated two channels
- Able to run all chemistries from the easiest to the most complex ones
- New full auto module handles automatically the external modules and accessories for the automation of complex chemistries
- Includes a multi stream peristaltic pump, independent electronic and detector modules

AMS SYSTEA www.ams-systea.com

Spectrometer for Atmospheric Measurements

EM27/SUN

- Features the new CAMTracker system which is an improved version of the well-known solar tracker utilizing an innovative camera-based feedback system following the sun as light source
- New CAMTracker also provides direct line-of-sight information and is insensitive to inhomogenous illumination
- Highly portable and thus suited for long term measurement campaigns in remote areas

Bruker www.bruker.com

Scanning Micro X-ray Fluorescence Spectrometer

M6 JETSTREAM™

- Provides a scan range of up to 800 x 600 mm^2 and a scanning speed of up to 100 mm/s
- Designed to analyze the chemical composition of very large objects on-site in a single run with spatial resolution between 50 and 1,200 μm
- Runs Bruker's ESPRIT software suite, offering an easy-to-use graphical user interface and a wide range of functions

Bruker www.bruker.com

Research Grade FTIR Spectrometer

TENSOR II

- Replaces the TENSOR 27/37
- Suited for advanced FTIR applications in R&D due to its high sensitivity and flexibility
- Also useful in routine applications for QC and material verification as it is compact in size and provides a very comfortable workflow
- The first R&D FTIR using a diode laser with a much longer hold time than HeNe-lasers included in conventional R&D FTIR instrumentation

Bruker www.bruker.com

PRODUCT SPOTLIGHT

IMAGING REIMAGINED

NEW MICROSCOPE'S BREAKTHROUGH TECHNOLOGY TAKES AIM AT BIOMEDICAL AND MATERIALS RESEARCH SAMPLE ANALYSIS

In March, Daylight Solutions announced the launch of the world's first commercially available laser-based infrared microscopy platform. The microscope, called Spero™, features breakthrough chemical imaging and analysis on a real-time basis and offers a combination of excellent visibility, instantaneous results in "live mode," and a small resource footprint.

"Spero provides data products and analysis capabilities that simply aren't possible with existing instruments; it represents a true game-changer for chemical imaging," says Daylight Solutions president Paul Larson. "As the first laser-based infrared microscopy platform, Spero will provide rapid, high-resolution results for applications ranging from cancer research and drug discovery to food safety and materials manufacturing."

That image resolution, combined with an ultra-wide field of view, allows researchers to observe micron-scale features while also covering large areas very quickly for high throughput applications, the company adds. The instrument operates in the mid-infrared region and provides high-fidelity spectral data for the accurate identification of molecular and chemical components of complex, heterogeneous samples. But, unlike current FTIR-based instruments, full-spectrum, high-resolution hyperspectral data cubes can be collected in minutes and the Spero's "live mode" capability allows users to observe samples with discrete frequency illumination, allowing real-time imaging of individual spectral features. The microscope also includes easy to use spectral imaging software.

"I was able to do more in the small amount of time that I spent with Daylight's Spero than I could ever do back home with the systems we have," says Dr. Michael Walsh, assistant professor in the Department of Pathology at the University of Illinois at Chicago. "This microscope greatly exceeded my expectations."

For more information, visit www.daylightsolutions.com/spero

NIR Spectrometer

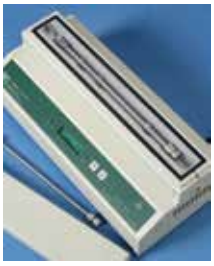
LF-Series

- Delivers four models in a standard bench package with fixed fiber optic, SMA-905 connection and a single TE-cooled InGaAs photodiode array optical system
- Suited to both laboratory and field applications
- Features reliable operation with all photodiode array construction and no moving optical parts
- Include stable performance with TE-Cooled InGaAs array

SPECTRAL EVOLUTION www.spectralevolution.com

HPLC Column Chiller/Heater

EchoTherm™ Model CO50



- Features a temperature range from 4.0°C to 100.0°C readable and settable to 0.1°C
- PID control software regulates temperatures to ±0.2°C, even at ambient
- This Peltier-based unit has 5-program memory of 10 steps per program and the ability to repeat any program from 1 to 99 times automatically
- Holds columns up to 30cm long by ¼" or 3/8" diameter

Torrey Pines Scientific www.torreypinesscientific.com

BASIC LAB

Total Organic Carbon Analyzer

Sievers M9

- Designed to measure TOC in a broad range of samples from ultrapure water to process waters
- Enhances productivity by producing TOC results in two minutes, twice as fast as its predecessor
- Offered in three versions: portable, online or laboratory
- Can measure conductivity in grab sample or autosampler modes

GE www.geinstruments.com

Pipette Automation Device

VIAFLO ASSIST

- In combination with a VIAFLO II electronic handheld pipette, enables the pipette's protocols to be performed automatically
- Reduces the need for traditional handheld pipetting to a minimum, relieving lab personnel from activities that may cause repetitive stress injuries
- Ensures tip immersion depth and pipetting angle are always the same, resulting in increased reproducibility and thus better results

INTEGRA www.integra-biosciences.com

Quick COD Analyzer

Model HC-607

- Provides fast, accurate analyses and is easy to use with coulometric titration
- A revision of the electrode material frees the user from performing multiple blank measurements and speeds up and stabilizes measurement operations
- The sliding electrode holder provides greater efficiency and smoother operation and electrode mounting and dismounting is simpler, safer and more reliable

JM Science www.jmscience.com

Diaphragm Vacuum Pump

N 920 KT.29P

- Provides lab technicians with adjustable vacuum performance, without the need for lubricating oil or recirculating water
- Also gives users quiet function with long product life in myriad laboratory applications
- In addition to N 920 KT.29P's adjustable vacuum performance, it delivers deep end vacuum up to 1.5 Torr, and a flow rate of 20 L/min

KNF Neuberger www.knfusa.com

Zero Nitrogen Generators

- Designed to transform standard compressed air into a safe, regulated supply of 99.9995% pure nitrogen with <0.1 ppm hydrocarbons
- Include a heated catalyst module and are specifically designed to replace P5 argon/methane mixtures as well as ultra-high purity nitrogen
- Feature an economy mode which allows the generator to switch into standby mode when there is no demand from the downstream instrument

Parker Hannifin www.parker.com

Refrigerating/Heating Circulators

- Provide precise temperature control for cold properties testing applications
- Designed for use with cloud point, freeze point, pour point, and cold filter plugging point testing equipment
- Feature temperature ranges as broad as -40° to 200°C, temperature stabilities as exacting as ±0.005°C, and are available in reservoir sizes from 7 to 75 liters

PolyScience www.polyscience.com

Balance

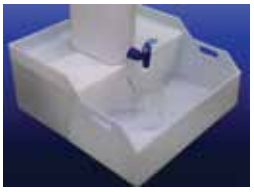
Entris

- Focuses on the most commonly used weighing applications and dispenses with costly additional functions
- Available in 15 models, covering a weighing capacity from 60 g to 8,200 g with a readability of 0.1 mg to 0.1 g
- Most models equipped with a monolithic weighing system featuring external adjustment or an internal, motorized adjustment function

Sartorius www.sartorius.com

Carboy Containers

Carboy Contain



- Available in two sizes; one designed to hold carboys up to 4 liters; and one designed to accommodate carboys up to 20 liters
- Up to 100 lbs can be easily accommodated and both sizes fit easily on countertops
- Feature one-piece polyethylene construction designed to provide easy clean-up and years of trouble-free use

Scientific Plastics scientificplastics.com

Laboratory Freeze Dryer

AdVantage Pro

- Features a new Intellitronics™ controller offering enhanced functionality and intuitive touch screen navigation
- One touch start-up and shut down ensure that user's product and freeze dryer are protected from inadvertent operational procedures
- Integrated performance and leak testing ensure system is always working optimally
- Alarm alerts, delivered via email, help notify the user of potential problems with the system

SP Scientific www.spscientific.com

Cryo Controller

Asia

- Just 16 cm—6.3 inches—wide, the easy-to-use control offers compact, high performance, and trouble-free cooling of flow chemistry processes
- Proprietary cooling technology achieves microreactor temperatures as low as -100 °C and tube reactor temperatures down to -70 °C, using only main power and eliminating the need for dry ice, liquid nitrogen, running water or a circulator

Syrris http://syrris.com/

Electronic Pipette

E1-ClipTip

- Interlocking technology provides enhanced sample security and makes pipetting more efficient with the ability to transfer samples quickly between different labware formats using the same pipette throughout the protocol
- Personalized interface and password protection ensures unified operation among users
- Program function allows users to store 20 programs, each with a specific name and calibration

Thermo Fisher Scientific www.thermoscientific.com

ULT Freezer

TWINCORE

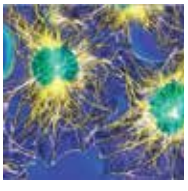
- Designed for -86°C storage of high-value samples
- Employs two optimized autocascade compressors but only requires one compressor to hold temperature up to -86°C
- Features an advanced 7" LCD touchscreen control panel, inventory management system, and each unit is assigned an IP address for monitoring functions by the Z-Sc1 WIZBOX network or user's in-house system
- Does not require a CO_2 backup

Z-SC1 Biomedical http://z-sc1.com

CHEMICALS, KITS & REAGENTS

Protein Delivery Reagent

BioPORTER®



- Lipid-based protein delivery system efficiently transports proteins into living cells
- Makes studying protein functionality faster and easier by bypassing the traditional DNA transfection, transcription, and protein translation processes
- After capturing the protein, the reagent transports the lipid protein complex into the target cell; the delivered proteins retain their structure and function while leaving the transduced cells unharmed

AMSBIO www.amsbio.com

Real-Time PCR Dye

Precision Blue

- Makes it easier for researchers to set up real-time PCR (qPCR) experiments
- Improves the visibility of qPCR reaction mixtures, enabling loading of small volume reactions with greater speed, accuracy, and precision
- Compatible with Bio-Rad's universal qPCR supermixes and does not interfere with SYBR® Green- or probe-based detection
- Concentrated 200x, and delivers 500 x 20 μl reactions

Bio-Rad www.bio-rad.com

Certified Solutions of Corticosteroids

Snap-N-Spike®

- New Certified Spiking Solutions® are of the corticosteroids pregnenolone, 17α-hydroxypregnenolone, cortisone, and 11-deoxycorticosterone at concentrations of 100 µg/mL in methanol
- Suitable for preparation of calibrators, controls, and linearity standards in clinical and diagnostic labs as well as hospitals and research settings
- Offer laboratories increased efficiency of labor and convenience of use

Cerilliant www.cerilliant.com

NGS Assay Kits

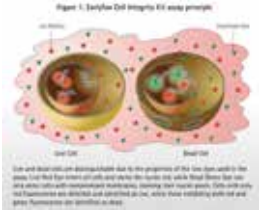
IsoFlux™

- Designed to enhance and complete the workflow for next-generation sequencing (NGS) using the IsoFlux System
- Enable mutation detection from circulating tumor cells using NGS
- Increase the overall target purity of the sample and provide a robust nucleic acid extraction method that is optimized for NGS
- Available for immediate use through the IsoFlux Discovery Services program

Fluxion Biosciences http://fluxionbio.com

Cell Integrity Kit

EarlyTox



- Stronger fluorescent signal significantly shortens exposure times compared to similar kits, cutting down the time spent on plate reader assays
- Only kit with a masking reagent to remove background signal, making it unnecessary to remove media to improve signal-to-noise ratio
- Pre-configured protocols and automatic calibration by Molecular Devices imaging cytometer reduces the need for parameter optimization and manual data analysis

Molecular Devices www.moleculardevices.com

INFORMATICS

Powder Flow Software

Powder Flow Pro Software Version 1.3

- The Quick 5-Point Flow Function Test is now integrated into the software
- New test can be accomplished in about 16 minutes as compared to the Standard 5-Point Flow Function Test which takes about 25 minutes to complete
- Allows for more rapid QA/QC checks on production powder batches
- Test provides the operator with five predefined consolidation stress measurements

Brookfield Engineering www.brookfieldengineering.com

Particle Size Analyzer Software

Mastersizer 3000

- New software for Malvern's Mastersizer 3000 laser diffraction particle size analyzer continues to lighten the analytical workload associated with developing robust particle sizing methods for industrial applications
- New operational features, such as an Optical Property Optimizer, simplify and streamline the process of method development
- A new result emulation tool eases the process of transferring methods from other particle sizing techniques

Malvern www.malvern.com

New CDS Compatibility

Dionex Instrument Integration (DII) Version 1.12

- Users of Thermo Scientific Dionex UltiMate 3000 series UHPLC and HPLC systems can now drive Thermo Scientific Dionex Corona Veo charged aerosol detectors and Thermo Scientific Dionex UltiMate 3000 ECD-3000RS electrochemical detectors with Waters Empower®
- DII enables control of these additional instruments on any LC system controlled by Empower for additional freedom in experimental design

Thermo Fisher Scientific www.thermoscientific.com

PRODUCT SPOTLIGHT

BOOSTING THE BUSINESS SIDE OF THE LAB

SYSTEM OFFERS SEAMLESS LAB-TO-BUSINESS CONNECTION FOR SCIENCE-DRIVEN ORGANIZATIONS

With the launch of Waters Corporation's NuGenesis Lab Management System (LMS) at the end of April, labs now have an alternative to traditional laboratory information management systems (LIMS). The software enables deeper insight into scientific challenges, accelerated decision-making, better business results, and compliance with government regulations.

Garrett Mullen, senior product marketing manager for laboratory informatics at Waters says that, historically, LIMS have been brought into a lab with the hopes of solving many problems at once, meaning they often take more time and effort to set up.

"With this approach typically no ROI is generated until the entire system is configured and up and running with LIMS solutions and this can easily be one to one and a half years," Mullen says, adding NuGenesis allows users to set up and run specific point solutions independently. That enables them to achieve productivity gains shortly after the project begins. "This allows a phased approach which is a leaner, more economical way of solving problems, in essence boiling the ocean one bucket at a time, not trying to do it all at once."

Key features of NuGenesis LMS include NuGenesis SampleShare, an optional, secure web-client for sample submissions and results management; NuGenesis Stability, a complete stability protocol management and testing solution to facilitate a consistent regimented workflow across lab operations; NuGenesis Connectors, a bi-directional link between lab systems and business applications; and Paradigm™ Scientific Search, a fully integrated scientific search solution for text, documents and science objects. The software's SDMS Dashboard provides a real time status for monitoring system components.

Mullen says NuGenesis can provide a single solution for many small- to medium-sized businesses that don't already have a LIMS, while in other cases it "can increase the value of existing systems like SAP and LIMS."

For more information, visit http://www.waters.com/nugenesis

Content Screening Platform

HCS Studio 2.0

- High-content quantitative imaging and analysis software platform serves a range of cancer research applications
- Allows users to pick from validated assays or a customized design with a full suite of image processing tools
- Simple interactive tools for assay optimization improve the performance and accuracy of image analysis on cells
- Works with software from Thermo Scientific High-Content Imaging platforms

Thermo Fisher Scientific www.thermoscientific.com

Sample Management Software

Mosaic 6.0

- Supports sample supply workflows in all sizes of life science organizations in industry and academia, from multi-continent, enterprise-wide installations, to those in a single lab
- Features a scalable and modular software infrastructure
- Offers seamless integration with third party IT infrastructure
- Includes improved interfaces for inventory management, enabling convenient and quick inventory search functions, even across multiple sites

Titian Software www.titian.co.uk

LAB AUTOMATION

Sample Sealer for Biobanking Storage

SampleSeal

- Uses automated heat-sealing technology to fully seal and individualize sample tubes in a single, automated process, completing a full rack of 96 or 384 2D-barcoded tubes in less than one minute
- Supports low-volume, high-density sample storage that both maximizes storage capacity and enables single-use access of samples for downstream use
- Minimizes the damaging thaw/re-freeze cycles that can impact sample integrity

Thermo Fisher Scientific www.thermoscientific.com

LIFE SCIENCE

Flow Cytometer

NovoCyte™

- Offers a powerful cell analysis tool for researchers who are unfamiliar with flow cytometers and/or those unable to afford such systems
- Allows researchers to detect up to 15 different parameters with enhanced sensitivity and resolution
- Customizable to meet researchers' current and future needs with options to add-on at a later date

ACEA Biosciences www.aceabio.com

Certified Reference Materials

- Now include quantitative mycoplasma genomic DNA prepared as Certified Reference Materials
- Supports ATCC's range of quality control products, which include the Universal Mycoplasma Detection Kit and a collection of 10 titered mycoplasma reference strains
- Calibrated to one or more specified properties, making them suited for use in challenging assays, verifying or comparing test methods, and benchmarking critical assay performance during assay validation or implementation

ATCC www.atcc.org

Multi-Mode Dispenser

MultiFlo™ FX

- Now available with optional RAD™ (Random Access Dispense) technology to further extend its application range and flexibility
- RAD technology offers single-channel dispensing to random individual microplate wells along with rapid reagent dispensing into large volume wells of 6- to 24- well microplates
- Can also be separately configured with an optional wash module for 6- to 384-well plates

BioTek www.biotek.com

Small Animal Treadmills

- Suited for forced exercise training and muscle fatigue studies in rodents
- Features reduced stress to subjects and smooth operation with the high performance, silent motor, even at high speeds
- Provides more rapid animal training with integrated shock grid which delivers constant shock despite the number contacts, ensuring minimal discomfort while promoting training

Coulbourn www.coulbourn.com

Droplet-On-Demand System

Mitos Dropix

- Capable of easily generating extremely miniaturized droplet compartments with exceptional control over volume, environment and isolation of contents
- Meets the increasing demand for screening massive numbers of biological reactions, increased speed of screening and reduced reagent consumption
- Introduces liquid sampling and processing over a 10 nL – 50 μL volume range utilizing droplet technology

Dolomite www.dolomite-microfluidics.com

Microplate Reader

EMax® Plus

- Designed for labs just starting up or looking to extend capabilities with affordable, yet reliable instrumentation
- Measures 96-well plates and comes with eight standard filter modes to cover the entire visible range
- Includes multiple licenses to the SoftMax® Pro software for endpoint and kinetic analysis of microplate data

Molecular Devices www.moleculardevices.com

Microplate Washer

MultiWash™+

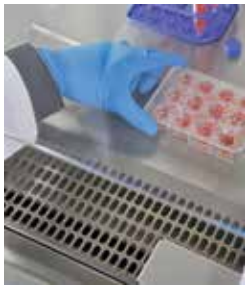
- Quickly washes with both 96 and 384-well plates, has 20 standard wash protocols, and a simple LCD screen interface to customize speed, volume, soak time, and aspiration settings
- Engineered to be simple to maintain and use, including features that reduce clogging and noise
- Includes a set of four wash/rinse bottles and one waste bottle for out-of-the-box operation

Molecular Devices www.moleculardevices.com

Cell Culture Surface

Nunclon Sphera

- Designed to allow many different cell types to grow in suspension consistently with virtually no cell attachment
- Especially important for researchers seeking to cultivate cancer and stem cell spheroids, since the product is able to grow uniform and dependable spheres
- Offers excellent quality for embryoid body formation of pluripotent stem cells



Thermo Fisher Scientific www.thermoscientific.com

Online Monitoring & Control System

2900M

- Features the YSI Sitini online sampler
- The Sitini can be set up to automatically draw fluids from the bioreactor, delivering samples directly to the 2900 biochemistry analyzer for testing
- Measures analytes such as glucose, glutamine, glutamate, lactate and many more
- Provides a simple and reliable solution for running user's bioprocess automatically, with accurate results in less than one minute

YSI www.ysilifesciences.com

Automated Microscope

Axio Scan.Z1

- Allows researchers to digitalize fixed tissue sections and cytologic specimens in bright-field and fluorescence
- Also allows as many as 100 microscope slides to be digitalized at one time
- Maximum protection for the sample is ensured by the Colibri.2 UV-free LED light source, as well as a focus finder with oblique illumination, called the ring aperture contrast

Carl Zeiss Microscopy www.zeiss.com

SUPPLIES & CONSUMABLES

Spheroid Microplate

XF^{e}96

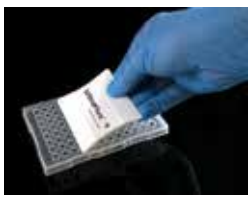
- This 96-well plate features geometry that enables functional, metabolic measurements of individual spheroids for the study of three-dimensional cell culture, which more closely mimics *in vivo* conditions
- Allows the real-time metabolism of multicellular spheroids to be analyzed and used for evaluating the metabolic response to therapeutic agents
- XF^{e}96 Spheroid FluxPak contains six cartridges, six microplates and calibrant

Seahorse Bioscience www.seahorsebio.com

PCR Sealing Film

UltraFlux®

- New range of products is economical and easy to use
- Consist of film and foil solutions; providing options for everyday plate coverage through use of two foil versions, and the UltraFlux® RT is suited for optical analysis during Real Time PCR
- A bundled plate and sealing film option is available



SSI www.ssibio.com

Nested LiHa Disposable Tips

- Allow up to five racks of the new 350 µl tips to be stacked on a single SLAS-format carrier
- Minimize the need for manual intervention and increase walkaway time for Freedom EVO® liquid handling workstations
- Nested 350 µl tip offers greater versatility with the same pipetting precision as the 200 µl tip, and is available in both Tecan Sterile and Tecan Pure options

Tecan www.tecan.com

ARE YOU IN THE MARKET FOR A...
LABORATORY BALANCE?

Choosing the correct balance for your application, or a series of balances that suit all of your application needs, is the first step in good lab weighing practices. If you choose the correct balance, calibrate it regularly, including any time the balance is moved to a new location, and keep it clean, your balance will reward you with many years of accurate operation.

Types of balances used by survey respondents

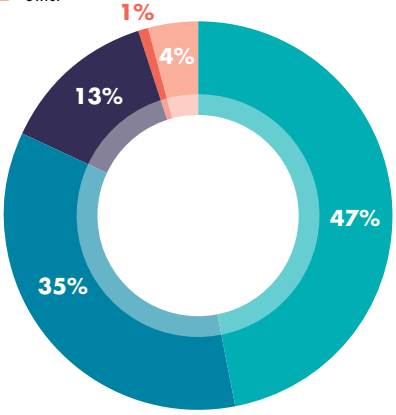
Micro Balance	11%
Analytical Balance	48%
Precision Balance	35%
Other Balance	4%
Ultra-microbalance	2%

Balance related components used by survey respondents

Moisture Analyzer	6%
Vibration Isolation Table	11%
Balance Enclosure	28%
Balance Printer	4%
Routine Test Weights	20%
Keyboard	2%
Barcode Scanner	1%
Evaporation Traps	1%
Weighting Table	14%
Software	3%
None of the above	8%

Nearly 27% of respondents plan on purchasing a new laboratory balance in the next year. The reasons for these purchases are as follows:

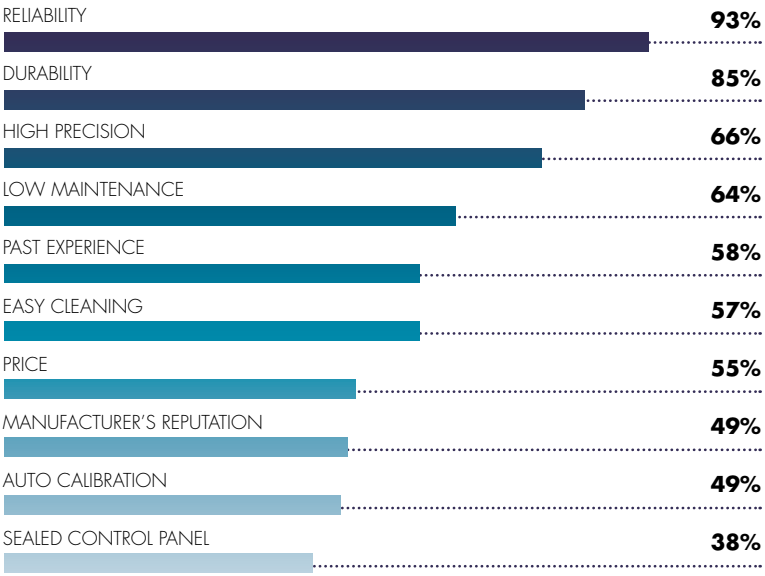
- Replacement of aging balance
- Addition to existing systems, increase capacity
- Setting up a new lab
- First time purchase of a balance
- Other



TOP 6 QUESTIONS
You Should Ask When Buying a Lab Balance

1. What is the heaviest sample you will weigh (including container weight) and what is the lightest sample?
2. What is the required +/- tolerance of your lightest sample?
3. How many decimal places in grams do you require for the displayed weight?
4. What type of samples will you be weighing and do you need to take into consideration the size of the weighing surface or the securing of a tare container?
5. Is on-site service available from a factory-trained service technician?
6. Do you need to interface the balance to another device such as a computer, printer, bar code reader, etc.?

TOP 10 FEATURES/FACTORS
respondents look for when purchasing a laboratory balance



Completed Surveys: 304

For more information on lab balances, including useful articles and a list of manufacturers, visit www.labmanager.com/balances

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ARE YOU IN THE MARKET FOR A... UV-VIS SPECTROPHOTOMETER?

Ultraviolet-visible (UV-Vis) spectrophotometry is arguably the most common as well as one of the oldest forms of absorption-based analysis. UV and visible regions of the electromagnetic spectrum are contiguous: UV wavelengths range from 10 to 4000 angstroms; they are visible from 4000 to 7000 angstroms.

Types of UV-Vis spectrophotometers used by survey respondents

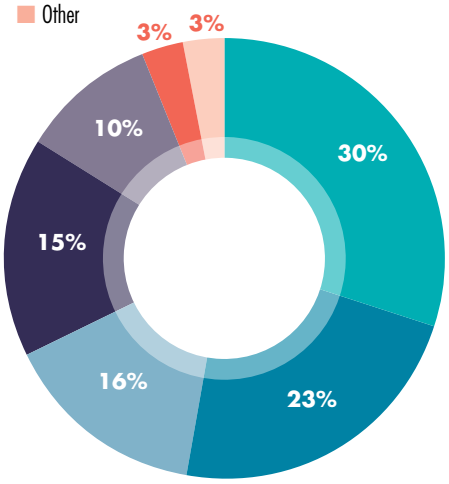
Single beam	41%
Dual beam	45%
Array based	11%
Handheld	3%

According to survey respondents, performance verification tests wavelength accuracy, stray light, resolution etc. are performed…

Annually	36%
Every six months	16%
Quarterly	12%
Monthly	10%
After every use	3%
Never	13%
Don't know	11%

Nearly 33% of respondents plan on purchasing a new UV-Vis spectrophotometer in the next year. The reasons for these purchases are as follows:

- Replacing an older spectrophotometer
- Addition to existing systems
- Need an instrument that provides faster acquisition and analysis of data
- Need an instrument that provides excellent reproducibility
- Need an instrument that is simple to operate and maintain
- Need an instrument that has a broad range of accessories
- Other



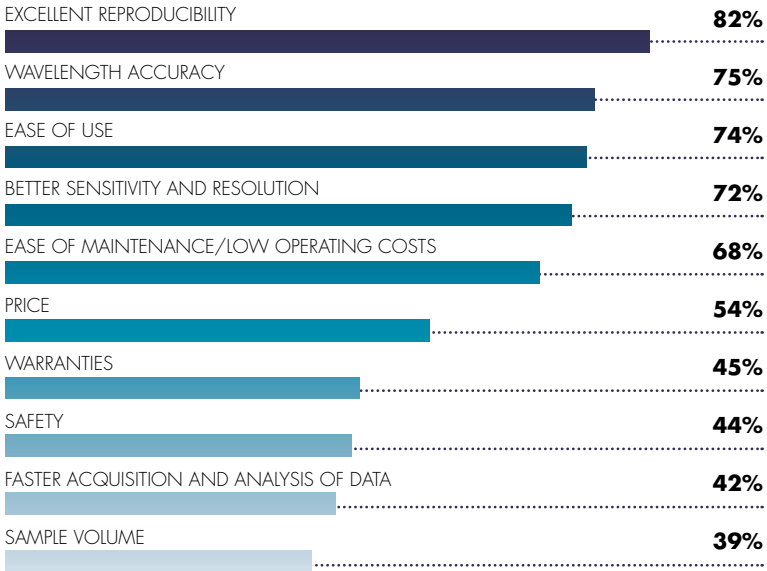
TOP 5 QUESTIONS

You Should Ask When Buying a UV-Vis Spectrophotometer

1. For what applications will you be using the instrument for? This will help you determine the detection range you require. Don't forget to consider future applications that may require a broader range.
2. What range of stray light performance are you comfortable with for your application and budget?
3. Consider what sort of samples you'll be working with in order to determine what absorbance range you will need in your UV-Vis spectrophotometer. For example, if it is a turbid or concentrated liquid or a solid sample that is optically thick, you may require a working absorbance range between 5 Å and 8 Å or higher.
4. What level of throughput and reliability do you need?
5. How much will the instrument cost? Don't forget to factor in the cost of maintenance, etc. along with the cost of acquisition.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a UV-Vis spectrophotometer.



Completed Surveys: 285

For more information on UV- Vis spectrophotometers, including useful articles and a list of manufacturers, visit www.labmanager.com/uv-vis

ARE YOU IN THE MARKET FOR A... VACUUM PUMP?

Vacuum pumps are an essential piece of equipment and are used in a wide variety of processes in most laboratories. Over the past 25 years, it has become apparent that vendors have made significant innovative improvements to vacuum pumps, with important developments in high vacuum technology, corrosion resistance, vacuum control, and improvements in the efficiency and ecological impact of vacuum pumps.

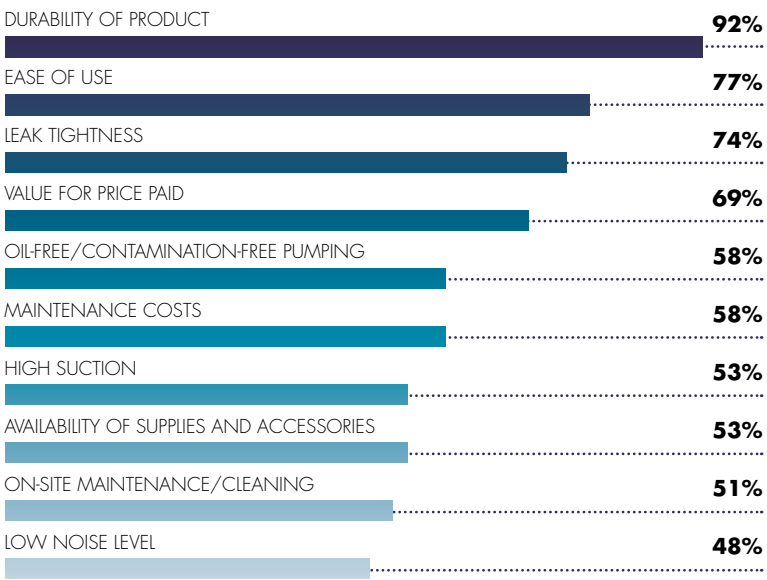
TOP 6 QUESTIONS

You Should Ask When Buying a Vacuum Pump

1. What will you be using the vacuum for? Filtration needs modest vacuum. Evaporation requires deeper vacuum. Molecular distillation requires even more. Match the pump to the use.
2. Can you use a dry (oil-free) vacuum pump? Oil-free vacuum pumps can support most lab applications. For the service advantages, choose a dry pump where possible
3. What is the pumping capacity at the intended vacuum level? Actual pumping speed declines from the nominal speed as depth of vacuum increases. The rate of decline differs among pumps.
4. Do you work with corrosive media? Standard duty pumps have lower purchase costs, but corrosion-resistant pumps will have lower lifetime costs if working with corrosives.
5. Should you invest in vacuum control? Electronics can improve reproducibility, protect samples and shorten process times when specific vacuum conditions need to be maintained.
6. What is the lifetime cost of operation? Include purchase cost, service intervals, servicing cost, pump protection (e.g., filters, cold traps), and staff time for operation.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a vacuum pump



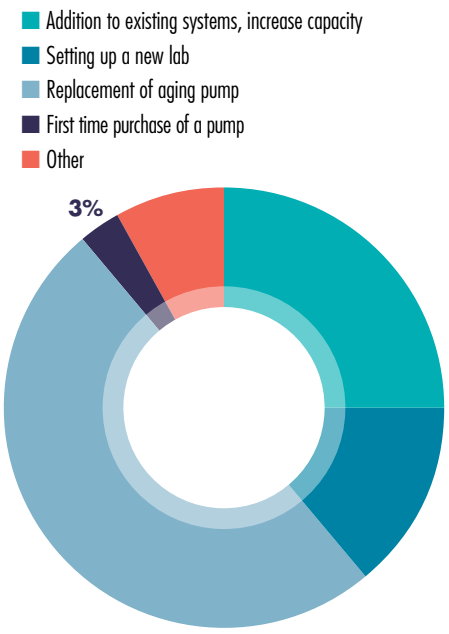
Types of vacuum pumps used by survey respondents

Oil-sealed direct drive pump	31%
Oil-free diaphragm pump	19%
Oil-sealed belt-drive pump	13%
Central vacuum to bench turrets	11%
Compressed air systems	9%
Water jet aspirator vacuum	7%
Oil-free scroll pump	5%
Other	4%

Type of vacuum control used by survey respondents

No control - just turn the pump on	37%
Manual adjustment of knob	20%
Electronic control on the vacuum application	17%
Central Vacuum - on/off control	13%
Electronic control on pump	12%
Other	1%

Nearly 22% of respondents plan on purchasing a new vacuum pump in the next year. The reasons for these purchases are as follows:



Completed Surveys: 220

For more information on vacuum pumps, including useful articles and a list of manufacturers, visit www.labmanager.com/vacuum-pumps

LAB WASHERS

CLEANING A CLEANING MACHINE **by Rachel Muenz**

For something so instrumental to keeping glassware clean, it only makes sense that maintaining the cleanliness of your lab washer is one of the keys to keeping it running properly.

"The most important thing about maintaining a glassware washer is to keep the inside clean," says Odette Nolan, product manager at Labconco (Kansas City, MO). "That includes the filter screen for any debris that's collected or anything that's falling off because that will cause pump problems if it's not clean." She adds the tank itself should also be cleaned.

John Lubas, professional service manager at Miele (Gütersloh, Germany) adds users should inspect sump filters on a daily or weekly basis and remove any debris, make sure they load the washer in such a way that the spray arm isn't blocked, and make sure they perform routine preventive maintenance on the machine to avoid costly repairs and downtime. Having the proper training is also critical to prevent problems with your lab washer.

"You need to get the proper training to operate the machine and consult the machine operating manual," Lubas says. "It's also important to use the proper chemistry or detergent for the application. There are different detergents available to wash items that are soiled differently. Using the right detergent is key to getting the glassware clean and preventing problems."

Nolan adds that using too much detergent is one of the most common errors people make when using their lab washers.

"What that ends up doing is leaving residue on the glassware as well as on the tank," she says. "We all tend to have a 'more is better' type of mentality where we think if we add more soap, there's going to be a cleaner result. Unfortunately, that's not always true. It'll end up leaving spots and white film."

Users can avoid this mistake simply by reading their manual, taking into account the hardness of their water and their application, and getting help from their manufacturer.

Lubas adds that using in-house personnel or outside contractors who don't have the proper training to do advanced work on the machine is another common mistake in the lab washer world.

"The improper use of 'non-approved' chemistry inside the washer can cause damage to seals, pumps and the stainless chamber," he says, adding that failure to clean broken glass, labels and other foreign objects from sump

▲ Most of the basic maintenance on a lab washer can easily be done by users themselves.

▲ Getting the proper training to operate a lab washer and consulting the machine's operating manual are important parts of keeping your unit running smoothly.

BENEFITS OF A MAINTENANCE PLAN:

- Specific inspection, maintenance and servicing guarantees full machine performance and machine uptime
- Reduced downtimes and avoidance of unnecessary repairs
- Increased productivity and uptime
- Safeguarding of investments
- Comprehensive information on technical condition of machines

filters is another error he sees often. Like Nolan, Lubas recommends talking to the manufacturer to get maintenance advice, along with only using OEM parts to service the machine and ensuring the product's safety and operating guidelines are followed.

Each manufacturer also has its own recommendations for how often users should do maintenance on their machines.

"Generally, if the lab is using the machine four to six times per day, one PM [preventive maintenance] per year is fine," Lubas says. "If the machine is being run during double shifts—more than an eight hour span—then I would recommend two per year or every six months. It's also a good idea to have a preventive maintenance visit if you are washing petroleum, oils, perfumes, etc.—glassware that is coated with solvents."

Nolan recommends users do maintenance on their washers as needed or at least monthly, on average.

While some vendors offer service plans of various levels with their washers, not all do, as most of the maintenance can be done by the user. For example, Miele offers preventive maintenance and inspection and evaluation plans as well as a full-maintenance service contract while Labconco does not.

"Glassware washers are pretty easy to maintain," Nolan explains. "Because they're a cleaning unit, don't put anything in there that's going to degrade the gaskets—the rubber parts—and it'll last you a long time."

Be sure to check out next month's Maintenance Matters, which will focus on mills and grinders.

NEW PRODUCT ANNOUNCEMENT

MP Biomedicals introduces the FastPrep-24 5G™! The most advanced sample preparation instrument yet!

INTRODUCTION:

Mechanical sample lysis is rapidly becoming the preferred sample preparation method in life science labs for the isolation of DNA, RNA, proteins, metabolites and other small molecules because the elimination of chemicals, enzymes, and detergents minimizes the introduction of potential inhibitors to downstream processes. The FastPrep-24 5G™ (Fig. 1) is the newest innovation in beat-beaters and produces the fastest lysis of even the most difficult samples.

OVERVIEW:

The FastPrep-24 5G is a software controlled, standalone instrument, designed with a first-of-its-kind user-friendly touch screen interface as well as many unique and innovative features. The high-speed, benchtop reciprocating instrument is intended for the optimal lysis of challenging and routine sample types. It is intended for use in applications that require grinding, lysing or homogenization of various solid sample materials. Sample types include but are not limited to the following: all types of human, animal and plant tissues including cultured cells; bacterial, yeast and fungal cells, including spores and oocytes; and environmental and metagenomic samples including soil and fecal samples.

INNOVATIVE FEATURES:

MP Bio, the leader in Sample Preparation, proudly introduces the newest member of the FastPrep Family of Sample Preparation Systems, The FastPrep-24 5G! The state of the art 5G system provides micro-processor control with a touch-screen user interface that gives you knowledge and power at your fingertips. Some of the new features include:

- Powerful- Highest speed available, improves quality of analytes
- Intuitive- Over 70 Recommended Programs, Just Pick and Start!
- Flexible- Optional sample holders allow processing up to 50 ml size under ambient or cryogenic conditional
- Complete- Lysing Matrix Tubes and Purification Kits from One Source

The heartbeat of the FastPrep-24 5G is the touch screen display with microprocessor control (fig 2). The display is a large, 7" diagonal HD monitor that is activated by a touch of the finger. The microprocessor controls the Graphical User Interface allowing the end-user to easily navigate through a choice of >70 MP Bio Recommended Programs, User-defined Saved Programs, or User-defined Custom Programs.

Recommended Programs are the heart of the 5G's functionality. These validated programs include all variable assay parameters. This is a valuable optimization tool for new users and is of special interest to those who are working with pathogenic or dangerous samples, as well as low abundance samples.

The highest available power, and the unique optimized motion, lyses samples by the multidirectional, simultaneous impaction of specialized lysing matrix particles. The FastPrep-24 5G provides quick, efficient and highly reproducible homogenization, getting your DNA, RNA and proteins into the protective buffer faster, resulting in higher quality and yields!

The USB port allows users to upgrade software as they become available easily by simply connecting to a laptop or PC (fig 3). A custom FastPrep App uploads new software versions quickly to the instrument. The App also allows the option to download assay history from the 5G's memory to the attached computer in the form of a CSV file. This feature is of critical importance in lab settings were run verification/documentation is necessary.

CONCLUSIONS:

The FastPrep-24 5G is a novel, ultra-high performance, sample preparation system that allows for the extraction of fully intact, biologically functional macromolecule from routine as well as highly resistant samples. Learn more at www.mpbio.com/sampleprep

▲*Fig 1, The FastPrep-24 5G™ Homogenizer System*

▲*Fig 2, Touch screen displaying Recommended Programs by sample type*

▲*Fig 3, USB Port on rear panel*

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FIGHTING FOR LAB SAFETY WITH S.C.A.T. EUROPE

After 15 years of constant improvement, S.C.A.T. SafetyCaps belong to the global safety standard in pharmaceutical and chemical laboratories. They enable operators to get solvent vapors under control and create perfect solvent conditions for their HPLC systems. The automated caps think ahead and fight health and environmental hazards directly at their origin - the solvent receptacle. Good laboratory practice often requires more useful and cost-efficient solutions than fume cupboards or extraction hoods. This is why S.C.A.T. caps are installed within seconds and provide 100% protection. In addition, solvent costs will be cut down remarkably by protecting the solvent reservoir with a SafetyCap. Even waste fluid containers can now be rebuilt into safe disposal devices, instead of being a hazard source.

Running a trouble-free HPLC lab requires avoiding accident risks, as well as keeping the system free of contamination. The SafetyCap system fulfils both functions with one simple and solid cap. The self-acting air valve blocks vapors and gases while pressurization and HPLC operation can take place as usual. However, the operator will realize significant quality advancement. Where contamination once used to cause retention time shifting and distortion of the chromatogram, there is now stability and reproducibility. The caps offer multiple sized tubing and capillary connectors which make them suitable for all types of liquid chromatography systems - regardless of their brand or manufacturer.

Securing your waste containers is just as easy. Putting the SafetyWasteCap on top turns a common canister into a disposal device with advanced safety features. The integrated exhaust filter collects hazardous vapors and prevents overpressure inside the container. The device even stays safely locked while discharging waste fluids via tubing directly from the HPLC system.

Wherever sample or solvent residues have to be discharged manually, the S.C.A.T. caps offer an integrated safety funnel which closes automatically after filling. This keeps the disposal device safely closed and prevents accident risks.

The modular system offers many additional features which can be added to the standard solvent caps. One of them is the integrated level sensor, helping the operator to keep an eye on filling levels and avoid unnoticed overflow. For those who do not operate HPLC systems and want to get their waste disposal under control anyway, S.C.A.T. also offers a wide range of safety funnels and disposal devices. There is also a series made of electroconductive plastic material against sparking and static charge.

Taking responsibility for health and environment protection is one of the lab manager's obligatory duties. On the other hand, it is easy to comply with these requirements quickly and cost-efficient, because the S.C.A.T. system has been developed especially for this purpose.

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PRE-OWNED EQUIPMENT MARKETPLACE

PARTING POINTS

Takeaways from this month's issue:

SAFE ENOUGH?

During the past few years there have been a number of very serious laboratory accidents that have resulted in severe injuries, extensive facility damage, and even fatalities. Lab managers can strengthen the safety culture in their labs through:

- Proper training for employees
- Observing staff at work
- Thinking of the "what if" scenarios
- Process Safety Management

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OUTSOURCING OPTIONS

As they sort out where their in-house laboratories fit within the enterprise, technology-driven businesses have been adopting outsourcing models to cut costs. The main benefits for outsourcing include:

- More streamlined costs
- Gives companies access to expertise and technology they don't have in-house
- Helps organizations reduce capital investments
- Allows companies to maintain timely service delivery

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MANAGING TIME

In order to increase efficiency, many companies today are under pressure to improve their time management practices. This is not an easy task, but four main strategies can help managers make the most of their workdays:

- Preplanning
- Effective scheduling
- Having contingency strategies
- Gathering regularly to meet the current needs of the lab

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PERSPECTIVE ON: A MICROBIOLOGY LAB

As principal investigator of the Michigan Geomicrobiology Lab in the University of Michigan's Department of Earth and Environmental Sciences, Gregory Dick and his staff study how tiny microorganisms influence larger Earth processes. He discusses:

- The variety of work staff members get to do in the lab
- His role in mentoring lab staff as principal investigator
- Challenges such as massive data sets that the lab faces and how it deals with them
- Projects the lab will be working on in the near future

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INSIGHTS ON LIQUID HANDLING

Liquid handling systems exist for nearly every lab, workflow, and throughput level, even for many labs that believe automation is too complex or too expensive. Recent trends in this area of instrumentation include:

- Systems are more accessible and easier to integrate with hardware
- The need for greater consistency is a major driver in growing the liquid handling market
- Labs uninterested in going automated just a few years ago are now buying into it
- The question of application specificity versus flexibility remains an important one

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