Lab Manager MAGAZINE
Run Your Lab Like a Business

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SCIENCE & THE PUBLIC TRUST

STRATEGIES FOR MANAGING COMPLEX SCIENTIFIC AND SOCIAL INTERACTIONS

THE FIRST ANNUAL LABORATORY SAFETY SURVEY

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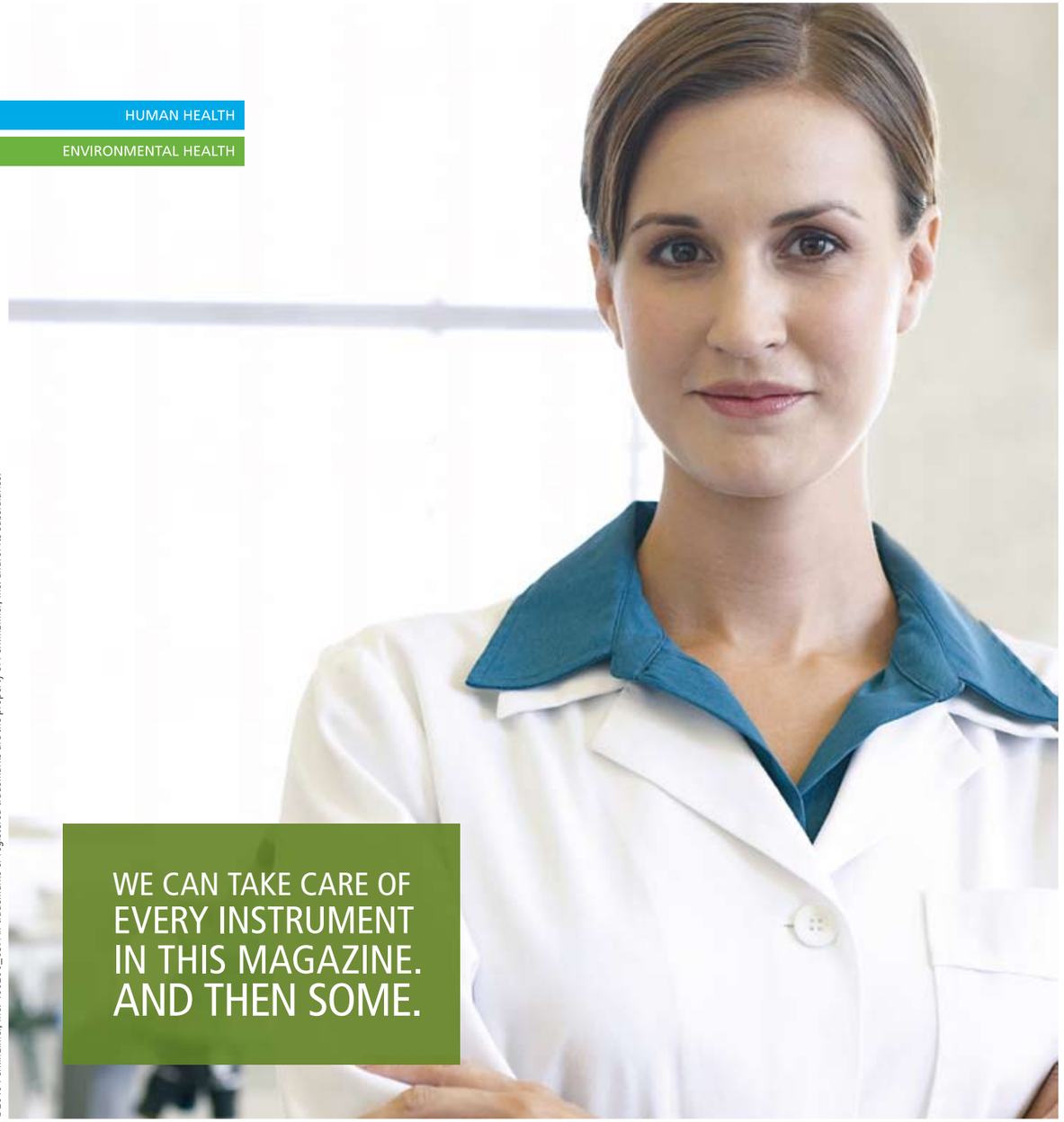

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SURVEY SAYS: A preliminary review of responses to our Fourth Annual Salary & Employee Satisfaction Survey indicates that 8% fewer respondents believe that their jobs are secure and 9% fewer feel valued at their organizations. When asked whether they felt they could trust what their organizations told them, 59% of respondents said they agreed or strongly agreed, compared to nearly 70% who felt that way a year ago. Our October issue will present the complete results.

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Social Science

Is climate change real or the hysterical imaginings of environmentalists? Is seafood from the Gulf of Mexico safe to eat? Are organophosphate pesticides the prime cause of ADHD? And which scientist's answers to any of these questions should the public believe?

"While scientific and technical analyses are essential, they will not and arguably should not carry the day unless they address, substantively and procedurally, the issues that concern the public," says Baruch Fischhoff, Carnegie Mellon University Professor of Social and Decision Sciences and Engineering and Public Policy in a recent article in the journal *Science*.

"We have the science needed for meaningful public involvement," he said. "However, in order to use it, senior leadership must view two-way communication as a strategic commitment," says Fischhoff.

As this month's cover story makes patently clear, the days of scientists and researchers holed up in academic or industrial labs detached from society are over. These days they must proactively communicate scientific information to the public in ways that stress "personal relevance and common shared values or risk ceding the stage to rivals and competing interests."

Based on many formal and informal discussions with lab managers, the topic of lab health and safety is consistently identified as highly important. For that reason we recently conducted our first Laboratory Safety Survey in which we asked our readers to share information about their labs' safety programs and practices. This month Vince McLeod shares the results and offers up the top best and worst lab safety practices based on what we learned. You might be surprised by the results and curious to find out how your own lab's safety practices compare.

Other articles of interest this month include a case study describing how the J&J Alza facility in Vacaville, CA used simulation-based planning of optimize operations in response to changing market needs and financial pressures. The article shows how simulation was used to predict the load on staff and equipment as well as how the lab schedule was integrated with the production stream model for a complete end-to-end flow.

In "Recycling Closed Laboratories," John Borchardt explains that instead of spending scarce capital to purchase or build a laboratory, firms can rent facilities in one of the large laboratories closed as a result of corporate mergers and acquisitions and reopened, usually under new ownership, as rental facilities. These facilities enable small and midsized companies to rent first-class laboratory space at relatively modest cost.

Introduced for the first time last month, our new Survey Says feature in September covers purchasing practices for centrifuges, glassware washers and water purification systems. If you happen to be in the market for the latter, we feature a product focus article on water purification systems on page 52, as well as a Lab Design & Furnishings article, "What to Consider When Designing a Customized Lab Water System" on page 34. For more information on glassware washers, turn to this month's pull out – an "Independent Guide to Purchasing a Lab Glassware Washer."

But to get the most out of this month's issue, review the table of contents or go page by page to find those articles of specific interest, from the role of customer service in your lab, to what's involved with using electronic signatures, to how to set up a cell culture lab. I'm sure there is something of value for everyone.

Calling All Photographers: *Lab Manager Magazine* is looking for a few budding Ansel Adamses to share their best photographs of scenes from their labs. Subjects can include the physical plant, staff members at work, the latest amazing instrument, or anything else you'd be proud to share. Photos need to be professional in subject and presentation and of a high quality (original file, 300dpi, 2MB minimum). Winning photos will be featured in our *Lab Manager Magazine* 2011 wall calendar. Please submit your photos (along with photo caption and credit) to me at pam@labmanager.com. The deadline for submissions is October 15th.

Pamela Ahlberg / Editor-in-Chief

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SCIENCE & THE PUBLIC TRUST

STRATEGIES FOR MANAGING COMPLEX SOCIAL AND SCIENTIFIC INTERACTIONS by F. Key Kidder

A 2009 Pew research poll about the state of science and its impact on society revealed that the high regard Americans have for scientists is unrequited. The profession, according to the poll, thinks the public is scientifically illiterate and disapproves of the media's dumbed-down, lackluster coverage of scientific issues.

This schism is perpetuated by the prevailing mode of scientific communication, the top-down deficit model, in which scientists force-feed the public a prescribed dose of simple fact, on the theory that the public suffers from a lack of scientific knowledge and that scientists know what's best.

But scientific communication researchers and other observers see a change, contending that outreach communications are in a transitional phase that recognizes the complexity of social and scientific interactions and attempts to address the problem of assigning responsibility.

> "Being engaged with the public at some level is just part of what it means to be a scientist."

Bruce Lewenstein, professor of science communication at Cornell University, sees "clearly a changing culture" wherein "being engaged with the public at some level is just part of what it means to be a scientist."

When he began teaching a graduate level course in public communication in 2007, Lewenstein asked students to raise their hands if they were "afraid their PhD supervisor would find out they were taking the class, because there was this attitude you shouldn't be communicating with the public." The class would laugh, says Lowenstein, and then about half would raise their hands. But this year, "not a single hand went up."

The arousal of interest about public engagement is driven by a confluence of factors—outreach snafus, research confirming the failings of the deficit model, and the ascendancy of new media and social technologies.

To extract more social value from funded research, funding agencies increasingly mandate outreach and educational components in grant proposals, criteria "designed to get scientists out of their ivory towers and connect them to society," says Arden Bement, director of the National Science Foundation.

But more fundamentally, this communication groundswell is a beachhead to prevent the erosion of public trust and preserve the image of scientific integrity—the *sine qua non* of science.

"We live in an age when most policy debates relevant to science…are collectively decided at the intersection of politics, values and expert knowledge," says Dietram Scheufele, professor and John E. Ross Chair in Science Communication at the University of Wisconsin–Madison and a leading voice for change.

Too often, the intersection is an accident waiting to happen for scientists on the firing line—whether in their dealings with restive publics, getting out front on revolutionary technologies, or mired in scientific controversy of numbing complexity and uncertainty.

The sum of scientific missteps has cast a pall over the profession—scientists cast as political and corporate errand boys, ethically challenged, spinners, prevaricators and proselytizers. The microscope has been turned on science.

Now for the good news: Science has accrued a wealth of what Scheufele calls "perceptual capital," the public goodwill manifest in the Pew poll. The trick, says Scheufele, is spending it wisely when controversy arises—using a more collaborative, consensus-driven approach to public engagement based on careful research that avoids communication muddles. At the present burn rate, the surplus of perceptual capital will drain down and reduce public support or threaten funding.

> "The 'politicization of science' degrades policy debate and undermines public faith in science."

"Scientists Behaving Badly" screamed a 2005 headline in the journal *Nature*. Lead author Brian Martinson decried the "striking level and breadth of misbehavior" of 3,000 government-funded scientists whose voluntary responses to an ethical conduct survey formed a spectacle of ethical transgressions. A parade of scientific perpetrators admitted to misdeeds from the egregious to the sublime, including 15.5 percent of respondents who said they changed how they conducted experiments, or their results, upon pressure from funding sources—the most commonly cited misbehavior. Martinson's study, thundered *The Boston Globe*, "threaten(s) the fundamental working of science." *The Wall Street Journal* weighed in to denounce the "brazen culture of lawlessness."

Nicholas Steneck, director of the Research Ethics and Integrity Program of the Michigan Institute for Clinical and Health Research, suggested during a 2006 American Association for the Advancement of Science (AAAS) science policy forum that "questionable research practices" could approach 50 percent of all research behaviors. (The outliers on Steneck's bell curve quantifying the ethical landscape were falsification, fabrication and plagiarism at one end and "responsible conduct of research" at the other, each with between 0.1 and 1.0 percent of all behaviors.)

"The climate change issue really focused attention of how scientists try to handle their relationships with the greater public," says Mark Frankel, director of the Scientific Freedom, Responsibility and Law program at the AAAS. It's challenging enough to communicate about an issue of such magnitude and uncertainty, he says, but worse yet were instances of scientists trespassing into the policy orbit.

"You basically had some scientists buttonholing politicians, saying, 'Look. Here's what the data shows, it's a real problem, we got to act and here are some suggestions.' Some did that willingly," says Frankel, "and some were naïve." Either way, "they wound up saying things they would never say in a journal getting peer reviewed."

The Bipartisan Policy Center, a think tank co-chaired by former House Science Chairman Sherwood Boehlert (R-N.Y.) and Donald Kennedy, former editor of *Science*, urged the Obama administration to "establish procedures

for keeping politics from clouding science in regulatory decisions," warning that the "politicization of science" degrades policy debate and undermines public faith in science. The use of ideological criteria to select members of federal scientific advisory committees has been scrutinized by the Government Accountability Office.

Global warming continues to wreak havoc with the scientific community's reputation. In late 2009, hackers released e-mails purporting to show data manipulation by global warming proponent/climatologists in England. The scientists were subsequently exonerated, but the retraction was not the stuff of front-page news. The incident, dubbed "Climategate," occasioned a *New York Times* editorial deploring "diversionary controversies."

> "Scientists are frequently their own worst enemies regarding good communications."

Oft-contentious stem cell research is another arena where scientists have engaged in what Frankel calls "exaggerated advocacy, really going out on a limb making claims" about cures. "This overstepping really hurt us. The other side comes back and says, 'OK, so where are all these cures?' Then you have the scientists who developed the California policies regarding stem cell research. They wrote their 10-year expectations into their documents before Phase 3 trials. That was responsible."

But Lowenstein, a self-described "historian who focuses on issues of public understanding of science," takes issue with the idealized concept of purity—of science separate from values—maintaining that a social and political drumbeat has always accompanied the march of science.

"When Galileo first invented the telescope, he was looking at Saturn and he found three moons for Saturn. Problem was, his financial support came from the Medicis, and there were four Medici brothers, and he did not publicly announce his findings until he'd found a fourth moon to satisfy his patrons. That's no different from scientists who look for the most commercially viable version of their work…." And some of the greats play fast and loose ethically, great "precisely because they follow their intuition," says Lewenstein, who cites HIV pioneer Robert Gallo, "famous for jumping, and sometimes that means his lab work is a little messy and everything is not quite documented. There have been some major accusations of fraud against him, which in the end have not been supported" but arise "because of the way he works."

Scheufele and other agents of change maintain that scientists are frequently their own worst enemies regarding good communications—more inclined to trust their intuition than take advantage of the growing body of interdisciplinary data, more accustomed to lecturing than listening.

The deficit model has been shown to have little impact on public perceptions or policy and may aggravate conflict, says Scheufele. More sophisticated techniques like framing and deliberative forums prevent polarization and encourage dialogue but risk drifting into "selling" science instead of the longer-term goal of engagement through participation and trust. Rule No. 1 for science communicators, says Scheufele, is knowledge of the value systems of target publics, since inputs are filtered through belief systems.

A recently concluded American Academy of Sciences multiyear workshop, "Improving the Scientific Community's Understanding of Public Concerns About Science and Technology," recommends democratizing science-related issues by moving discussion upstream to give the public greater ownership. Amy Gutman, President Obama's newly appointed chair of the Presidential Commission for the Study of Bioethical Issues, announced that she would embark on a course of "deliberative democracy" to find common ground on controversial issues.

The deficit model represents "first-order thinking" about science/society relations, says Alan Irwin, dean of research at Copenhagen Business School, while the American Academy of Sciences proposal—with its bottom-up thrust toward building dialogue, trust and ultimately consensus—is of the second order. Irwin argues that third-order thinking—characterized by full consideration of issues and policy by all stakeholders and informed by science—is still lacking.

Media is event driven, science is a process; communicating the constancy of scientific uncertainty is an enormous challenge. A National Academies report on climate change recommends engagement—"iterative dialogues" between scientists and stakeholders—as optimal. "Perhaps the best role for scientists is to think of themselves not as communicators but as conveners and facilitators," says Matthew Nisbet, associate professor in American University's School of Communications.

With the fragmentation of established media and the ascent of digital and social technologies, media literacy becomes paramount for scientific communicators. One observer likened the state of scientific public discussion to "waves in a shallow pan" with "a lot of sloshing and not much depth." As print media recedes, scientists can bypass former intermediaries and use the Internet, blogs and social media sites to communicate directly with various publics. Global warming "dismissives" are a small minority but wield disproportionate influence through adept use of new technologies. By striking early and digitally, scientists can set the narrative agenda for others to follow. The shrinking resources of most news organizations preclude serious enterprise reporting.

The onus is on science to be more anticipatory. When science spills over into the public space, organizations must proactively communicate messages stressing personal relevance and common shared values or risk ceding the stage to rivals and competing interests that may couch developments in terms of conflict, complexity or uncertainty.

Lewenstein has two tips for lab managers: 1) Collaborate and pool resources to hire a professional communicator to work with local schools, museums and media. "Every lab says we'll spend our money to build a good website. The world doesn't need more websites."

2) "Don't cite the idea you are in a social world. Recognize it and work with it."

F. Key Kidder *left journalism to pursue a career in government relations, politics and PR, but he still likes to keep one hand in writing. He can be reached at k2@keykidder.com or 410-828-6529.*

SCIENCE & THE PUBLIC TRUST

CUSTOMER SERVICE

THE LAB MANAGER'S ROLE IN DEVELOPING A FIRST-RATE TECHNICAL SERVICE STAFF by John K. Borchardt, Ph.D.

Effective customer service builds customer loyalty. It makes it easier to sell current products, additional products and new products to firms that are already your employer's customers. This results in higher profit margins even if your prices are no higher than your competitors'. It also enhances your firm's reputation in your customers' industries, making it easier to win new customers. While new-product and process development programs may have a higher profile in your company, they usually rely on effective technical service to be successfully introduced into the marketplace. It is sales from existing products that fund development of these new products and processes. An effective customer service process is usually required to sustain these revenues.

"When the people who work for you feel valued, they will make your firm's customers feel valued."

The best single way for lab managers to promote outstanding effective technical service is to take care of the lab people who take care of customers. When the people who work for you feel valued, they will make your firm's customers feel valued. This builds customer loyalty. So don't make technical service specialists feel like second-class citizens compared with researchers. The two types of jobs require somewhat different skills, but that doesn't make research superior to technical service.

The right people

Effective technical service begins with having the right people in technical service positions. This in turn requires hiring people with the technical skills and personality to do well in customer service positions. Technical service positions often don't require the deep knowledge of a science or engineering discipline that research positions do. This means that advanced technical degrees are less essential to customer service positions. Lab managers should keep this in mind when considering job candidates.

Instead, the need is for individuals eager and willing to learn the technologies practiced in the industries that include your firm's customers. Typically, the technical service specialists in your group or department will need to master at least the basics—and usually more—of how customers use your products or processes in their businesses. Depending on the size of your customer service group and the range of different applications for your group's products, a technical service specialist commonly focuses on one or two industries. However, technical service specialists may need to master the basics of more industries than this.

These requirements mean that being a fast learner and being enthusiastic are important qualities to look for in a job candidate. So are a reasonably outgoing personality and the ability to work well with others. Indeed, the best technical service candidates enjoy becoming knowledgeable in their customers' industries and working with others. Since customer service representatives will often present technical information to customers, sometimes in the form of formal oral presentations, oral presentation skills are important, as are written communication skills. These qualities, especially for new graduates, are harder to assess by reading résumés. Observing candidates' behavior during interviews and discussing these various attributes with their references assumes increased importance.

Training

Once you've hired good candidates, you need to integrate them into your company's culture, particularly its customer service culture. This means providing training in key areas required for them to deliver outstanding effective service. This often means strengthening the skills mentioned in the previous paragraph. For example, when I first joined Shell Development Company in the mid-1980s, all new employees took two three-day courses. The first was effective listening and the second, delivering effective oral presentations. The first was particularly useful since I had never studied anything similar to this course. During this course, I learned skills I have attempted to practice ever since. By listening carefully to customers and asking an effective mixture of open-ended and closed-ended questions, customer service specialists can gain a better understanding of customers' needs and concerns.

Delivering effective customer service may mean taking one or more short courses in the customers' technologies if such courses are available. They are often offered by professional societies.

Once the customer service specialist learns the key skills required to provide exceptional customer service, the lab manager must see that these skills are reinforced with ongoing coaching and feedback. Often the best way to do this is to ensure that the staff member works closely with sales representatives who should have the needed interpersonal skills and a deeper relationship with the customer. (Sales representatives often visit with customers more frequently than do customer service specialists.)

"... being a fast learner and being enthusiastic are important qualities to look for in a job candidate."

Lab managers should evaluate the performance of their customer service specialists on at least an annual basis. They should consult with sales representatives with whom their staff members work. They may wish to talk directly to customers' personnel to see how customer technical service could be improved. This needs to be done with care, as you don't want to give the customer the impression you have doubts about your staff members.

There should be provisions for providing recognition of outstanding technical service. These can be both monetary and nonmonetary rewards such as a plaque or framed certificate.

Effective strategies and tactics

One needs more than excellent technical service representatives. One also needs effective technical service

strategies and tactics. Companies often have broadly implemented strategies for developing and maintaining relationships with customers and prospective customers. Called "customer relationship management" (CRM), they usually depend on computer-based technology to organize, automate and coordinate sales and technical support activities. It is important not to let CRM overly automate and dehumanize the personal interactions also necessary to promote customer loyalty.

One way to promote these personal interactions is to have tech service staff members periodically visit the customer's plant or lab facility with sales representatives. The tech service specialist describes new products and services under development that may interest the customer. The specialist can go into the lab to demonstrate new projects or test procedures the customer may want to adopt. He or she can learn firsthand the customer's problems and concerns and can better understand the customer's technology through discussions and through plant and laboratory tours.

Restrictions on business travel may mean that these meetings should be held using videoconferences or Web conferencing.

A converse approach may be to have major customers visit your laboratory. Besides seeing discussions, your customers can see tests in progress in your applications labs. They can also talk to researchers to learn about new products or services nearing commercialization. Taking customers on plant trips to show them how the products they use are manufactured and the quality assurance tests performed before products are shipped can reassure them about product quality. One or more of your technical service staff members and the sales representative who services their account can serve as your customers' host during their plant visit.

One strategy to deal with reduced travel budgets is to hold meetings with customers during technical conferences both your staff members and customers will be attending. These can range from mealtime discussions to longer, confidential business meetings held in small, private meeting rooms. I used this strategy during paper industry conferences. These discussions would last two or three hours. Occasionally lab staff members, business managers and sales representatives not attending the conference would fly in for these private discussions.

Have your customer service representatives actively seek customer feedback and complaints. Effectively handling minor complaints can improve your chances of retaining the customer and working effectively with them when major problems arise. Work on preventing problems as well as reacting to and solving them once they occur.

> "By listening carefully to customers... customer service specialists can gain a better understanding of customers' needs and concerns."

Make customers aware of your value

Can you compare a customer's sales or costs before and after they began using your product to determine how much your product increased profits? This can be difficult to do but demonstrates your firm's value to the customer.

Work with the customer to develop case histories of the use of your product that demonstrate how it increased production, reduced operating costs or otherwise increased efficiency. Depending on circumstances, these case histories can increase your sales of a product to this customer. For example, one of your customer's plants may be using your firm's product but others are not. A case history demonstrating plant performance before and after the plant began using your product can persuade other plants to use the product—increasing your firm's sales while providing increased benefits to the customer.

It may be possible to present the case history to other potential customers in the same industry. One way to do so is a joint paper presented at an industry trade conference and authored by your customer service representative and customer personnel. However, this may not be possible, because the customer may not wish to be identified. In this situation, you can have your technical service representative write the paper in such a way that the customer's identity is not disclosed and can't be clearly deduced from the information provided in the paper. One can take the same approach in writing a technical bulletin to post on your firm's website and distribute to potential customers. It's best to work with your customer when doing this, to be sure that this approach does not raise concerns. It may be necessary to remove particular case histories from the drafts of conference papers or technical bulletins to avoid damaging your relationship with the customer.

Other strategies

Can you bring your customers business? This may mean encouraging your own firm to buy their products or services. It may mean steering a potential customer for their products or services to your customer should circumstances arise that will make this possible.

Often technical service work performed for one customer can help sales representatives and other technical support specialists better serve other customers. To accomplish this, some firms, particularly larger, global firms with multiple laboratories scattered across the globe, integrate CRM with knowledge management (KM) systems to make technical service results available to technical service specialists in widely scattered laboratories and working with different customers.

This communication is not a major challenge in small firms with a limited number of technical service specialists often working in a single laboratory. However, even in this case it may be worthwhile to have a software-based system integrating CRM with KM, since old results may be relevant to a different customer years later. Despite the costs of CRM/KM systems, they may be cost-effective for companies of all sizes if used consistently.

It can be very helpful to be able to retrieve knowledge given to various sales representatives and technical service specialists about problems faced by customers in a given industry or problems shared by different industries. Such information, if it is retrievable and collectible, could be used to guide new-product development programs and to generate new markets for existing products.

Co-development—working with suppliers to develop new or improved manufacturing processes and with customers to develop new products—can reduce development costs while speeding improved products to market. This benefits your own firm, suppliers and customers. Early revenue is especially important for smaller firms and start-up companies, which often have limited cash resources. If markets take too long to develop, laboratory budgets could be reduced even to the point of some staff members losing their jobs.

All these measures will improve your technical service staff members' morale and productivity.

Dr. John K. Borchardt *is a consultant and technical writer. The author of the book* Career Management for Scientists and Engineers, *he often writes on career-related subjects. He can be reached at jkborchardt@hotmail.com.*

INTERNAL CUSTOMERS

By John K. Borchardt

These principles and strategies also work with your group's internal customers within your own company. These include production plants for which your work group is developing new manufacturing processes as well as business development managers and sales personnel for whom your group is developing new products.

These strategies enable external customers to put faces to names and make them more likely to call your staff about problems or new-product needs rather than calling your competitors. Customers will better value your staff members and the services they provide. As your staff members get to know your customers as more than voices at the other end of the telephone line or as names on e-mails, they will be more motivated to help customers solve problems. These strategies build trust between your staff and your customers.

MANAGING EXPECTATIONS

A STEP-BY-STEP PROCESS TO IMPROVE COOPERATION AMONG DEPARTMENTS by Bruce L. Katcher, Ph.D

Does something like this ever happen to you?

You are backlogged with work in your lab and receive an urgent call from the senior vice president of new product development in your organization, asking you to rerun a test you conducted for him last month. He wants the results by the end of the day. There is no room on the schedule for your staff to conduct the test for the next two weeks, and there is a request procedure that must be followed. It's a no-win scenario. If you change the schedule, your other internal customers will be upset because you will not be meeting *their* expectations.

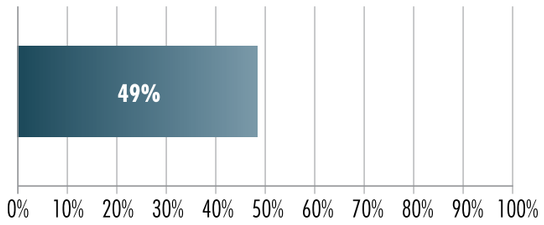
We have also found that most employees believe they are providing better customer service to their internal customers than those customers say they are receiving from them. You may think you are providing excellent service to your internal customers, but they probably don't think it is as good as you do.

In the example above, you might be thinking, "Doesn't the SVP understand our situation? Doesn't he know that we have other customers who need to be serviced and that everyone has to wait his or her turn? If he saw the world from where I sit, he would understand."

How do you keep this problem from happening every day?

Many employees just do not feel other departments in their organization are adequately servicing them. Our research in more than 80 organizations, and with more than 60,000 employees, shows that only 49 percent of employees believe that cooperation is good among departments. See chart below.

Cooperation is good between my department and other departments in our organization.



> "Only 49 percent of employees believe that cooperation is good among departments."

The truth is that most people do not understand and cannot see the world from your perspective. Instead, if they don't get their way, they view the other person or department negatively. They assume that the other person doesn't care, is uncooperative, or is just not a good employee. You probably do the same thing.

This psychological phenomenon is called "attributional bias." When we view the causes of our own behavior, we tend to think about the situation we are experiencing (e.g., all the other urgent requests we have received, our limited lab space, our inadequate staffing levels, etc.). But when we view the behavior of others, we are quick to think that the reason they do not comply with our request is because of something negative about them (e.g., they are lazy, uncaring, or uncooperative).

LEADERSHIP & STAFFING

So let's turn back to the request from the senior vice president. What do you do?

- If you say, "It can't be done," you and your department will be viewed as uncooperative and rigid. Further, in these days of downsizing and layoffs, who wants to be viewed as a non-team player?
- If you say, "yes," you will be sending a message to your other internal customers that they are unimportant. You will also be saying to your employees that it is OK to break the rules.

> "Most people do not understand and cannot see the world from your perspective."

The key is properly managing expectations: your expectations and the expectations of your customers. You all need to be on the same page, focusing on what you can each do to work well with each other.

It's like the old story about the difference between heaven and hell. This guy goes to visit hell and he sees people seated around a big long dining room table full of all types of delicious food. But they are all starving. Why? They are all holding 6-foot-long utensils and can't feed themselves.

He then visits heaven. There, he sees the same scene. Everyone is seated around a big dining room table filled with food. They also are holding 6-foot-long utensils. But they are all happily eating and content. Why? Each person is using his or her utensil to feed others around the table.

The mantra in your organization should be how each department can help every other department. *You cannot control the behavior of others, but you can control your own behavior.* You need to focus on how you can make it easy for your customers to do business with you, and others need to focus on what they can do to make it easy for you to do business with them.

We often help our clients develop this mindset through what we call "The JFK Exercise." In John F. Kennedy's famous inaugural address, he said, "Ask not what your country can do for you—ask what you can for your country." This exercise helps people throughout the organization to develop this mentality.

Here is an example of how we applied the 6-step methodology for one of our biotechnology clients.

Step 1 – Identify key departments

We first identified several departments in which cooperation was critically important. We then worked with two departments at a time. One of the pairings was the engineering and manufacturing departments. Just like you can't force a couple to go to couple's counseling if they are not interested in doing so, it is vital that the selected departments are sincerely interested in improving how well they work together.

Step 2 – Conduct a baseline internal customer satisfaction survey

We then created two detailed questionnaires. One survey measured how employees from the engineering department felt about the service they were *receiving* from the manufacturing department, and the service they were *providing* to the manufacturing department. The other survey measured how employees from the manufacturing department felt about the service they were *receiving* from the engineering department, and the service they were *providing* to the engineering department. Here are a few examples of items from each survey:

Survey of engineering employees

- The manufacturing staff has a very good understanding of our capabilities.
- The manufacturing staff does an excellent job of providing us with the lead time we need to provide them with our services.
- The manufacturing staff does an excellent job of making themselves available to us to speak with them.
- The engineering staff does an excellent job of responding to requests for information from the manufacturing staff.

Survey of manufacturing employees

- The engineering staff has a good understanding of our processes.
- The engineering staff does an excellent job of delivering equipment to us in a timely manner.
- The engineering staff does an excellent job of making themselves available to us when we need them.
- The manufacturing staff does an excellent job of providing the engineering staff with complete and accurate information about problems with equipment.

Step 3 – Identify expectations and plans to meet them

We then met with the major players from both the manufacturing and engineering departments for a half-day workshop. During the meeting, we engaged in five activities:

1. First, we presented the results of the surveys. This provided them with insights about the many improvements that were desired by their internal customer.
2. Second, we asked each group to independently go off and develop a list of what they needed from the other group. Manufacturing developed a list of what they needed from engineering, and engineering developed a list of what they needed from manufacturing.
3. Third, the group reassembled, and each department presented to the other department the list of its needs.
4. Fourth, the groups separated again and developed a list of what they were going to do to meet the needs of the other group.
5. Last, the entire group reconvened and each department told the other department how it planned to meet their needs.

Step 4 – Implement changes

The departments now had a better understanding of what the other department needed from them. They spent the next three months implementing the changes they had promised the other department.

Step 5 – Reassess internal customer satisfaction

Three months later we readministered the internal customer satisfaction surveys to both departments and compared the results to the baseline.

Step 6 – Fine-tune and recommit

Both departments met again. During this meeting we presented the survey results and pointed out where there had been improvements in service and where improvements were still needed. The groups also fine-tuned their plans for improving the services provided to each other and recommitted to the process.

We conducted similar programs for other departments in the organization as well. The process is not rocket science. Primarily, it requires commitment by both parties, survey expertise, and a good facilitator. I recommend you try it.

Managing expectations cannot simply consist of you trying to tell other departments and individuals in your organization what you can and cannot do. It must be a collaborative process in which both parties learn to understand and respect each other.

Bruce Katcher *is the president of Discovery Surveys. His firm conducts surveys of employees and customers, and helps organizations improve cooperation between departments. His award-winning book,* 30 Reasons Employees Hate Their Managers *(AMACOM), reports the results of surveys he has conducted of more than 60,000 employees in more than 80 organizations. You can subscribe to his free monthly e-newsletter at www.Discovery-Surveys.com. Dr. Katcher can be reached at: BKatcher@Discovery-Surveys.com or by phone at 781-784-4367.*

TEN FAST TIPS TO TIME MASTERY

MAXIMIZING TIME UNDER PRESSURE

by Lorna Riley

For many professionals, time is like a tidal wave that threatens to crash in on the best-laid plans with only the slightest warning. Here are 10 tips to get on top and in control of your most priceless resource—the time of your life!

1. Reduce time-wasting activities.

Eliminate time drains in your activity log. Look for interruptions, meetings, crises, an inability to say "no," lack of objectives/priorities, indecision, procrastination, unclear communication, attempting too much, and leaving tasks unfinished.

2. Respect your time.

If you waste 30 minutes a day, by the end of the year you will have lost the month of February. Treat time as "personal capital." Invest it in activities that pay off in dividends such as increased revenue, customer retention, stress reduction, work-life balance, etc.

3. Restrain time commitments.

Avoid overcommitting. Work overload leads to diminishing returns. Don't take on more than you can comfortably handle. There's always enough time for what really matters. Save time for yourself each day. You'll build reserves of energy you'll need when things get hectic.

4. Sort the urgent and important.

Decide what must be done now (urgent) and what contributes to the mission (important). To feel in control of your time, reduce the number of urgent and important matters (A priorities) so that you can invest 80 percent of your time on important but *not* urgent matters (B priorities). B priorities have to do with preventative measures, crisis elimination, creating life-work balance, etc. Use the 20-80 rule to separate the vital few from the trivial many. Invest 20 percent of your time in your top priority to be 80 percent effective.

5. Eliminate distractions.

To eliminate time wasters, be ruthless about eliminating situations that intrude on your personal time. Assign interruption times, move to a quiet location, use voice mail, or start work before the crowds come in.

6. Find information fast.

Studies show that 20 percent of time is spent searching for and/or just handling information. To be organized, be able to put your hands on whatever you need in your workspace within 60 seconds.

7. Break the procrastination habit.

This is possibly the greatest time waster of all. Make a radical change in your routine by breaking major tasks into subtasks. Take it one bite at a time. Start on the easier parts first. Use the "As long as I'm here" technique to get the ball rolling. Reward small victories.

8. Use other people's time to leverage your own—delegate.

The greater your responsibilities, the more help you need from others. Always ask, "Who else can I get to do this for me?" Delegate, delegate, and then delegate more until you are doing only what *you* can do.

9. Be creative with your time.

Discard costly habits and replace them with more innovative techniques. Barter time with others, trade favors, consolidate activities geographically, plan ahead, have a Plan B ready. Keep your eye on the goal, exploring new ways of reaching it if you hit a wall. Nothing worthwhile ever came easily.

10. Add hours to your time budget by working smarter, not harder.

Use e-mail, speed-reading and memory techniques; make good decisions quickly based on what's important; only handle paper once; multitask; and delegate.

***Lorna Riley** is a 25-year veteran international professional speaker, trainer, published author, and CEO of Chart Learning Solutions. She has created more than 80 training programs, four Coaching Guides, 220 eLearning modules, and assessments in sales, leadership, management, and customer service. You can reach her at Lorna@chartlearningsolutions.com or by phone at 760-639-4020.*

TECHNOLOGY & OPERATIONS

SIMULATION-BASED PLANNING

OPERATIONAL RESULTS INCLUDE REDUCED CYCLE TIMES AND IMPROVED EQUIPMENT UTILIZATION AND SCIENTIST EFFECTIVENESS

by Mike Lickley and Jim Curry

Simulation is growing in popularity as a best-practice tool that allows companies to move to the next stage of optimization of the pharmaceutical manufacturing, quality and laboratory environment. It is due both to the sophistication and the robustness of the tools available, as well as the need to optimize operations in response to changing market needs and financial pressures.

Simulation tools have been available for 40 years, but advances in computer technology have now made them truly practical for use in managing operations in laboratories, which by their nature are complex due to the mix of tests conducted, the variety of equipment involved and the scientist skill sets needed.

"Across the three labs, there are 155 different types of test equipment, totaling 2,035 pieces of inventoried items."

A simulation-based planning system has a variety of uses within a laboratory for Lean teams, Six Sigma experts, lab supervisors and management. This article describes our experience and learnings from the use of simulation over the past four years in a complex laboratory environment that conducts a variety of tests for in-process, product release, stability and raw materials as well as ad hoc research analyses.

This article describes how simulation can be used within a lab to predict the load on staff and equipment, using a scenario testing "what-if" capability for shift changes, campaign size, test mix and volume changes. It also describes how the lab schedule can be integrated with the production stream model for a complete end-to-end flow.

The models used in both laboratories and production are OpStat's Lean simulation models that use Excel inputs for test details, equipment inventory and shift skills assignments, as well as outputs for management summary and detailed reporting.

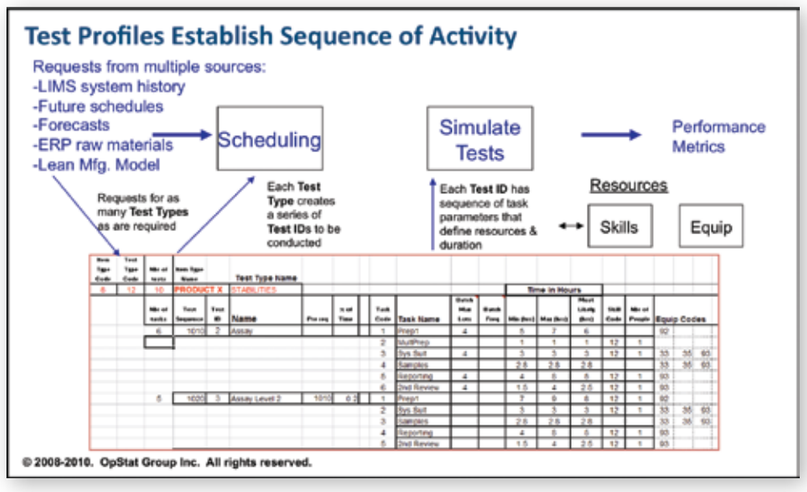


Figure 1. Lab Model Overview. Simulated requests from multiple sources follow the actual or proposed rules for scheduling / operating the laboratory.

Description of facility

The J&J Alza facility in Vacaville, CA, has three laboratories, one primarily for raw materials and two for commercial products and controlled and noncontrolled substances. Organizationally, there are three commercial lab teams aligned with the different production streams in the facility and the raw materials team. The equipment in the raw materials lab can also be used by the commercial teams when needed.

Across the three labs, there are 155 different types of test equipment, totaling 2,035 pieces of inventoried items. As a representative year, in 2006 the facility completed a total of over 8,500 test requests, requiring over 70,000 individual attribute tests, i.e., 70,000 assays. Total staff in that year was 190 scientists and supervisors.

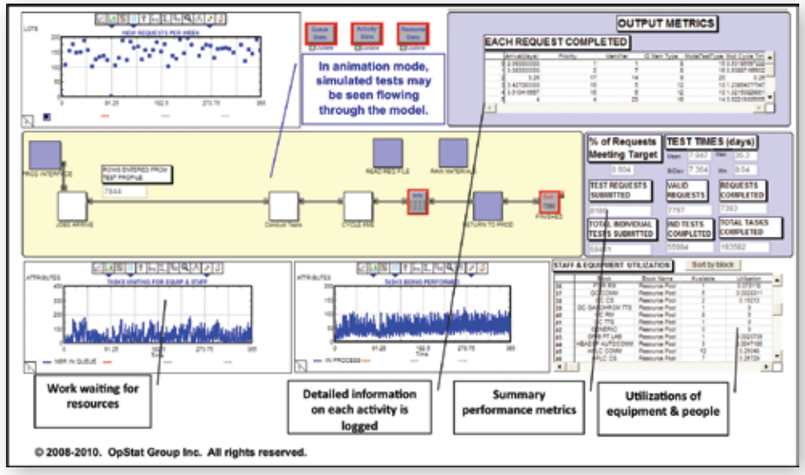


Figure 2. Model Summary Outputs Performance metrics are produced as the demand flows through the process.

In the Quality organization, there is also a separate QA documentation department responsible for test documentation review and sign-off. This department's resources and estimated process times are defined to the model, as are the testing lab's skills and equipment.

Management vision

The Process Excellence, Quality and Production management at the Alza facility had the foresight to utilize best-practice tools to improve operations with sustainable processes that included making laboratories

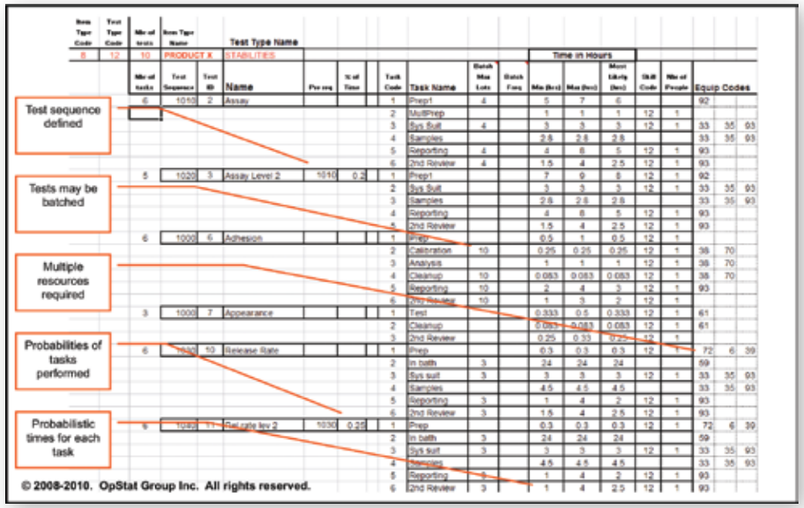


Figure 3. Test Profile. Each material and test type combination may have unique test attributes and detailed tasks. Use of probabilistic parameters are controlled by an on/off switch setting.

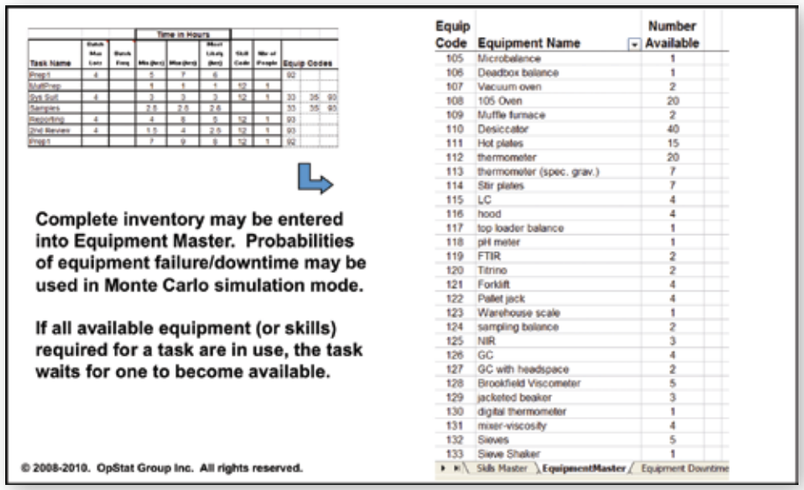


Figure 4. Equipment Inventory. The Test Profiles reference the individual pieces of equipment specified.

part of a seamless production flow. This included shared metrics, starting with ordering of raw materials and progressing through final product release.

The end-to-end view highlighted where some improvements in one area could cause problems in others. For instance, traditional Lean manufacturing concepts of smaller lots and more frequent ordering of raw materials can cause a workload problem for pharmaceutical labs that must test each lot received. The objective was to optimize the entire flow.

The vision also included applying the use of an OpStat Lean Laboratory simulation model, similar to one already successfully part of the manufacturing planning process. This helped to learn the facts, to understand the dynamics in the laboratory. A laboratory is a type of "job shop" where, depending on the test type and product, the equipment and skills required vary.

Resource utilization metrics in a job shop tend to be lower than with a process flow, where there is a high degree of repeated operations. Capacity planning for staff and equipment, particularly expensive equipment such as GCs and HPLCs, relies on understanding the facts and dynamics in the operation.

Objectives for system

The overall objectives within the context of the end-to-end system were to "Lean" the lab, i.e., eliminate variability and delays wherever possible and meet throughput commitments for all types of tests.

The complexities in the operation are similar to those faced in all test laboratory facilities, mainly that it is difficult to understand all the interactions that take place and impact the results in meeting commitments to complete test requests. As requests arrive at the facility, a prescribed set and sequence of attribute tests are required. These specify:

- The equipment that needs to be available
- Skill sets that need to be available
- Probabilities that certain conditional level two or three tests will need to be completed

The simulation model allowed different priority schemes to be tested, and responsibilities for defining who allocates equipment and skills and when they are allocated. The model also allowed the impact of equipment downtime to be measured, as well as the impact of process variability, using the latest probabilistic Monte Carlo simulation techniques.

"A laboratory is a type of 'job shop' where, depending on the test type and product, the equipment and skills required vary."

The model needed to be able to simulate the laboratory requirements for the distinctly different production streams, incorporate the analytical tests that were not as predictable as the regular production tests, and measure performance with metrics that were meaningful to the lab supervisors and Quality management.

Laboratory model overview

The model uses spreadsheets for data inputs, including actual test history, forecasts, test profiles and equipment, and skills matrix. It then processes tests based on priorities and rules to determine lab capacity. Summary reports are output in spreadsheets and graphs. Figure 1 shows the flow of input, processing and outputs for the model. Once the model has completed a run, a detailed overview summary is provided as shown in Figure 2. This one-page view provides a data-rich overview of lots completed, cycle times and resource loading. Drilling down into the model gives further details, and Excel reports are provided for further analysis.

Using the model for planning

The sources of demand for the labs consisted of a variety of different types of tests and required turnarounds. Some in-process tests required completion within a few hours while the production stream waited, while others had up to 30-day requirements. In total, the mix of work included tests for lot clearance releases, multiple types of

in-process, stabilities, customer complaint investigations, equipment swabs, validations, R&D analytical requests and raw materials receipts. Some of these demands could be predicted based on production schedules, while others were more random and used probabilistic distributions.

"The model uses spreadsheets for data inputs, including actual test history, forecasts, test profiles and equipment, & skills matrix."

Supervisors provided inputs on the test requirements for their areas of responsibility down to the detailed task level and required resources. Figure 3 shows the sequence and requirements for test execution. Since batching of attribute tests and setting up level-loaded schedules where possible are important to throughput, batch quantities and frequency are entered in this Test Profile. Figures 4 and 5 show examples of the equipment inventory and skills scheduling inputs. The supervisors also performed a reasonableness checkout for each step in the process and were trained to use the system.

The model was first validated by using the volume history from the LIMS system; equipment outages from the metrology system were also input to the model. The volumes and actual process times from completed tests were run through the system, and output metrics for completion vs. target times were compared to actual management metrics that had been derived in the manual system.

Once validated vs. management metrics, the model was ready for "what-if" scenario evaluations. Forecasted volumes and test/product mix were applied to see the resulting impacts on throughput performance and resource utilizations. Early on in its use, the model gained credibility when it showed dynamics that at first appeared counterintuitive. For example, the accepted thinking was that HPLCs were a critical bottleneck. However, the model showed that a type of balance was a bottleneck for a number of different products and tests. When these data were presented to the scientists in the lab, they confirmed the delays they were encountering on a regular basis.

The model was fed from Excel workbooks, which made the training easier. The inputs included the test matrices with min/max times for each activity, equipment inventory, skills and shift assignments, actual LIMS history, and forecasted volumes and mix changes. The model was also set up to feed an Excel output workbook that had been compiled manually, so that the metrics were consistent with what management had been used to. The probabilistic capability of simulation is a key benefit to the technology, since it provides metrics such as ranges of results and confidence intervals around service levels and utilization results. Probabilistic inputs may be based on minimum/maximum estimates or specific probability distributions as the expertise in the use of the system grows. Figure 6 has an example of a probability distribution for demand derived from actual LIMS history.

Data management is an important aspect to using a system such as this. The four team supervisors and Process Excellence staff all had access to the model, so keeping data in sync required some up-front planning. A core copy of the latest configuration was maintained on a shared server, and the files were then available to whoever was going to run a scenario.

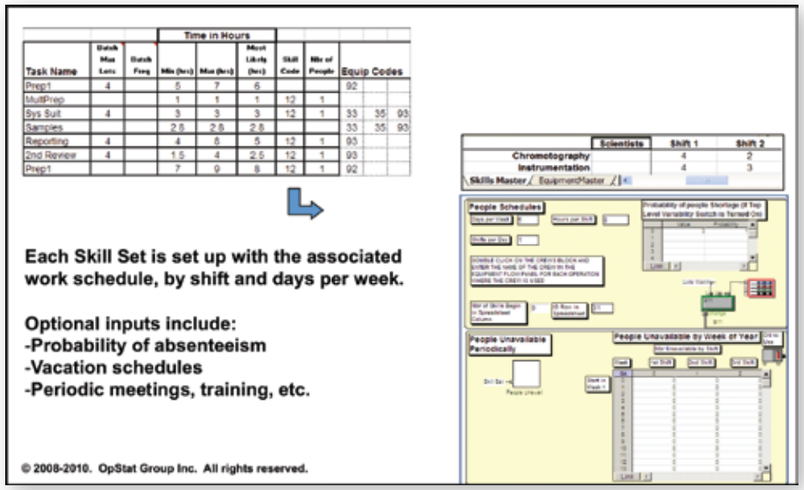


Figure 5. Skills Inventory. Individual people and/or groups of skilled scientists may be entered by shift schedule.

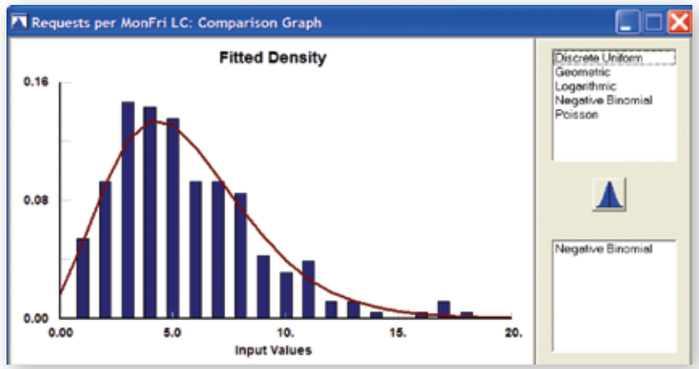


Figure 6. Probability Distribution Input. Variability in demands on laboratories is frequently skewed distributions. This is an example of daily variability of a subset of non-production test requests; weekly variability also has different characteristics. Production test demands are driven by production schedules.

Results

The result of deploying capacity simulation cannot easily be quantified individually but must be considered as a part of our overall sitewide Lean initiative and a contributor in our achieving year-over-year process improvement for multiple years while maintaining benchmark results in lab quality. The simulation was used to level the workload, integrate the labs into a rhythm cycle synchronized with production where possible and incorporate standard work metrics to manage the staff.

Operational results were reduced cycle times and improved equipment utilization and scientist effectiveness. Perhaps more important, the simulation provided needed understanding of the real capacity of the laboratory and insights on the drivers of capacity utilization and service level.

Summary

When we consider the complexity of most supply chains, our teams need tools to be able to predict future performance based on a wide variety of input variables, changing conditions, and demand uncertainty and volatility. The OpStat Lean Laboratory capacity simulator helped our site achieve the imperative—which is true of most supply chains—to reduce cost while improving customer service.

The OpStat simulator was used in both the development of staffing plans and in communication to supply chain partners on expected lab delivery performance. It was a vital tool in understanding and driving process performance improvement. By predicting lab capability and optimizing operations, the lab was able to participate and contribute to overall supply chain synchronization, waste reduction and asset utilization while improving cost and delivery performance.

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TECHNOLOGY & OPERATIONS

THE ABCs OF ELECTRONIC SIGNATURES

SUCCESSFUL TRANSITION FROM PAPER TO ELECTRONIC DEPENDS ON SOPS, SOFTWARE FEATURES, AND VALIDATION

by David Nettleton

The Food and Drug Administration's 21 CFR Part 11 allows a company to implement computer systems that will greatly increase the efficiency of individuals, reduce errors by identifying risks in the processes that use software applications, and increase overall productivity. When the law took effect in 1997, it aligned the world of regulation with the evolution of computers. It allows "paperwork" documentation to be significantly reduced or completely eliminated.

Computers have made people much more productive, so it is natural to use electronic records in place of paper records. Every company has electronic records, but most companies are so unsure about electronic signatures that they print out copies of electronic records and sign the paper. What these companies don't understand is that it doesn't take much effort to become Part 11 compliant for both electronic records and electronic signatures.

While regulatory and accrediting agencies are auditing companies for compliance, computer systems in general are changing, and therefore what needs to be audited is changing. The law hasn't been changed to provide any meaningful details, so companies and the auditors are continually trying to understand the specifics of compliance. This problem is shared by all industries under regulation.

How can you eliminate paperwork altogether by implementing electronic signatures?

If you have electronic records and you print them out for signature approval, the implementation of the electronic signature will completely replace the need to print. Every approver will instead provide his or her signature electronically.

Any signature process involves these steps: review what is to be approved, identify who is to do the approvals, identify the meaning of the signature, make a unique indication that the person really did make the approval, and include the date of the approval. Once all approval signatures are made, the document being signed is kept in a safe place with limited access to avoid loss or alteration.

An electronic signature can be one of several different things. Most of the time an electronic signature uses the same username and password that is used for system access. Biometric devices such as fingerprint scanners are superior, but concerns about civil liberties have prevented this technology from being adopted. Also, fingerprint scanners don't work well for people who wear gloves. Retinal scanners are the next type of biometric device, but most people aren't willing to look into a laser beam several times a day. A few years ago the digital signature was touted as being the next best thing. A digital signature, also known as a digital certificate, is a complex computer-to-computer system that involves encryption.

Most companies are sticking with the familiar username and password for secure access to their computer systems and therefore use the same for their electronic signatures. The process for this type of electronic signature follows the same basic steps as any approval process but has some differences that are far superior.

To review the electronic records to be approved, a user can read the document directly on the computer screen or print a disposable copy of the document. Despite all the advances in computers and the idea of going paperless, many people prefer to read documents on paper. The difference here is that the paper used for reviewing is not going to be retained. To perform an electronic signature, the computer software displays the names of the approvers and the meaning of the signature. The meaning is usually a short sentence. An approver enters his or her username and password and the system confirms they match, just as it does when that person logs in to the system. As soon as the first electronic signature is made, the software immediately locks the electronic records to prevent modification by anyone and the date, time, and meaning of the signature are permanently linked to the electronic record. This is to ensure that all approvers are approving the same information. At this point you have a securely approved set of electronic records that cannot be modified, is available online, and is backed up to allow for disaster recovery. In all ways, electronic records with electronic signatures are superior to paper records. And electronic signatures are much less expensive and readily available.

What is preventing companies from using electronic signatures?

Even after people understand the specific requirements, there is still resistance due to the elimination of the handwritten signature. The electronic version is far superior but it doesn't offer the same level of comfort.

Is there a way to have electronic signatures and still have the handwritten signature?

The answer is absolutely yes! A digital pen allows for an electronic signature on paper with a real ink pen. What is amazing is that people get to work with pen and paper while at the same time everything they do with the pen is captured on an electronic equivalent. See Figure 1.

IMAGE COURTESY OF EXPEDATA, LLC - ©2010

The digital pen works exceptionally well for data capture on forms and for electronic signatures. Here is how it works for an electronic signature. You create a form or document. The digital pen software prints the electronic document record and a hidden pattern on plain paper. People sign and date the paper documents with the digital pen that records everything they write. Many people can share the same pen. When someone inserts the pen into a dock connected to a standard computer, the data in the pen is transferred to the digital pen software, where the original electronic document record and the electronic copies of the handwritten signatures are combined. The entire process is fully secured by encryption. At this point you have a securely approved set of electronic records that cannot be modified, is available online, is fully searchable, and is backed up to allow for disaster recovery. In addition, you have the familiar and comfortable paper record with the ink signatures. If that paper should be lost, all you have to do is print the electronic copy of it and again have the familiar handwritten signatures on paper.

When using a paper form with a digital pen, the process is much the same. Each time a form is printed, a unique hidden pattern is automatically added. When someone writes on the form with a digital pen, every ink stroke is captured. If someone writes on multiple forms and performs multiple electronic signatures, all are kept straight by the software when the pen is docked. This is also true when multiple people using multiple digital pens write on the same form. A digital pen can hold about 200 pages and be used for a week before needing to be docked to transfer the data and recharge the battery. It is natural and easy to fill out a form with a pen. You can supply dates, times, numbers, and text; check boxes; and write cursively with-

out any training. It really is less expensive, faster, easier, and more comfortable than a handheld computer device such as an iPhone or BlackBerry.

What exactly is required to use electronic records and signatures in place of paper records?

There are three primary areas of compliance: standard operating procedures (SOPs), software product features, and validation. What the regulations intend is for companies to implement good business practices. This is in alignment with the concepts of Good Manufacturing/Clinical/Laboratory Practices (GxP).

As all regulated companies know, the company's SOPs describe how processes are to be performed. In the implementation of those processes, Part 11 allows any paper record to be replaced with an electronic record provided the computer system has appropriate features and is validated. Let's explore the details of each area one at a time.

SOPs

There are several SOPs needed to address the overall SOP system and IT infrastructure for software and electronic data.

1. SOP Management–how to create, approve, and distribute SOPs
2. Training–how to record the training of staff and ensure that they have the experience and education necessary to perform their jobs
3. Internal Audits–how to conduct self-assessments to ensure that staff comply with their SOPs
4. Facility Security–how buildings are secured to ensure that the data is physically secure
5. Data Backup–how electronic data is backed up and stored off-site
6. Data Archiving–how to make room on a server by copying data to removable media and then deleting it from the server
7. Network/Computer Security–how the network, server, and workstations are logically secured
8. Software Installation–how to perform computer hardware and software installation
9. System Security Reviews/Audits–how audits of security vulnerabilities are conducted in order to ensure ongoing data protection
10. System Maintenance Event Recording–how to record hardware and software changes to your servers
11. Disaster Preparation/Recovery–the plan for dealing with disasters both small and large
12. Record Retention–how long to keep each type of document, file, etc.
13. Electronic Signature Policy–how to use electronic signatures so they are the legal equivalent of handwritten signatures
14. Computer System Validation–how to validate commercial off-the-shelf software (COTS); this often is the 10-step risk-based documentation approach

System features

More than 40 industry standard software product features are needed to ensure that the computer system is secure, contains audit trails for data values, and guarantees the integrity of electronic signatures. Examples of industry standards for security include minimum password length and minimum password change frequency. Examples of industry standards for audit trails include recording of user, date, time, old data value, and new data value. The product features are included in the software by the software developer and are often configured by the users during validation.

Computer system validation

Every computer system must have documented evidence that the system does what is intended and that users of the system can detect when the system is not working as intended. Validation must follow the company's SOPs, and virtually all companies find the risk-based approach to computer system validation to be the most efficient and cost-effective method of validation available. The 10-step risk-based approach includes the following fill-in-the-blank documents:

1. User Requirements
2. Validation Project Plan
3. Installation Protocol
4. Installation Report
5. Functional Specifications
6. Hazard Analysis
7. User Testing Protocol
8. User Testing Report
9. System Release Report
10. Validation Completion Report

The key to compliance is to use the law to your benefit, and not to try to ignore it or circumvent it. When you buy a computer system to become more productive, doesn't it make sense to use Part 11 to maximize productivity?

TECHNOLOGY & OPERATIONS

How much effort is required to become compliant?

To draft all the required SOPs takes approximately two days.

To perform a gap analysis of a software product vs. the required software features takes approximately two hours. Once the gaps are identified, the users will need to work with the software vendor to coordinate upgrades, and user procedures need to be drafted to define workarounds for both the short and the long term. This "filling of the gaps" takes approximately one day.

Validation, following the 10-step risk-based approach, takes approximately seven team days for a medium-sized software application. A team usually consists of three to five people who represent the interests of all the users of the system. These "congressmen," so to speak, complete the fill-in-the-blank validation documents.

> "Computer systems in general are changing, and therefore what needs to be audited is changing."

Why is there is so much noncompliance and so much fear of Part 11 and especially validation?

The simple answer is that there has been little leadership in this area. Historically, all the players involved have not known what to do and have pointed fingers at each other. The regulated company gets very little from the regulations. IT departments are not experts on regulations and the many different software applications that they support. In fact, the users and IT are often confused by the inconsistency in the product features of the applications they use. Quality assurance staff most often do not have the computer skills and experience needed. Software vendors are themselves not regulated and therefore don't really understand what the users need. Users are focused on doing their jobs and don't understand the requirements that Part 11 places on them.

The FDA and the Department of Health and Human Services have not, and legally cannot, provide specifics for compliance. Industry has developed standards, but sharing between companies that compete with each other is difficult at best. And probably the biggest problem of all is that there are few resources who know all the pieces and can provide the leadership needed to coordinate all the players.

Achieving higher productivity and security

If you want to make your staff more productive quickly, you can use the computers you already have. 21 CFR Part 11 and all the equivalent laws make it possible. In about two weeks you can address the SOPs needed for the IT infrastructure, industry-standard product features, and validation of a computer system. During validation you can include electronic signatures, eliminate paper, and increase security. This is the recipe for how companies can compete globally.

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PURE WATER

WHAT TO CONSIDER WHEN DESIGNING A CUSTOMIZED LAB WATER SYSTEM

by Jeffrey Denoncourt

Purified water is the most common reagent found in laboratory facilities, used throughout experimental protocols in virtually every type of application. Whether used for washing glassware, buffer preparation, cell culture, or a highly sensitive analytical technique, the appropriate grade of water is essential to support research projects and maintain productivity.

"... the appropriate grade of water is essential to support research projects and maintain productivity."

A vast array of purification technologies, materials, design, and installation options are available to deliver purified water throughout a laboratory facility. Identifying the combination best suited to meeting individual user and departmental needs throughout the laboratory facility can be a daunting task. Further complicating the design of a lab water system are usage patterns and purity requirements that can vary widely among labs, floors, and departments within a single facility.

This article describes several key factors that must be considered when designing a customized lab water system and outlines best practices for defining purity level and volume requirements. Options for water distribution design and equipment are also described.

Where to begin?

Designing a new lab water system or retrofitting an existing system requires a thorough understanding and working knowledge of contaminants, purification technologies, industry standards, user requirements, and water distribution options.

A successful water system design begins with a clear and precise definition of user needs throughout the facility. The purity level and volume of water required at each point of use can vary considerably and therefore must be fully assessed in order to properly inform the designer of the water purification system.

Contamination	Parameter and unit	Type III	Type II	Type I
Ions	Resistivity MΩ-cm	> 0.05	> 1.0	> 18.0
Organics	TOC (ppb)	< 200	< 50	< 10
Pyrogens	(EU/mL)	NA	NA	< 0.03
Particulates	Particulates > 0.2 µm (units / ML)	NA	NA	< 1
Colloids	Silica (ppb)	< 1000	< 100	< 10
Bacteria	Bacteria (cfu/mL)	< 1000	< 100	< 1

▲ *Table 1. Summarized guidelines of water quality standards.*

Water Quality	Applications
Type III water	**General and non-critical application** Feed to: washing machines for final rinsing of glassware, heating baths, autoclaves, etc.
Type II water	**Standard applications** Buffer preparation; Microbiological media preparation; Feed to: clinical analyzers, weatherometers, wasing machines, all SST autoclaves; Preparation of reagents for chemical analysis or synthesis; Feed to Type I ultrapure water systems, etc.
Type I water	**Critical applications** HPLC mobile phase preparation; Blank preparation; Sample dilution in GC, HPLC, UHPLC, AA, ICP-MS and other advances analysis techniques; Preparation of buffers and culture media for mammalian cell culture: Reagent preparation for molecular biology, etc.

▲ *Table 2. Different water purity levels are required for different applications.*

A number of organizations offer detailed standards for water purity levels. While there is some variation across these standards, most classification schemes have three purity levels—Type I, Type II, and Type III—with Type I being the most pure (Table 1). When assessing user needs, it is important to keep in mind that different laboratory applications require different types of purified water (Table 2).

Once water purity requirements are defined, it is essential to calculate the volume of water that will be required at each use point. This calculation must take into consideration all use points requiring pure water including sink faucets and instruments such as glassware washers. Timing of water usage must also be determined. Is the expected usage relatively consistent over

LAB DESIGN & FURNISHINGS

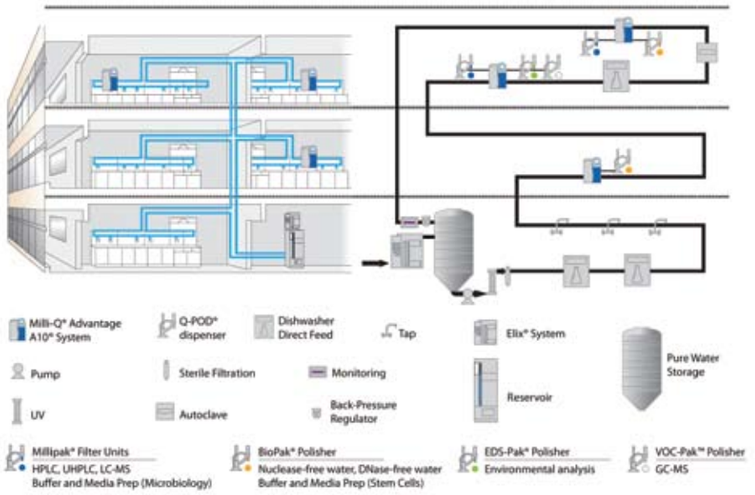


Figure 1. Central system configuration with distribution throughout the whole facility.

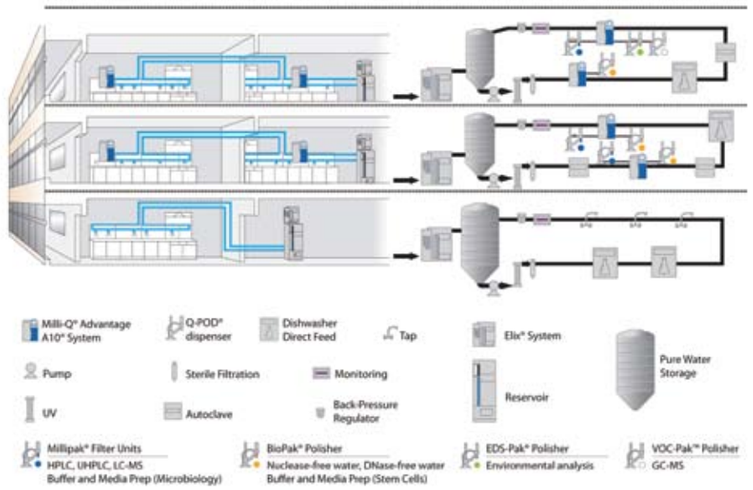


Figure 2. Floor-by-floor or department-by-department system design.

a typical workday or are there times of peak demand? Will water be used over a 24-hour period or limited to an eight-hour workday? Will there be demand for water on the weekend?

When assessing volume requirements, it is also important to estimate the maximum simultaneous usage when there are multiple points of use. This information provides guidance as to the proper size of equipment, flow rates and pressure requirements of the water system designed for the facility.

Pure water supply configuration options

The overall configuration of a system used to provide pure water throughout a laboratory facility can be customized in a number of ways in order to meet that facility's unique needs.

The traditional design approach to supplying pure water to a facility has been to lay out a single loop with several hundred or thousand feet of pipe throughout a facility, with a larger single water purification system, storage tank, and distribution pump in a central location (Figure 1). However, several alternative configurations exist for the design of a total pure water system. Considering these alternative approaches can help identify the design that will best meet the needs of the facility.

A simple variation of the central location pattern may include duplex make-up purification systems or distribution pumps. This approach provides redundancy of these key components, which allows one system to shut down for routine maintenance or service while the other remains operational.

When volume and purity requirements vary widely within a facility, the water system can be configured by floor or by department with smaller systems designed to meet "local" user requirements. A large system with a separate distribution loop can address areas where high-volume needs exist (such as a central glassware washing station), while other departments or floors can be addressed via smaller systems and smaller distribution loops (Figure 2).

Small, point-of-use systems can also be incorporated to meet individual user or laboratory needs for ultimate flexibility (Figures 3 and 4). These small point-of-use systems include a local purification system, storage, and additional polishing to meet water quality requirements. This approach eliminates the need to extend central piping to all departments and can vastly simplify the main total water purification system. In some cases a laboratory facility's pure water requirements can be met using only multiple small point-of-use systems, eliminating completely the use of distribution piping.

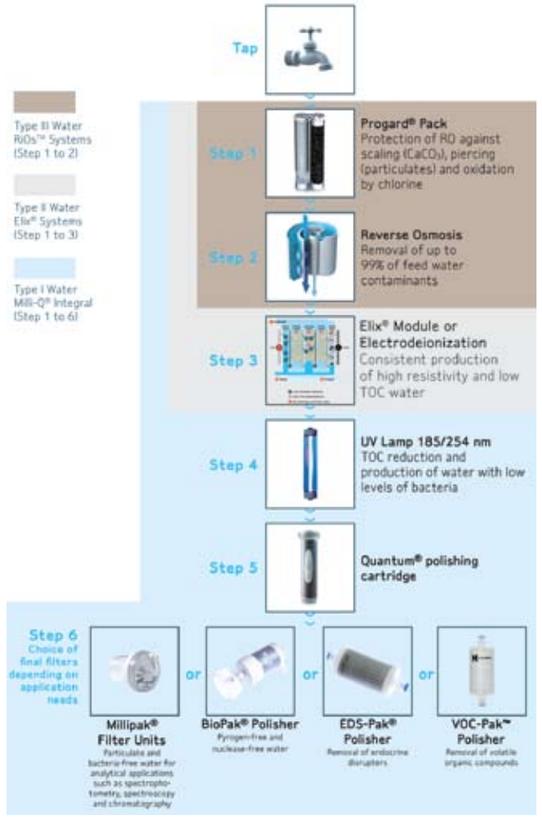


Figure 5. Multi-step purification process required to achieve different water quality levels.

	Inorganic	Organics	Bacteria	Particulates
Carbon		●		◗
Microporus Filtration			●	●
Distillation	◕	◗	◕	◕
Reverse Osmosis	◕	◕	◕	◕
Ultrapure Ion Exchange	●	◗	◔	
Electrodeionization	●	◗	◗	
Ultraviolet Light		◕	●	
Ultrafiltration		◗	◕	◗

Table 3. Effectiveness of various purification technologies in removing common water contaminants. Circles indicate the relative effectiveness of removal; a full circle is approximately 100% removal of the contaminant.

Purification system selection and design

Proper design of a water purification system requires a customized combination of purification technologies and system components to achieve the necessary water quality and capacity for all facility applications.

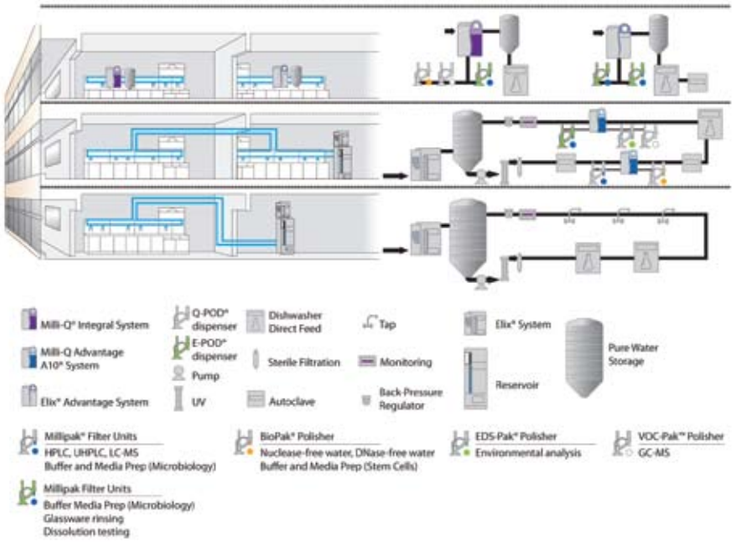
The four major categories of contaminants (inorganics, organics, microorganisms, and particulates) found in tap water can be naturally occurring, substances added at water treatment facilities, man-made compounds, or derive

from materials contained within systems used to distribute water.

Since no single technology can remove 100 percent of the contaminants commonly found in tap water, lab water systems must incorporate a combination of approaches to produce purified water. Table 3 (on previous page) summarizes the most commonly used water purification technologies and their effectiveness in removing these contaminants. Figure 5 (on previous page) illustrates a multi-step purification process required to achieve different water quality levels.

In addition, careful consideration must be given to selection of the production rate of the make-up purification system, the volume of the storage reservoir and specifically how the pure water will be delivered to the points of use. A properly designed system will satisfy all the customer's water demands (including the peak demand), with the water "turning over" frequently to avoid stagnation and minimizing risk of contamination.

▼ *Figure 3. System design by floor or by department with some small specific individual systems.*



"... lab water systems must incorporate a combination of approaches to produce purified water."

Various components of the water purification system should be customized to meet facility requirements and maximize user convenience. These components include:

- Make-up water purification system

  The make-up water purification system produces the total volume of water expected to be consumed by an individual user, department, or in the case of a larger central system the complete facility each day. The make-up system, starts with tap water and purifies it to a level that meets predefined quality requirements.

- Storage reservoir

  Purified water from the make-up system is stored in the reservoir to help cover peak periods of high demand. The make-up system and the storage reservoir must be sized together to meet the daily pure water demands.

- Delivery and distribution of pure water

  Pure water from a larger central system will require a distribution pump, additional purification equipment to maintain water quality and distribution loop piping to bring water through a facility to use points at the correct flow rates and pressures. Small individual systems need to include point-of-use dispense points to conveniently deliver water.

- Point-of-use delivery and polishing

  Water that is accessed from the distribution loop via multiple point-of-use locations can include additional polishing at delivery points to increase water quality to meet the needs of more sensitive applications. Small individual systems may include polishing integrated into the system to increase water quality.

Conclusion

A well-designed lab water system can help ensure the success and integrity of research from the smallest academic labs to the largest research laboratory buildings.

Successful water purification systems effectively align purification technologies, mechanical components, and installation options with user needs throughout the laboratory facility. Designing the optimal system begins with a thorough understanding of user requirements, usage patterns and facility layout. A wide range of configuration options can then be evaluated and customized to create the optimal system.

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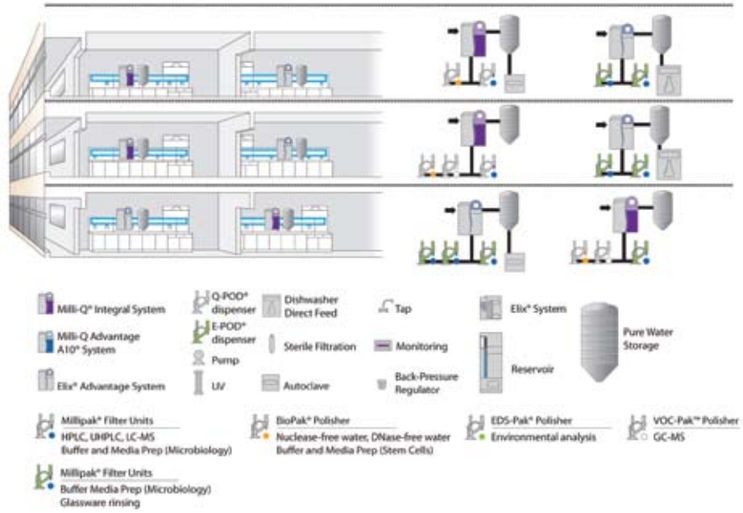
Visit www.millipore.com/A&E to access Millipore's new "Total Water Solutions Guide".

▼ *Figure 4. Lab water system incorporating small point-of-use systems to maximize flexibility.*



DESIGN FOCUS: SUSTAINABILITY

BEST PRACTICES IN GREEN DESIGN

by Jay M. Brotman, AIA, and Robert B. Skolozdra, AIA

When considering the design and construction of a new laboratory space, the question of environmentally sustainable or "green" design will arise early on. With the issue of sustainability fast becoming ubiquitous in our culture, the benefits of green design and building are prized highly by architecture, engineering and construction professionals as well as by many in the scientific community at large.

In keeping with the commonly held notion of the three pillars of sustainability—people, planet and prosperity—a lab project is best approached when framed with the question "Can we design and build a new research facility that benefits all the building stakeholders and the planet as well?" And in fact, there are novel lab-design techniques that significantly reduce not only negative impact on the environment but also operational, maintenance and energy costs. Many of these approaches also create a healthy environment for the facility's occupants, fostering such added benefits as improving the productivity and usefulness of research.

> "It is crucial that laboratory owners, users and designers agree on project goals and parameters."

For these benefits to be realized with minimal increases in capital costs, the design approach must be fully integrated. Adding a few green elements to a traditional lab design may not only fail to yield the desired benefits but also could negatively impact other building systems. The best approach is a holistic one: integrate all design and building elements by taking a sustainable approach, from the earliest stages of planning through the operation of the facility, and by expressing the client's mission, from the overall plan to the smallest detail.

1. Planning stage

First, it is crucial that laboratory owners, users and designers agree on project goals and parameters. Clearly articulating the specific requirements and ambitions of each stakeholder at the beginning of the design-build process is critical: you have to get *everybody* to the table and set the project's priorities from the earliest stages. This can be best accomplished in a project positioning workshop held with the architect and engineer before design work has begun. Everyone present will be able to understand not only his or her individual role in the process, but also what compromises may be required and how the agreed-upon priorities may affect the achievement of individual goals.

The owner, for instance, may be confronted with the increased front-end capital costs of incorporating sustainable design features. But if the owner understands from the outset that the savings from reduced operational costs in high-performance labs will quickly offset the increase in initial outlay, he or she can be a willing, even enthusiastic partner in the development of the sustainable lab. In this way, stakeholders are less likely to ask about cutting corners and reducing costs in later project phases.

▲ *A well-designed and sustainable laboratory is achieved through a workshop process involving all project stakeholders, beginning during the planning stage and continuing through all phases of design, construction and even operation. The renovation of the Kline Geology Lab at Yale, pictured, was the result of such a process.* PHOTOGRAPH COURTESY OF OLSON PHOTOGRAPHIC.

LAB DESIGN & FURNISHINGS

During the workshop process, a stakeholder from the facilities department may find, for instance, that the green lab will have more controls that require monitoring or learn that the lab may need to operate more closely to certain safety tolerances than another comparable facility does. The user will learn from the workshop process how staff members and technicians will function in the space and how lab equipment will be operated, such as turning off water supplies and closing fume hoods, so that control systems are working at their highest efficiency levels.

All stakeholders should benefit from participation in the workshop process, and this will also mean a greater overall benefit to the space. And in addition to the long-term cost savings enjoyed by the owner, the facilities manager will have a shorter list of responsibilities and the user will occupy a safer, healthier lab space. Of course, this workshop process will be especially successful if the meetings continue throughout all phases of design and construction.

2. Green certification and LEED

Being the first name in certification for green building, the U.S. Green Building Council (USGBC) LEED rating program is well known, largely respected and occasionally controversial. Some owners will insist that a new facility follow LEED guidelines and file for certification. With respect to laboratories, this creates unique challenges.

Because there is no "LEED for labs" category in the program, guidelines developed for other building and project types will have to be used. A well-known example is the restructuring of the interior of a new laboratory for the Yale School of Medicine. Designed by the local New Haven architecture firm Svigals + Partners, the project received a Gold rating under the rubric of LEED for Commercial Interiors (LEED-CI) and was chosen by the USGBC as a case study for developing a LEED standard for lab renovations.

Because the category of Commercial Interiors is a rather awkward fit for a laboratory, the design team needed to constantly adjust its approach. For instance, LEED requirements for energy use are quite strict; even the application of heat-recovery units in the HVAC system put only a minor dent in the requirements. The big problem for lab energy use is ventilation: higher air exchange rates, required for the safety of building occupants, mean a higher energy load is needed.

LEED certification may not always be the best goal for laboratory design, and the LEED checklist is only one of many available systems. Stakeholders should agree

early on whether LEED is project essential and also should discuss whether the project could achieve goals of sustainability that surpass LEED requirements. If the team members agree to seek LEED certification, they should then make surpassing the LEED requirements a part of the strategy, in part because exceeding the requirements is laudable, but mainly because it is unlikely that the Green Building Certification Institute—the body that awards LEED credits, points, certifications and rankings—will approve each and every individual credit for which the project team has applied.

In the meantime, while the USGBC drafts an Application Guide for Laboratories (LEED-AGL), the design team might consider the Environmental Performance Criteria (EPC) created by the Laboratories for the 21st Century program (Labs21), upon which LEED-AGL is being developed. Though the EPC is not a rating or certification system, the guidelines are specifically geared toward labs and are very useful in this context. Other programs worth exploring include Green Globes, Energy Star and GreenGuard; each may offer a set of guidelines that fits better with the specific project's goals.

3. Materials and systems

Certain aspects of engineering and building design are magnified in the context of laboratory

Because there is no "LEED for Labs" program, guidelines developed for other building and project types will have to be used for a project to be LEED certified. The Yale School of Medicine Sterling Hall renovation project received a Gold rating under the LEED for Commercial Interiors (LEED-CI) category.
PHOTOGRAPH COURTESY OF WOODRUFF/BROWN ARCHITECTURAL PHOTOGRAPHY.

spaces, as seen in the example of ventilation. Another example is water use: labs typically use between three and eight times the amount of water used by comparably sized commercial office buildings. So what choices will best equip the laboratory to function sustainably and satisfy requirements for safety or for LEED?

The best strategy is the one that works for all sustainable design: to tackle the largest issues the most aggressively. In new construction projects, the team might consider the potential benefits of greywater reuse and storm-water capture systems, which offer a large savings potential. On the other hand, a major culprit of lab water inefficiency is the traditional cup sink, which uses running water to create a vacuum for waste. The design team might consider instead the installation of a vacuum system that works without cup sinks. A similar installation helped the Yale School of Medicine project achieve a 24.5 percent improvement from the baseline in water efficiency.

Power and energy use are, of course, a major consideration in efforts to achieve sustainability. Fume hoods are a major component of any lab, so system choice and design require a good deal of attention. What are the users' needs? Will constant-volume, variable-volume or low-flow systems serve the needs of the expected research programs? Will the choice address energy savings without compromising safety requirements?

Controls for lighting and HVAC systems should be chosen in consultation with both the users and the facility's staff, who must once again balance safety with efficiency. Often the best choice will be dual-sensor controls, which operate upon detection of both heat and motion, rather than only

Casework is a major design component in lab facilities, so choosing the best product can benefit the planet and occupants significantly. Alternatives to traditional metal casework, like composites or wood, shown here in the Yale Sterling Hall of Medicine I-wing, can be sustainably sourced, comparably priced and foster a healthier environment, inside and out.
PHOTOGRAPH COURTESY OF OLSON PHOTOGRAPHIC.

one of the two. The result is a lower chance that the system will operate accidentally while the area is empty, thus wasting energy. Another good strategy is to zone the HVAC and lighting systems so they respond to the needs of specific user types. This may be especially useful with ventilation: group the spaces with the heaviest ventilation requirements into one zone—perhaps closer to the outside of the building—to reduce overall HVAC energy consumption.

Labs use a great deal of casework in their interiors, and careful selection of materials and components can go a long way toward achieving sustainability goals and LEED points. Traditionally labs are furnished with metal casework, which is often available with recycled content. However, stakeholders may consider the benefits of wood and other casework materials, such as bamboo, which can be sourced locally and at costs comparable to those for metal. The casework installed in several Yale School of Medicine projects is derived from wheat, a rapidly renewable resource, with panels of maple veneer. In this case, the maple was certified by the Forest Stewardship Council (FSC), which ensures that the wood is from a sustainably managed forest.

4. Optimizing the interior environment

An additional benefit of wood veneer casework is the appearance. Pleasing to the eye, the wood finish contributes to the enjoyment of the space by its occupants, and because its components emit low levels of volatile organic compounds (VOCs), the casework contributes to the health of the occupants as well. In this way, the casework becomes part of a strategy to optimize the lab as a workplace and research tool: using the space efficiently, designing the space for lowest carbon output and increasing the space's positive effects on the occupants.

In addition to zoning lighting and HVAC systems, daylighting strategy is also a crucial component of a holistic approach to the green lab design. Correct use of daylight begins early, with site selection and building orientation. Where this is not possible or applicable, daylight can still help reduce electrical lighting costs and climate control needs while simultaneously fostering a healthier, more productive laboratory facility.

The design should attempt to introduce natural daylight into most work areas. Using a strategy that incorporated windows and partial dividing walls, the Yale School of Medicine interior renovation achieved a design that brings natural daylight into 90 percent of the facility's discrete spaces.

Views of the facility surroundings should also be maximized, though this is not as crucial as the daylight itself. It is recommended that exterior views be incorporated especially into gathering areas, both formal and informal, as studies have shown that a pleasant view fosters a rich environment for collaboration and for interaction in general.

A final note regarding floor planning: because ventilation is such an important issue with regard to both occupant safety and energy consumption, the stakeholders may deem it wise

The renovation of Sterling Hall's C-wing at Yale Medical School realized a design that brings natural daylight into 90 percent of the facility's interior. Sustainable lab design should attempt to introduce daylight and exterior views into the most possible work areas. PHOTOGRAPH COURTESY OF OLSON PHOTOGRAPHIC.

to invest in digital modeling such as computational fluid dynamics (CFD) or another building-specific tool. The purpose of CFD is to create a model that tracks airflow from supply to exhaust and through the space in between. An accurate CFD model can identify where in the intended design the air stratifies or pockets. The engineering team can then recommend alternate supply diffusers and arrangements, which will create a safer lab with *lower* air change rates.

With tools both simple and complex, laboratories can be as green as their owners and occupants want them to be. In today's competitive marketplace for great researchers and better science, an up-front investment in sustainability can add the third pillar of *prosperity* to facilities that also work well for their *people*—and the *planet.*

***Jay Brotman**, AIA, is partner and director of technical services, and **Robert Skolozdra**, AIA, LEED AP, is a partner and LEED design specialist. Both are with Svigals + Partners, an integrated architecture and art provider specializing in research and educational facilities. The company is based in New Haven, Connecticut.*

ASK THE EXPERT

« EXPERT: Dr. Peter Hodder

ASK THE EXPERT

SETTING UP A CELL CULTURE LABORATORY

by Tanuja Koppal, Ph.D.

Dr. Peter Hodder is the senior scientific director and head of Lead Identification Division at the Translational Research Institute and an Associate Professor in Molecular Therapeutics at The Scripps Research Institute in Florida. Scripps Florida is a branch of The Scripps Research Institute (TSRI), based in La Jolla, California. The Institute was designed to link basic research to a focused drug discovery and development platform using new technologies and translational research. Scripps Florida has a set of interdisciplinary academic departments (Cancer Biology, Infectology and Molecular Therapeutics) and a Translational Research Institute (TRI) that supports these efforts. Dr. Hodder directs Scripps Florida's high-throughput screening (HTS) and compound management operations and has over a decade of drug discovery research experience in the pharmaceutical industry and academia. His 20 member group employs sophisticated technologies to implement and screen novel assays against both Scripps' proprietary >600,000 member library as well as the NIH's >300,000 member MLPCN collection. To date, his group has successfully completed more than 70 industrial and academic HTS-related collaborations that have identified and characterized several "lead" compounds with drug-like properties. Dr. Hodder is also an adjunct professor at the Florida Atlantic University, Boca Raton, and is engaged in the discovery of novel anti-bacterials. He received his Ph.D. in chemistry from the University of Washington in 1999 and joined the Merck Research Labs, where he was employed, until he moved to Scripps Florida in 2005.

Dr. Peter Hodder, senior scientific director and head of Lead Identification Division at The Scripps Research Institute in Florida talks to Tanuja Koppal, Ph.D., contributing editor to Lab Manager Magazine, about his experiences moving from big pharma to academia to set up a high-throughput screening laboratory from the ground-up. He highlights some of the factors that were critical to his decision making when he started designing his labs and ones that are important today for the efficient use and maintenance of the space and equipment.

Q: When did you get involved in designing the cell culture and screening labs at Scripps, Florida?

A: When I joined Scripps, we first started out in a temporary building where everything—the tissue culture, high-throughput screening (HTS), robotics and compound storage—was in one room and that was a mess. When we had to move into a new, permanent facility I got involved with the lab design from the very beginning. Being a screening lab we cannot really discriminate on the type of assay that comes to us, so we work with a variety of cells—mammalian, yeast, insect and microbiology-derived cell lines. For us it's all about location, location, location. For instance, we designed the mammalian cell culture lab such that it is accessible from both the assay development and robotics labs, but at the same time, since it's located in one corner of the facility, it does not get much traffic. We also generate a lot of waste, and so we have a vestibule where service personnel can get in and pick up waste without disturbing the environment.

> "... it's far more useful to have many multi-layered flasks and incubators."

Q: What are some of the key factors to be considered as you design and use a cell culture facility?

A: There are really four things that are very critical—cleanliness, organization and business rules, maintenance and, in terms of the facility itself, there is training, location, and access. When it comes to cleanliness, look into everything, from the air quality to the materials you use for the flooring and furniture. In our particular case, with using HTS, we have to control all the fiber that can get into the equipment and the assay plates. We have to be anal retentive about the air quality in terms of particulates! Our systems are set up to minimize the possibility of dust or particulates causing any airborne infections to the cells and even if they are introduced, they are cleared out rapidly because of the airflow. When it comes to maintenance, all the equipment we use, such as the tissue culture incubators and ultra-sonic vaporizers, are all sophisticated devices that are actively controlled and can self-sterilize. In some ways, this makes them less robust and they need more routine maintenance. Hence, in some cases we use secondary back-ups to monitor the environment within these incubators to constantly calibrate temperature, carbon dioxide and humidity.

We have received nearly 50 to 60 cell lines in the past few years and we have set up milestone-driven protocols for everything—for quarantine, microplasma testing and such and that's very important. As long as you are well organized and have good business rules set up, it really works well. It is then independent of the equipment we use and is more dependent on the people who use it. That comes down to training and personnel. People must know what to do and they should want to follow the rules. Establishing a routine and protocol-driven facility is very important.

Q: Would you do anything differently if you were to do it today?

A: At the time that we were setting up and designing the lab the trend was to buy large automated robotic systems. So we had all the necessary hook-ups installed and the space dedicated for automation. But then we realized that different cells need different culture conditions and hence, we needed different incubators for different projects. So if you are in a lab like ours that handles different cells and sets up different screens, it's far more useful to have many multi-layered flasks and incubators. It is much more efficient than spending the time and effort to get the robot to do what you want it to do.

Q: How early did you have to pick your screening format?

A: This applies not only to tissue culture but to every piece of equipment that I buy. Everything we have has wheels on it! For instance, a workhorse incubator becomes quarantined and has to be moved out. If we need more storage, a refrigerator or a cold storage unit moves in. This has been good for us because we did not anticipate the different types of cells we would be handling. Something else that I didn't anticipate in the lab design was our increased cell culture storage capacity due to the different types of cells we have. With the diversity of cells, serum, media, and storage units, it benefits us to have things on wheels so we can re-structure, re-purpose and move things in and out quickly.

If you are looking to set up a new lab or upgrade an existing one, pay attention to technologies that have changed in the last decade. For instance, we do a lot of transfections in our lab and those can now be automated and we don't have to rely on the older methods. A lot of the technology in terms of cell storage and handling has also improved, so less maintenance is needed. So keep an eye on the new trends.

A glimpse of the work going on in the tissue culture lab which is a part of Scripps Florida's high-throughput screening facility.

PHOTO CREDIT: FRANCK MADOUX, SCRIPPS FLORIDA

EVOLUTION OF THE LABORATORY VACUUM PUMP

BY JOHN BUIE

Vacuum pumps are an essential piece of equipment and used in a wide variety of processes in most laboratories. However, despite numerous advances over the past 70 years, many industry professionals still believe that vacuum technology has not progressed, and that there is no benefit from updating a laboratory pump.

However, if one studies the evolution of the laboratory pump over the past 25 years, it becomes apparent that this is an area of significant innovation, with important developments in high vacuum technology, corrosion resistance, vacuum control, and improvements in the efficiency and ecological impact of vacuum pumps.

In **1206**, the suction pump, a predecessor to the vacuum pump, was invented by the Arabic engineer Al-Jazari. It was not until the fifteenth century that the suction pump first appeared in Europe.

In **1643**, the first mercury barometer was invented by Evangelista Torricelli, based upon earlier work by Galileo. The first sustained vacuum was achieved later the same year.

In **1654**, Otto von Guericke invented the first true vacuum pump, and used it to evacuate the air between two hemispheres in order to demonstrate that they could not then be separated by two teams of horses (the famous "Magdeburg hemispheres experiment").

In **1874**, a new style of pump consisting of vanes mounted to a rotor that turned within a cavity was patented by Charles C. Barnes of Sackville, New Brunswick, Canada. This type of pump became known as the rotary vacuum pump, and took depth of vacuum to a new level.

In **1855**, Heinrich Geissler invented the mercury displacement pump and used it to achieve an unprecedented vacuum of around 10 Pa (0.1 Torr).

In **1911**, Professor Dr. Wolfgang Gaede first reported the principle of the molecular drag pump at a meeting of the Physical Society in Karlsruhe. The pump was extremely well received and was considered to be the major event of the meeting. After many problems and setbacks, the first 14 pumps were ready for sale by the fall of 1912.

In **1915**, Irving Langmuir invented the diffusion pump, using mercury as the pump fluid. The use of mercury enabled the pump to continue working at elevated temperatures, but was soon replaced due to its toxicity.

By the **1920s**, the oil-sealed rotary vane mechanism was the typical design for most primary pumps.

In **1926**, M. Siegbahn developed the first disk-type molecular drag pump.

In **1929**, Kenneth Hickman developed synthetic oils with low vapor pressures. These would soon prove invaluable in gas diffusion pumps.

In **1930**, Cecil R. Burch and Frank E. Bancroft filed for a patent for the gas diffusion pump using low-vapor pressure oils. The patent was granted in 1931.

In **1937**, C.M. Van Alta developed the first diffusion pump with a capacity of greater than 100 liters/second. Also in this year, the multi-stage, self fractionating diffusion pump was invented by L. Malter.

In the late **1950s**, researchers at Varian invented the ion pump in order to improve the life and performance of its own high-frequency microwave tubes used in radar technology. The ion pump was able to achieve an ultra-clean vacuum environment.

In **1953**, Raymond Herb invented the first practical Getter-ion pump, which prevented the vacuum chamber from rusting through the use of titanium metal.

1950

In **1954**, the single-cell ionic pump was developed by A.M. Gurewitsch and W.F. Westendorf.

In **1955**, R. Herb invented the orbiton pump with electron-impact Ti sublimation.

In **1957**, researchers at Varian invented the Nobel Vaclon pump, the first electronic device to operate without fluids or moving parts and be resistant to power failures. The all-electronic pump made surface science possible for the first time.

In **1958**, Pfeiffer Hockvakuumtechnik GmbH invented the turbomolecular pump, improving on the performance of diffusion pumps and Gaede's molecular pump. Also in this year, Varian introduced the modern Vacsorb cryosorption pump.

In **1960**, Varian introduced the Vaclon pump, the first pump able to operate at rates of 1,000 liters/sec.

In **1961**, C. H. Kruger and A. H. Shapiro developed the statistical theory of turbo-molecular pumping that is still the basis of much research today.

In **1969**, K.H. Mirgel developed the vertical unidirectional turbomolecular pump.

In **1971**, Osaka Vacuum manufactured the first domestic turbomolecular pump for small-scale applications.

In **1972**, Varian's Vacuum Division introduced the contra-flow concept, allowing higher test port pressures by using a simplified vacuum system design.

In **1974**, the first oil-free piston vacuum pump was developed by John L. Farrant.

In **1980**, Osaka Vacuum Ltd. developed the compound molecular pump.

In **1982**, VACUUBRAND introduced the first chemistry-design pump with a full fluoropolymer flow-path. This pump's design allowed it to overcome the performance challenges of fluoropolymer flow under pressure.

In **1984**, the Drystar dry (oil-free) vacuum pump was patented by Edwards High Vacuum Limited. The dry claw pump became essential to the semiconductor market.

In **1987**, VACUUBRAND introduced the first microprocessor vacuum pump controller able to detect vapor pressures and adapt vacuum levels to changing solvent conditions.

In **1988**, VACUUBRAND introduced the first lab vacuum pumps with integrated solvent vapor recovery. These pumps allowed users to capture and recycle waste vapors rather than exhaust them into the atmosphere.

In **1990**, VACUUBRAND introduced the first dual-application chemistry vacuum pump, capable of electronically controlling one application while providing filtration vacuum to a second port.

In **1991**, VACUUBRAND introduced the Chemistry-HYBRID pump that integrated both a rotary vane pump and diaphragm pump on a single shaft and motor. As solvent vapors from the pump oil were continuously distilled in this hybrid pump, oil changes were reduced by 90 percent compared with single rotary vane pumps.

1980

In **1994**, VACUUBRAND introduced the first local-area vacuum network, subsequently named VACUU-LAN®, with integrated check valves and chemistry-resistant components. This network allowed up to eight different lab vacuum applications to be simultaneously operated by one pump. This approach became the norm in lab vacuum supply across Europe.

In **1996**, VACUUBRAND introduced the PC 2001, the first frequency-controlled diaphragm vacuum pump. This pump allowed vapor pressures to be electronically detected and adapted in response to changing solvent conditions without programming. It was also able to operate hysteresis-free.

In **1998**, Varian developed TriScroll® Dry Pump, the only two-stage vacuum pump on the market at the time. This pump employed a unique, patented TriScroll pumping capability.

In **2000**, Pfeiffer Vacuum launched the vacuum DigiLine™ — the first full line of digital vacuum gauges.

2000

In **2002**, VACUUBRAND introduced the MD1 VARIO-SP pump, the first fully integrated 24 VDC variable-speed diaphragm pump, offering new options for instrumentation designers.

Also in **2002**, Pfeiffer Vacuum brought a magnetically-coupled line of rotary vane pumps to the market.

In **2004**, VACUUBRAND introduced its "XP-series" of compact rotary vane pumps. These pumps had one-third of the environmental impact of traditional belt drive pumps without sacrificing vacuum and pumping speed.

In **2007**, VACUUBRAND introduced the Peltronic® condenser, the first electronically cooled condenser that allowed vacuum pump waste vapor recovery without an external coolant for the first time.

In **2008**, Pfeiffer Vacuum launched the HiPace™, capable of operating at rates of 1,000 to 2,000 liters/second.

In **2009**, VACUUBRAND introduced the VSP 3000, the first chemistry- and shock-resistant Pirani vacuum sensor. This pump allowed robust monitoring of rotary vacuum applications, with vacuum pressures down to 10-3 mbar.

In **2009**, KNF Lab launched the wireless SC920 series vacuum pump system, featuring fast and precise processing, quiet operation and easy regulation of all vacuums. The wireless remote control allowed users to locate the processing equipment away from the pump to save lab space, avoid needless opening of the fume hood and remove tangled cables.

THE FUTURE FOR LABORATORY VACUUM PUMPS

Innovation in vacuum technology is currently being driven by the many diverse manufacturing and research processes that rely on vacuum systems, particularly the manufacture of semiconductors. With increasing demand for reliable and efficient vacuum techniques, the rate of innovation looks likely to increase in the immediate future.

Experts predict that vacuum pumps of the future will offer greater reliability and be able to operate for longer periods of time before maintenance is required. Laboratory pumps are also expected to be smaller, more efficient, and generate less heat, noise and vibration. It is likely that they will also better resist corrosion and be easier to clean and repair.

Technological developments are likely to include higher shaft speeds and innovation in pumping mechanisms for improved performance. Vacuum pumps are also expected to incorporate novel materials and improved design to further improve performance and reduce operating costs.

NEW WRINKLES FOR OLD STANDARDS

by Angelo DePalma, Ph.D

Centrifuges, one of the true workhorse instruments of modern laboratories, were also one of the earliest scientific appliances. Core centrifuge applications (blood separation, sediment analysis, removal of particles from fluids, biological separations) remain vibrant, but new ones have emerged, particularly from molecular biology and biochemistry.

"Modern centrifuges feature advanced touch-screen controls that can dial up any parameter or stored method."

If one trend stands out in these markets, it is that sample sizes are shrinking: flasks have given way to ever-smaller tubes, vials, and eventually microplates.

"We're seeing many protocols transferred from tubes to microplates, and with that a demand for a means of centrifuging the plates," observes Maurizio Merli, product manager for benchtop centrifuges at Thermo Fisher Scientific (Milan, Italy). "With these applications, customers are also demanding more speed (*g*-forces) and capacity."

Microplates were not designed for traditional centrifuges, but most manufacturers offer centrifuges and rotors that handle these devices. Rotors use special swing-out buckets that process shallow-well microplates at low *g*-force and tall or deep wells at much higher speeds. Rotors used at high *g*-force have only two buckets and are designed to supply the highest possible *g*-force and the lowest possible friction and noise.

Jeff Antonucci, a product specialist at Hettich (Beverly, MA), mentions food as another strong market for centrifuges. Some of the more interesting applications he has recently worked on include measuring the fat content of milk, extracting honey from honeycombs, determining the water-holding capacity of fish muscle, and quantifying the percentage of pulp in orange juice. One restaurant recently approached him with the idea of using a benchtop centrifuge to extract essential oils from nuts and herbs. "Customers present us with all sorts of problems and special needs," Mr. Antonucci says.

Instrument improvements

Although centrifuges are relatively simple devices, protocols often call for precise control of *g*-force, rotor acceleration to maximum force, duration, and temperature. Older instruments had three knobs (speed, time, temperature). Modern centrifuges feature advanced touch-screen controls that can dial up any parameter or stored method.

Plastics and composites are edging their way into benchtop systems for a number of reasons. As sample sizes get smaller, the masses required to move them around can shrink as well. Mr. Merli refers to a "universe" of materials in modern benchtop models, including carbon fibers and fiber-reinforced plastics. These materials are lightweight but often as strong, durable, and chemically resistant as metals. They also absorb deformations better than metals and are significantly safer, due to their diminutive size and weight, in the event of a crash.

"More and more applications are jumping from floor to bench as a result of these improvements," Mr. Merli tells *Lab Manager Magazine*. "We're seeing performance now in benchtop units normally associated with floor models, including microprocessor control, energy efficient motors, and the use of composite materials."

"We're seeing performance now in benchtop units normally associated with floor models."

What customers want

Mr. Merli identifies two main groups of centrifuge purchasers: those who perform routine work and those who value flexibility. The first group includes technicians in environmental or blood processing labs who rely on a limited number of protocols; the second are more science-oriented. "They look for instruments capable of following the evolution of the laboratory," Mr. Merli says. "These customers consider the centrifuge as more of an investment than a routine tool."

Ease of use is something all customers ask for. According to Mr. Merli, ease of use can be delivered in many ways, but simplifying the interface is not necessarily one of them. The challenge to manufacturers is to present an interface that provides the average user with access to all critical features without having to refer to a user manual. His mission is accomplished, he says, when he sees a potential customer at a trade show who can access 95 percent of the centrifuge functions after exploring the instrument for five minutes.

"Noise reduction has also been high on the wish list of centrifuge users."

Noise reduction has also been high on the wish list of centrifuge users. "When you have a machine right next to you constantly running at thousands of rpm, you want it to be as quiet as possible," Mr. Antonucci says. Hettich has focused on making their benchtop models quieter by employing brushless motors (now industry-standard), better insulation, and a more effective air seal. These strategies, he adds, also make the centrifuge safer.

It would be difficult to imagine replacing a centrifuge with anything other than another centrifuge. Maurizio Merli recalls a quote he heard years ago: "Every morning, someone wakes up and figures out how to eliminate centrifugation from their process. Luckily, somebody else wakes up and finds a new use for centrifugation."

Angelo DePalma *holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. You can reach him at angelo@adepalma.com.*

REMOVING HEAT AT THE POINT OF USE

by Angelo DePalma, Ph.D

Chillers are refrigerators that cool down samples or processes to preset temperatures by removing heat from one element and transferring it to another, typically air or water. The term "recirculating" refers to the cooling liquid—typically water, water/glycol, or silicone fluids—that is pumped through the system to be cooled and returned to the chiller. Choice of cooling fluid is critical: The liquid must remain fluid at low temperatures or it will not recirculate; and some good circulators, like ethanol, are highly flammable.

Recirculators are defined in terms of physical size (benchtop to large process units), operating temperature, and cooling capacity. "The range is from small benchtop units to about six feet tall," says Mark Diener, product manager at Julabo (Allentown, PA). Lab units rarely get larger than that. Process industries requiring high-volume chilling achieve it with liquid nitrogen instead of mechanical refrigeration.

Despite their name, some chillers also provide modest heating, to about 40ºC. These units, which may also cool to about -20ºC, are replacements for water cooling.

Chillers operating down to about -40ºC are relatively inexpensive and use a single compressor. The price jumps significantly for the -40ºC to -95ºC temperature range because these systems use two compressors. Units cooling to below -100ºC require three compressors and may cost in excess of $100,000.

> "Units cooling to below -100˚C require three compressors and may cost in excess of $100,000."

Chiller applications include plastics processing and testing, cryogenic testing, cooling lab instrumentation, biology, and chemical synthesis. One customer of Julabo's, which was affiliated with the aerospace industry, purchased a low-temperature chiller to conduct a six-month-long vacuum experiment that simulated deep-space conditions. What was placed inside the unit? "That particular application was top secret," Diener tells *Lab Manager Magazine*. Similar units are also used in the pharmaceutical industry, he says, to run low-temperature organic synthesis.

One emerging use for chillers is to provide cooling for rotary evaporators, a mainstay of chemistry labs. Many jurisdictions today have enacted strict single-pass water restrictions. These refer to water that is immediately disposed of after use, which has been the norm for cooling water. In many labs today, the water aspirator has been replaced by a vacuum pump, and the cooling water for the condenser with cooling fluid from a recirculating pump. "Some systems daisy-chain two rotovaps to a single recirculator," Diener says. "And you don't have to use very low temperatures at all. If you operate your rotary evaporator properly, you can easily remove most solvents with the chiller set at 5ºC."

Julabo has calculated that a recirculating pump used on a rotary evaporator can pay for itself in less than four years through lower water and sewage costs.

Purchase considerations

Users usually specify chillers by cooling range, but cooling capacity—the amount of heat the unit can remove from a process—is equally important. Customers should always check capacity for the specified temperature. Vendors can usually help with the calculation.

In their recent survey of worldwide customers, Thermo Fisher Scientific (Newington, NH) identified five areas for improving their chiller products: reliability, global suitability, ease of use, flexibility, and service. From lab washers *do* work and perform advanced and esoteric washing."

Small, under-counter washers with forced-air drying and HEPA-filter capability represent a growth market for washers, says Espiritu. "Models with these features used to be three feet wide. Now they're about as large as a home dishwasher, and they can give you glass that is bone-dry in fifteen minutes." Another market is for washers that clean labware used for trace metals analysis. For this application, the washer replaces a process of soaking in dangerous acid baths and manual rinsing.

"We sell a lot into wastewater treatment plants that use BOD bottles," says Sprung. "Generally, if they have reusable glassware, they need … to wash it in a way that provides repeatable results. Hand-washing results can vary significantly."

Purchase decisions

To Sprung, price is "always a factor" in lab washer purchases because "washers are considered luxury items."

Espiritu agrees—to a point. "Price is more of a factor for buyers who are not familiar with what constitutes a good washer," particularly when users are not consulted before the acquisition. He continues, "If the wrong washer is purchased, users can feel shortchanged because the washer does not address their requirements. The correct attitude with regard to price is to think long range, and ask, 'What is the price of *not getting* the more expensive washer?'" Possible outcomes include inconsistent washing for critical labware, too-long wash cycles, waste of water and cleaning aids, and short service life.

Other factors affecting purchases include warranty, service, brand recognition, and users' past experience with washers.

Lab workers accustomed to labware washers rarely pine for the days of hand-washing. "For a lot of laboratories… a robust, functional washer is like oxygen," says Espiritu. "They cannot get through a single day without it."

> "Small, under-counter washers with forced-air drying and HEPA-filter capability represent a growth market for washers."

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FEEDING MULTIPLE OPERATIONS AND APPLICATIONS

by Angelo DePalma, Ph.D

Water is the lifeblood of all laboratories. Purified water, in particular, serves a variety of operations and applications, from wet chemistry to instrumental analysis.

Maricar Tarun, Ph.D., applications scientist at Millipore Corp. (Billerica, MA), explains that lab water comes in three basic types: type 1 (the purest), type 2, and type 3. Type 1 ("ultrapure") water, the most expensive to produce, is used for highly sensitive analytical techniques with very low detection limits, such as HPLC, LC-MS, GFAA, and ICP-MS. It is also used to prepare buffers and mammalian culture media for cell culture and in vitro fertilization, as well as for molecular biology applications including DNA sequencing and PCR.

> "Units that combine purification technologies are replacing much older distillation systems that predominated two decades ago."

Type 2 water is used in general laboratory applications such as buffers, standard pH solutions, and microbiological culture media preparation, as well as to feed clinical analyzers, cell culture incubators, and weatherometers—instruments that allow artificial or accelerated weathering tests. Type 2 water systems are often used to pretreat water for type 1 water systems.

Type 3 water is the lowest laboratory water grade. It is recommended for glassware rinsing, heating baths, filling autoclaves, and to feed higher-grade lab water systems. Types 2 and 3 are referred to as "pure water," but the gap between these grades and ultrapure is substantial. There may be differentiation even within grades. For example, "water for injection," a high-purity water with ultra-low bacterial specifications used to formulate pharmaceuticals, runs toward the bottom end of type 2; "triple distilled" water is equivalent to higher-end type 2 water.

Producing type 1 water requires a combination of multiple water purification technologies such as reverse osmosis, deionization, activated carbon treatment, and ultraviolet radiation. "Polishing" systems are fed water from a type 2 or 3 pretreatment system to produce type 1 water.

Units that combine purification technologies are replacing much older distillation systems that predominated two decades ago. Stills remain in place in some labs, notes Paul Whitehead, Ph.D., R&D laboratory manager at ELGA LabWater (Woodridge, IL). "But they're becoming less popular due to their energy requirements. Besides, most labs need water that is purer than that, particularly with respect to trace impurities and bacteria." Today's top water systems produce type 1 water for approximately 15 cents per liter, Dr. Whitehead says—a relative bargain for such a high-quality laboratory product.

Complete water purification systems, which combine pretreatment and polishing in one unit, produce type 1 water directly from tap water. Complete systems eliminate disadvantages of central water purification systems that serve as a pretreatment step. The major drawback of central systems is that they have delivery loops that are complex, expensive, and difficult to maintain or extend. Nevertheless, plant-level systems are popular in large R&D organizations such as pharmaceutical companies.

"A complete system also allows users complete control over all water purification steps and the final water quality," says Dr. Tarun. "Laboratories that do not have a reliable source of type 2 or 3 water to feed a polishing system can greatly benefit from a single, compact system in any lab with a tap water feed."

Trends in laboratory water purification technologies are dictated by:

- Advances in instrumentation or applications toward higher sensitivity and analyte selectivity
- The existence of "emerging" contaminants in tap water that may not be efficiently removed by existing purification technologies
- Smaller analysis volume requirements

Dr. Tarun explains that flexibility is another driver. "Many laboratories combine several areas of expertise and, therefore, have a range of applications with specific requirements. For example, one application requires nuclease-free water, while another requires water low in organics." An ideal water system, she says, should incorporate all these attributes.

Purchase decisions

Pricing and budget are always considerations at the point of purchase, but other factors are at least as important, for example:

- Applications – What will the pure or ultrapure water be used for? Can the lab get along with type 2 or type 3 water? Does the lab anticipate taking on new applications or workflows that might require type 1 water?

> "Today's top water systems produce type 1 water for approximately 15 cents per liter ..."

- "Instant" and daily volume needs for ultrapure and pure water
- Feed water available in the laboratory – Does the lab have access to good and reliable central water purification (which could serve as the pretreatment step)?
- Water-quality monitoring needs; for example, resistivity and total organic/oxidizable carbon (TOC) monitors to ensure that the purification is performing up to specification
- Level of certification required, particularly for firms serving legal or regulated industries

Water purification systems from major vendors operate similarly and produce water at or above advertised specifications. Differentiators, says ELGA's Paul Whitehead, are ease of use. "Customers like systems with fancier, volumetric dispensing, where the user dials up a volume."

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PERSPECTIVE ON: A UNIVERSITY RESEARCH LAB

UNIVERSITY LABORATORIES MORE CRITICAL NOW DESPITE FLAGGING SUPPORT

by Bernard Tulsi

Earlier this year, University of Michigan professors Paul N. Courant, James J. Duderstadt, and Edie N. Goldenberg, writing in *The Chronicle of Higher Education,* outlined what they considered a failing relationship between the states and the federal government with respect to higher education. They wrote, "Today, the state side of the partnership is failing. Public institutions of higher education are gravely threatened. State support of public universities, on a per student basis, has been declining for over two decades; it was at the lowest level in 25 years even before the current economic crisis. As the global recession has deepened, declining tax revenues have driven state after state to further reduce appropriations for higher education, with cuts ranging as high as 20 percent to 30 percent, threatening to cripple many of the nation's leading state universities and erode their world-class quality."

> "Centers with multidisciplinary capabilities may be best suited for large grant projects."

One case in point is the state of Michigan. Columnist Rick Haglund, writing in the area-based publication mlive.com, noted that three of the state's leading schools, the University of Michigan, Michigan State University, and Wayne State University, collaborated in 2006 to form the URC with the goal of securing more dollars or preventing deep cuts in funding from the state government, which is battling serious financial challenges.

Such positioning for cash has been the source of some tension among institutions. "There has even been a rift between the three research universities and the state's 12 other universities, which say they do research too. They've been opposed to extra money for the Big Three research universities," wrote Haglund.

On top of financial cutbacks from the state government, the universities face growing public skepticism about

the value of funding universities, according to Haglund. He cited the results from a new joint national study by the Public Agenda and the National Center for Public Policy and Higher Education, which found that "most Americans believe colleges operate like businesses, more concerned with their bottom line than the educational experience of their students."

Sciences, University of Maryland in College Park. "In any given semester, I deal with about 1,300 to 1,800 students and about 50 teaching assistants," says Jones.

Explaining how the laboratories are organized in her organization, Jones says, "There is a cadre of about nine faculty members who teach and are responsible for the labs associated with their

▲ *Amy Coles of the University of Maryland's Department of Chemistry and Biochemistry setting up an organic chemistry teaching lab.*

That's hardly the case at the University of Maryland, where in the fall of 2010, the general chemistry laboratory classes will have close to 900 students, the bio-analytical lab will cater to more than 400 students, and general chemistry for majors will have just under 100 students, according to Maryann McDermott Jones, Ph.D., undergraduate laboratory coordinator, Department of Chemistry and Biochemistry, College of Chemical and Life

courses." She explains that no one in this group is involved in research and that the labs are strictly for instructional purposes and do not offer commercial services such as analytical testing or product development. Furthermore, all activities are paid for with university funds directly.

Jones explains that the university as a whole enjoys an excellent relationship with the National Institute of Standards and Technology (NIST) and that

PERSPECTIVE ON: A UNIVERSITY RESEARCH LAB

graduate students get access to the laboratory facilities at NIST. "In addition, there are a number of specialized institutes with which this department has connections, and to which faculty members have allegiances, as is the case at a number of other universities."

Even though Jones acknowledges the important boost that the recent American Recovery and Reinvestment

▲ *Vera Sitnova of the University of Maryland's Department of Chemistry and Biochemistry setting up a general chemistry teaching lab.*

Act (ARRA) grant (stimulus) funds provided in helping universities to add jobs, grow their research, and develop new technologies, she noted that her department did not benefit directly. She adds, however, "The College of Chemical and Life Sciences has been very good at getting funding from external entities like Howard Hughes Medical Institute (HHMI), and so we have money specifically for the purpose of developing new approaches for undergraduate teaching laboratories."

Supporting the teaching staff with their laboratory requirements is another team headed by Irving M. Kipnis, Ph.D., who also serves as a lecturer within the Department of Chemistry and Biochemistry. Kipnis's team is responsible for acquiring, stocking, and maintaining the equipment, reagents, and consumables for ongoing laboratory activities and for responding to any changes in the regimen of experiments in the curriculum.

Dr. Jones says that this is definitely a time of smaller budgets. "When we introduced the bio-analytical labs program about three years ago, we received a lot of funding that came specifically through the college." This enabled the acquisition of a number of unique and interesting pieces of equipment, which would not be possible in the current environment, she added.

The net effect of shrinking budgets, according to Jones, has translated into a daily need to do more and prepare more students with fewer resources. "The equipment we acquired for the bio-analytical labs, for example, may be appropriate for running two labs for the course in the same time period. Both this summer and last spring, we were running three sessions. That meant that we were using the equipment more extensively than we should have.

"The practical consequence of that is we run labs at varying hours of the day. We routinely end up running a number of different sessions at night because that is the only way to accommodate all the students who want to take our lab courses. To say the least, that's difficult."

The reality is that the college has to accommodate more students with the same resources. As a result, it runs night classes at least three times a week—not the night school, which is separate—for the full-time programs. Jones says that the facilities have not reached the saturation point as of yet. She notes, however, "The practical fact is that we have a fixed number of physical labs, [pieces of] equipment, and teaching assistants, and every time we open a new section of, say, between 18 and 24 students, we need to fund another teacher, which can have a steep price tag."

Jones acknowledges that such stringencies permeate universities and colleges throughout the country. She adds, "In fact, University of Maryland, at this time, may be luckier than most."

Focusing on future prospects for university laboratories, Jones says, "We are aiming to make the undergraduate laboratory experience one in which students see the real-life application of what they are doing, and where they can understand how, in our case, chemistry impacts their lives; and there is certainly a movement to make the laboratory experience greener."

> "Faculty members are in charge of all aspects of their labs—staffing, equipment, and other issues."

Steven L. Suib, head of the Chemistry Department and Board of Trustees Distinguished Professor at the University of Connecticut, says that at his institution each department has its own labs for both teaching and research. "There are also institutes and centers that have laboratories for specialized research such as materials science, environmental science and engineering, and clean energy and engineering, all of which are different and operate in different ways," he says.

In a number of cases, these centers have multidisciplinary approaches that cut across traditional classifications. While some have been created to address specific cross-disciplinary questions by their founding faculty, centers with multidisciplinary capabilities may be best suited for large grant projects, especially from private foundations, that require the collaboration of large teams of researchers and often have an international focus.

Suib says that he has conducted research in all the centers and institutes at the University of Connecticut, all of which have been initiated by and are being run by university staff and faculty. "At this university there are people who are members of departments who are located solely in some of the centers and institutes because their research falls into those specific classifications. There are others who have labs in the centers and in their departments, and still others who only have labs in their home departments—it works in many different ways," he says.

None of these laboratories provide fee-for-testing or other commercial services. "There is some incubator space for early-stage companies, but not very much," says Suib. Sometimes companies move into the incubators to get access to the lab facilities and faculty members, and in some cases they are initiated by faculty members.

Suib says that in the Chemistry Department, each individual is the head of his or her own lab. There are some rule-making entities such as the university committees for safe practices and waste management, but faculty members are in charge of all aspects of their labs—staffing, equipment, and other issues. The Chemistry Department has some special shared facilities, including a mass spectrometry lab, an NMR lab, and a surface science lab, all run by dedicated staffers paid by the university.

Turning to the question of funding, Suib says about 50 percent of the graduate students are paid from external grants. The other 50 percent, because of the university's service orientation, are teaching assistants, so they are not paid from external grant funds.

Suib notes that funding in general is less generous than in the past. "The places that my department applies to for funding are federal sources like the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE), and the Department of Defense. Those are the major sources still. Some funding does come from industry for joint collaborative projects, and sometimes it is possible to access state funds for specialized programs such as stem cell research."

> "University lab management by scientists versus professional managers can be a problem."

Suib believes it is true that even the federal sources have narrower subject areas that they are prepared to fund. "There needs to be some applied long-term goal…it is difficult to propose something that is purely basic and get funded now." He believes that when the current funding, including ARRA (stimulus) cash, runs out, finding replacements will be tough. "There are questions about whether we are heading back to the bleak funding picture of three years ago or whether it will get worse than that… there is a lot of fear out there that it could be the latter," he says.

Suib's department has eight different disciplines—analytical, inorganic, organic, physical, polymer, solid state, environmental, and biological chemistry. "We currently have funding in all those different areas, with probably more in biological chemistry and materials chemistry than in the other areas." He adds that there is considerable interest in the areas of medicinal and pharmaceutical chemistry and health-related research, as well as in nanotechnology and polymer chemistry.

University lab management by scientists versus professional managers can be a problem, says Suib. "There are more rules and regulations now, greater accountability, and in the end we are all responsible and need to keep track of the key requirements. Scientists are not trained in those areas, so we either need to have capable staff or do it ourselves or both, and probably 'both' is the best answer to this issue."

Turning to future opportunities and challenges, Suib says, "One thing that seems to be quite fashionable now is interdisciplinary research. This involves departments and centers and institutes all working together in a multidisciplinary effort. Those are difficult to organize and get funded, they have intense competition, and there are ongoing coordination challenges. Nonetheless, that seems like the direction with the most movement right now."

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RECRUITING TOP SCIENTIFIC TALENT

Each day, thousands of global organizations recruit highly talented scientists to fill vacant positions.

Some organizations may hire top talent on their own, without any help from an outside firm. However, for all the organizations that hire employees without any outside assistance, there are just as many that partner with staffing companies to help them throughout the entire hiring process. By doing so, these organizations are able to recruit scientists with detailed skill sets and established career goals within the scientific community for a specific position.

Yet some organizations have preconceived notions about the candidates that staffing companies will find for their open contingent, contract, and direct-hire positions. As staffing companies strive to improve their clients' hiring experiences, it is important to examine some common misunderstandings.

Perception – Candidates are not the "right fit."

When organizations hire employees, they are not only interested in obtaining talent that will fulfill organizational goals, but in individuals who will also become high-performing team members. If candidates are not able to adapt to organizational cultures, communicate well with their fellow employees, and quickly understand their team members' and company's goals, they may not be able to reach their full potential.

In the past, many science organizations have hired candidates with the help of staffing companies only to find that their new employees did not have anything in common with the other members of their team. Such unsuccessful hires have led many organizational leaders to believe that candidates recruited by staffing companies will likely not be a successful fit within their organizations. Staffing companies and contingent employees are proving this theory wrong in today's workplace.

> "Recruiters are more prepared now than ever before to find 'right fit' scientists."

Solution – Candidates adapt to organizational cultures and reach their full potential.

Many staffing specialists are investing their time and energy in gaining credibility within the scientific community. Through consistent organizational research, regular interviews with managers, and constant communication with science professionals, recruiters are more prepared now than ever before to find "right fit" scientists. Such research and communication efforts have helped recruiters not only understand the exact strategies and product directions that organizations have, but also identify scientists who will help companies meet their objectives.

At the same time, staffing companies regularly meet with clients to ensure that they completely understand the client's organizational structure and culture in order to recruit and hire some of the most talented scientific professionals.

Ann Jagielski is an experienced research and development professional who has gained a variety of work experience within the coatings industry with the help of staffing companies. During her contract positions, she has been able to reach her full potential within each of the organizations for which she worked.

"In each of my three contract roles, the staffing company that recruited and hired me truly helped me adapt to organizational structures," Jagielski said. "In addition, my fellow coworkers were always willing to assist as well, allowing me to not only feel comfortable in my role, but to pursue new opportunities once my contract position had ended."

Perception – Candidates are not adequately prepared for the daily tasks of their jobs.

Some candidates' areas of expertise may not be aligned with the requirements of the position for which they have been recruited. Without having the necessary soft skills, past work experience and appropriate, work-related educational backgrounds, many candidates are simply not prepared for the daily tasks of their positions. Therefore, staffing companies work closely with clients to understand their expectations of candidates.

Solution – Versatile candidates possess diverse skills and adapt to all employment situations.

Without a doubt, the most successful contingent and full-time scientists adapt easily to the ever-changing daily tasks of their current assignment; accept any new responsibilities they may be offered; and acclimate to organizational structural changes, especially as the global economy continues to fluctuate.

Multitalented scientists who possess diverse skills will be prepared to adapt to unique situations within their organizations. They will be well prepared for the tasks of their jobs, whether they work as contingent employees or accept full-time positions once their contract assignments have ended. To further improve candidates' diverse skill sets, many staffing companies offer soft skills training opportunities to their employees free of charge.

"My staffing agency was able to prepare me for my position by ensuring I had the proper skills the client was looking for, well ahead of the beginning of my new role," Jagielski said.

Such preparation leads to a long-lasting, successful relationship between the client and the candidate.

"Many recruiters have excellent relationships with their clients. As a result, they are able to visit particular companies and meet with the managers who candidates will work for," Jagielski said. "This enables both the recruiter and the candidates to understand exactly what skill set will be needed for a specific job."

Perception – Candidates do not understand the company's culture.

Finally, many candidates might not be familiar with their company's organizational culture, leading to a variety of issues within the workplace, including miscommunication; misunderstanding of social roles, and lack of knowledge regarding effective, historical business practices and philosophies.

Consequently, many scientific managers' willingness to hire contingent and full-time scientists with help from staffing companies has diminished recently. Despite managers' perceptions of candidates, many staffing companies have improved their screening capabilities in order to find the "best fits" for clients based on organizational cultures.

Solution – Top talent adapts to various organizational cultures.

So how have staffing companies begun to resolve this perception regarding candidates and organizational culture? In short, staffing specialists are currently recruiting top scientific talent through high-quality, timely screening mechanisms. Certainly, highly talented, dedicated scientists are versatile enough to adapt to numerous types of cultures, especially as workforces continue to attract an increasing number of contingent workers and the global scientific industry continues to evolve.

By matching such scientists to highly reputable organizations, staffing companies will begin to reduce managers' perceptions regarding candidates and organizational culture, as candidates continue to use their talents and skill sets to positively impact global organizations during the coming years.

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LAB SAFETY

COMPRESSED GAS CYLINDER SAFETY

BASIC RULES FOR THE USE, CARE, TRANSPORT AND STORAGE OF COMPRESSED GAS CYLINDERS by Vince McLeod

An explosion rocked Schweitzer Hall, which houses chemistry and biochemistry labs, on the Missouri University campus a few short months ago, injuring four students and lab technicians.[1] It could have been much worse. It is suspected that combustion of stray gases being used in an experiment, hydrogen being the prominent one of interest, led to the blast. The cause is still being investigated at the time of this writing, but we thought it would be a good time for reviewing our use and storage of compressed gases in the lab.

Laboratory research facilities use a wide variety of compressed gases. These can range from the classic inert gases such as nitrogen, carbon dioxide and argon to the highly flammable hydrogen, involved in the accident above, to acetylene and oxygen used for welding to the specialty gases such as isoflurane and halothane used for anesthesia. So in this issue, the Safety Guys offer a few basic tips on safe use of compressed gas cylinders and preventing accidents and close calls.

"... all cylinders should have permanent stamped markings on the shoulder."

How do you know what you are dealing with?

Compressed gas is loaded into, transported in and used from heavy-walled metal cylinders. These cylinders come in all sizes and shapes from little one-pound lecture bottles to railroad tank cars. The size most commonly used in research laboratories and facilities is the eighty-pound cylinders, referred to as "K" size bottles. They are about eight inches in diameter and 48 inches tall and can contain a wide array of compressed gases.

The requirements for manufacture of cylinders are detailed in Title 49 Code of Federal Regulations, Part 178, Specifications for Packaging.[2] For our purpose, we just want to point out that all cylinders should have permanent stamped markings on the shoulder. These should show the DOT specification; the proper service pressure (in gauge pounds per square inch, psig); the manufacturer's symbol and serial number; the owner's symbol; and, most important for safety, the date(s) of the initial qualification test and any subsequent tests. Cylinders need to be retested every five years of service. In addition to the permanent markings, the cylinder should also have an identifying label on the shoulder indicating the cylinder's contents.

Basic rules for safe handling of cylinders from acceptance to zero (gas left)

What follows here is a condensed set of basic guidelines applicable to all gas cylinders. The Compressed Gas Association publishes an excellent reference[3] as well as a large number of pamphlets on specific gases with more detailed information. An attempt to cover all the different classes of compressed gases is beyond the scope of this article, but we will gladly respond to readers' special concerns, perhaps with follow-up articles if interest is high.

Step 1: Before accepting or receiving compressed gas cylinders, perform a quick inspection.

All cylinders should be shipped with regulators removed and safety caps in place. Check cylinders for heavy rust or pitting, and refuse any questionable ones. Check the certification date(s). Finally, make sure each cylinder has a durable label that cannot be easily removed and that clearly identifies the contents.

Step 2: Transport compressed gas cylinders with care.

Since we are moving cylinders only from the vendor supply truck to our storage area or directly to the laboratory or facility use area, this step is straightforward but often done haphazardly or with a cavalier attitude. Compressed gas cylinders should be transported using only wheeled carts designed for this purpose. Make sure safety caps are in place and cylinders are secured to the cart. When moving multiple cylinders, do not allow them to bear against or strike each other. Finally, know the route you will travel and remove all potential obstacles. If lift gates or ramps are used, enlist a spotter or helper before moving cylinders.

Step 3: Develop specific safe handling and use procedures for your compressed gas cylinders.

Depending on the specific gas used, safety procedures can become quite complex. For example, extremely hazardous gases may require dedicated ventilated storage cabinets, safety interlocks and elaborate alarm systems. Here are a few basic ground rules to follow. When transporting, ensure all cylinders are properly secured. Common methods include chains, straps and specialty clamps. Install a proper regulator when in use, and when not in use, remove the regulator and install safety caps. Maintain adequate ventilation and temperature control for the area. Finally, close the valve and release the pressure in the system at the end of each use.

Step 4: Don't forget about storage areas.

Most sites have a designated area for compressed gas cylinder storage, particularly large facilities and those with high-volume use. These areas are often relegated to the back closet and overlooked. General safety considerations include many already mentioned above, such as securing cylinders to prevent tipping, falling and knocking together; having regulators removed and safety caps installed; and maintaining good ventilation and temperature control. There are a few important additions, however. First, the area should be locked and secured against

▲PHOTOS COURTESY OF RICH CANNON, UNIVERSITY OF FLORIDA LAB SAFETY DEPARTMENT.

SAFETY TIP

INVOLVE EVERY STAFF MEMBER IN SOME ASPECT OF THE SAFETY PROGRAM

There's a tendency to think that if someone is appointed safety coordinator, they have to do all the work for the rest of us. False! A coordinator is just that. Each person needs to be responsible for safety in general and for a specific part of the program in particular. Here's a list of a number of different specific assignments:

Lecture bottle gas cylinders
Highly toxic compounds
Emergency response
Reference materials
Alcohol inventory
Fire equipment
Flammables storage
Specimen storage
Accident records
Chemical inventory
Heavy metals
Pyrophorics
Oxidizers
Acids and bases
Refrigerators
Showers and eye washes
Electrical hazards
In-service training

Take turns doing a monthly lab inspection. Take turns presenting a 5 to 10 minute safety topic at department meetings. Take turns telling the principal/superintendent about needed repairs (with the department head's permission).

Who does your chemical hygiene plan review? The CHO, the safety committee? Give it to three, four, five members of your department and treat them to the CHP review luncheon.

The best safety programs are the ones that get everyone most involved. Safety is not a spectator sport!

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

theft and vandalism. Preferably, the cylinder storage area should be located away from emergency exits. The next most important issue is storage by compatibility, along with proper separation between hazard classes. Be sure to check local fire codes, which specify distances and quantities allowed. Clearly mark all empty cylinders and segregate these from full cylinders as well. Empty cylinders should be moved and handled with the same care as full ones and returned to the vendor promptly.

Summary

Taking the time to develop and implement a compressed gas safety program for your research or production facility will go a long way toward preventing accidents and potential tragedy. Most fixes and corrections are low cost and easily installed and maintained. Compared to the costs associated with the alternatives, it is hard to argue against a good compressed gas safety program.

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LAB SAFETY SURVEY

THE FIRST ANNUAL LABORATORY SAFETY SURVEY

SAFETY IN NUMBERS

by Vince McLeod

"Research tells us 14 out of any 10 individuals like chocolate."[1] Who can argue with that?

But seriously, while the results of our recent survey on laboratory safety may not be a box of Godiva, they are sure to please many of you because it appears from participants' responses that a safety culture has taken hold. And that is good news for employees and employers alike. Surveys can provide interesting and useful information, especially when questions are well thought out and comprehensive. Most respondents will give truthful and accurate answers. Folks that take the time to read and respond usually do not furnish false data. Worker health and safety is not a funny business. Fortunately, many of our readers agree, based on our lab safety survey results.

Before we get too far into discussing those results, we want to express our sincere appreciation to all the readers—more than 400 of you—who took the time to complete the survey. We hope the results reinforce the importance of workplace safety and prove that there truly is safety in numbers.

Who responded?

It is always good to know who provided your data. Most of the respondents for our lab safety survey were from research labs and at the supervisory or management level. Respondents working in industry research labs comprised 30%, while another 21% said they currently work in university or college research labs. Laboratory supervisors, managers and directors made up 43% of respondents, followed by chemists and scientists at 11% and technicians at 9%. The remaining 37% consisted of QA/QC managers, safety managers, engineers, professors and corporate management. Twenty-five percent of respondents were involved in research and development, and 24% provided technical services and operations. Another 19% worked in quality control, quality assurance or validation. To complete the picture of our respondents: 16% worked in either the environmental and chemical fields, with another 10% each in the biotechnology and pharmaceutical arenas. The balance of respondents was spread evenly among microbiology, food/beverage and clinical research.

Table 1. Which best describes the type of research organization or market/industry you currently work in?

Industry Research Lab	**30%**
University/College Research Lab	**21%**
Clinical Research, Hospital/Medical Lab	**14%**
Contract Lab	**9%**
Private Research Institution	**8%**
Government Research Lab	**7%**
Other:	**15%**

For those who say size matters, we included a couple of questions on the total number of employees in the organization as well as the number working in the immediate laboratory. Most respondents were employed in small businesses or organizations. Twenty-nine percent worked for facilities with between 100 and 500 total employees, and another 24% worked for small entities of fewer than 100 employees. Only 10% worked for organizations of 10,000 employees or more. Furthermore, most respondents worked in small laboratories, with 46% indicating 10 or fewer employees in the lab and another 25% with 25 or fewer workers.

Table 2. How many people work in your lab?

More than 101	**7%**
51 - 100	**9%**
26 - 50	**13%**
11 - 25	**25%**
1 - 10	**46%**

Table 3. How many people work in the organization?

50,000+	**3%**
10,001 - 50,000	**7%**
5,001 - 10,000	**7%**
1,001 - 5,000	**18%**
501 - 1,000	**12%**
100 - 500	**29%**
Less than 100	**24%**

Generating the numbers

Interestingly enough, many laboratories are conducting self-inspections, with 83% of respondents agreeing or strongly agreeing that periodic inspections are performed by lab staff. In fact, 32% have employees conduct inspections annually, and another 23% have lab safety evaluated on a monthly basis. This is an excellent way to keep safety fresh in everyone's mind and to find and correct potential hazards or problems. For the 15% that responded negatively to this question, we strongly encourage you to start a lab safety survey program as soon as possible.

Safety Survey Details I – The Top 10

We cannot hide the fact that, based on responses to the lab safety survey, our readers are doing a pretty good job of providing safe workplaces and watching out for their employees when it comes to safety. Positive responses averaged 80% or better on 44 of 56 specific safety questions. In looking at all responses closely, we assembled a list of the 10 things labs are doing best in terms of safety and these are presented in Table 4. Topping the list is the use of protective gloves to prevent skin contact with chemicals, with 98% agreeing this is done. In a close second place at 96% is keeping fire extinguishers accessible and ready to go. Third place saw a three-way tie between adequate lighting, use of PPE and proper electrical grounding (each receiving 95%). Another three-way tie followed closely for sixth place at 94%: maintaining electrical plugs, cords and receptacles; keeping fire doors unobstructed; and providing a current laboratory safety manual. Tied for the last two spots on the list were labeling chemicals and using eye protection.

Table 4. 10 Best Safety Areas

Protective gloves are available and worn for laboratory procedures where skin contact with chemicals may occur.
Fire extinguishers are accessible and regularly charged.
Work areas are adequately lit.
All other protective clothing (lab coats, aprons, etc.) or respiratory protection is available and worn in the laboratory.
All equipment is properly grounded (three-prong plugs in good condition).
Current chemical and lab safety manuals are accessible to every worker in the lab.
Fire doors are unobstructed and easily closed.
Plugs, cords and receptacles are in good condition (no splices or frayed cords).
Chemicals are properly labeled to identify contents and hazards.
Safety spectacles or other eye protection are available and worn in the laboratory.

Safety Survey Details II – The Bottom 10

You knew it was coming. Yes, there are areas where improvement is needed, so we had to compile the companion list of the 10 things with the lowest positive responses. The bottom 10 list is given in Table 5 and is headed by ergonomically adequate lab furniture at 74% positive responses. Having written standard operating procedures for all tasks placed second with 73%, followed closely by labeling all circuit breakers at 72%. Fourth place is held by performing hazard evaluations/exposure assessments for toxic materials used in the lab, which garnered 63% positive responses. There was a tie for fifth place at 60%: between having a designated chemical hygiene officer and keeping at least 25psi in gas cylinders to prevent backflow. Ranking seventh is having restraints on shelving to keep items from falling, earning 55% positive responses. Just 52% responded as having proper signing for areas containing compressed gas cylinders, placing this eighth on the list. Labeling refrigerators as unsuitable for flammable storage collected only 44% affirmative responses. And the bottom of the bottom 10, labeling laboratory sinks not suitable for drinking, got the survey low positive response of 36%.

> "It appears from participants' responses that a safety culture has taken hold."

Table 5. 10 Worst Safety Areas

The furniture is ergonomically adequate.
Standard operating procedures (SOP) have been written for each task.
All circuit breakers are labeled to indicate what equipment is served by each.
Hazard evaluations and exposure assessments have been conducted for high hazard/low PEL material use in the lab (e.g. formaldehyde, methylene chloride, etc.)
There is a designated Chemical Hygiene Officer for the lab.
Gas cylinders are not emptied completely, but left with 25 psi to prevent backflow.
All shelves have lips, wires or other restraints to prevent items from falling.
Rooms containing compressed gases have a sign outside the room stating COMPRESSED GAS and the name of the gas and hazard class.
Non-spark-proof refrigerators (household types) are labeled "Unsafe for Flammable Storage."
Sinks are labeled "Industrial Water - Do Not Drink."

In summary, we can say there is safety in our survey numbers. In general, responses were very positive for more than three-quarters of our questions. In terms of getting more employees, including management, involved and buying into the safety mindset, it is evident that readers' laboratories are establishing a safety culture. Hopefully, everyone will take a look at the 10 lowest areas and use that list to evaluate safety in the lab. And the more people we can get to participate, the better and safer our workplaces will be.

While our survey numbers tell a story, they do not provide a complete picture. Let's not become lackadaisical when it comes to safety. We do not want to become like Homer Simpson, whose view of statistics was revealed when he said, "Aw, people can come up with statistics to prove anything, Kent. Forty percent of all people know that."[2]

For complete survey results, go to www.labmanager.com/survey2k9/.

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BUSINESS MANAGEMENT

RECYCLING CLOSED LABORATORIES

RENTING SPACE IN VACATED RESEARCH FACILITIES OFFERS COST SAVINGS AS WELL AS LESS OBVIOUS ADVANTAGES by John K. Borchardt, Ph.D.

The high costs of building a laboratory present a major financial challenge for small companies and start-ups. At the same time, mergers and acquisitions, primarily in the pharmaceutical industry, are resulting in the closure of very large modern laboratories employing 1,000 or more people. This is not a new trend. Such closures have occurred periodically when waves of mergers and acquisitions swept various industries or when poor economic conditions forced the closure of large laboratories. Results of earlier mega-lab closures discussed below indicate how recently shuttered labs could evolve.

Instead of spending scarce capital to purchase or build a laboratory, firms can rent facilities in one of the large laboratories closed as a result of corporate mergers and acquisitions and reopened, usually under new ownership, as rental facilities. These facilities can enable small and midsized companies to rent first-class laboratory space at relatively modest cost. Many of these mega-laboratories also include offices, small production plants and warehouse space.

Renting laboratory space in a large, formerly closed laboratory offers other advantages as well. Government emissions permits are required for laboratories. Obtaining these permits often requires many hours to complete the necessary paperwork, followed by months of waiting time for the permit requests to be processed. The time and expense of obtaining these permits usually can be eliminated when leasing space because the permits already exist for large, multiuser laboratories. Another advantage: janitorial and other services can be shared by the tenants, reducing the cost to each tenant.

"These facilities can enable small and midsized companies to rent first-class laboratory space at relatively modest cost."

University of Pittsburgh Applied Research Center

In 1985 Chevron acquired Gulf Oil and consolidated R&D operations in California. It closed Gulf's corporate research center near Pittsburgh and donated it to the University of Pittsburgh in 1986. This is a very large facility: 53 buildings having a total of 1 million square feet of laboratory, office, manufacturing and warehouse space on 85 acres of land, 12 miles from the University of Pittsburgh. The university renamed the lab the University of Pittsburgh Applied Research Center, U-PARC, and began seeking tenants. In three years employment at U-PARC increased from 250 to more than 1,000 as companies moved into the site.

Aerial view of the University of Pittsburgh Applied Research Center.

PHOTOGRAPH COURTESY OF THE UNIVERSITY OF PITTSBURGH APPLIED RESEARCH CENTER.

Tenants have many amenities. The buildings are connected by underground pedestrian tunnels that tenants can use during inclement weather. Tenant employees have access to an on-site cafeteria, catering service, meeting/conference space, post office, credit union, picnic areas, locker rooms and shower facilities. Besides laboratory, office and storage space, there are 32 small-scale manufacturing plants that include petroleum, petrochemical and chemical-based technologies. Advanced manufacturing and testing capabilities include environmental, synthetic fuels, biotechnology and other emerging technologies.

Jeff Latcheran, of real estate management firm Oxford Development Company, facility manager for the U-PARC site, noted that companies have leased about two-thirds of the leasable space while the University of Pittsburgh and its affiliated Manufacturing Assistance Center occupy the remainder. Intertek PARC Technical Services, a subsidiary of Intertek Group Plc, is the largest corporate tenant, occupying 11 percent of the leasable space including oil refinery pilot plants and automotive testing service facilities.

While several Fortune 500 firms rent space, most of the approximately 120 U-PARC tenants are small and midsized firms. Plextronics, with 58 employees, is one example. The firm develops and manufactures conductive polymers used in solar cells and other advanced electronics devices. The firm rents more than 20,000 square feet of space for laboratory, manufacturing and headquarters facilities.

Shell's former California lab

More than a decade before U-PARC was established, another major oil company, Shell, closed its big research lab in Emeryville, a suburb of San Francisco. This was part of a process in which Shell centralized its research and headquarters operations in Houston. Despite its closure, the lab was to have an exciting future. This was the period that saw the birth of the biotechnology industry, and the San Francisco area was one of the hotbeds of the nascent technology. Initially left empty, the lab was occupied by one of the pioneering biotechnology firms, Cetus Corporation, established in 1971.

Only a small start-up company when it moved into the Emeryville laboratory, Cetus grew rapidly as it developed biotechnology manufacturing procedures that have become the foundation of the biotechnology industry. Cetus also developed several new drugs. The company went public in 1981. It continued to spend heavily on research but encountered financial difficulties in 1990 when the U.S. Food and Drug Administration delayed approval of its new drug for treating renal cancer, called IL-2.

Biotechnology firm Chiron Corporation acquired Cetus in 1991 and continued research using the Emeryville laboratory. Chiron gradually grew, eventually employing about 2,300 employees. It was acquired by Novartis, a major pharmaceutical firm, in 2006. Novartis established a new division, Novartis Vaccines and Diagnostics, which currently occupies the laboratory.

Renting space

Other companies with declining laboratory needs never closed their labs but did rent parts of them to other firms. One example is Eastman Kodak. The Eastman Business Park (EBP) is the former Kodak Park, a 1,200-acre site containing 3 million square feet of building space in Rochester, New York. In addition to laboratories, manufacturing facilities and offices, the site also has a 2,000-seat auditorium, cafeteria, fitness center and

Interior view of a lab in the University of Pittsburgh Applied Research Center.

PHOTOGRAPH COURTESY OF THE UNIVERSITY OF PITTSBURGH APPLIED RESEARCH CENTER.

gymnasium. Emergency medical services are available on-site, as are a credit union and shops where one can purchase lab safety glasses and safety shoes.

EBP currently hosts around 20 external businesses in addition to Kodak's remaining research efforts. Besides large firms employing hundreds, such as International Paper Company and divisions of such Fortune 500 companies as Johnson & Johnson (the Ortho-Clinical Diagnostics, Inc., division), midsized firms such as Arnprior Rapid Manufacturing Solutions and small start-up firms such as 2008 start-up Transparent Materials LLC with five employees also occupy laboratories at EBP. (According to founder Joseph Bringley, Transparent Materials is using nanotechnology to develop medical implants that better integrate into the human body and speed the healing process.)

> "... janitorial and other services can be shared by the tenants, reducing the cost to each tenant."

Transparent Materials employees include former and retired Kodak scientists. In leasing labs at EBP, Transparent Material scientists have access to Kodak's analytical equipment so they can pay for advanced testing as needed without having to purchase the expensive laboratory equipment.

Besides Kodak's analytical capabilities, EBP tenants also have access to various Kodak services including project and construction management services and energy management consultation. For instance, rather than build its own production plant, start-up firm Novomer, with 23 employees, will use an idle one at Eastman Business Park to produce sustainable materials using waste carbon dioxide—a greenhouse gas—as a primary raw material. The materials can be used as computer casings and other products. Mike Slowik, Novomer's manager of strategic planning and analysis, says that by using Kodak's manufacturing services his firm will get substantial quantities of test materials into the hands of prospective customers much faster.

David Stokla, while director of EBP, noted that EBP's mission is "to sell properties that are no longer needed by Kodak." This means selling as well as renting EBP buildings. For example, in late 2009, LiDestri Foods, Inc. purchased a 625,000-square-foot building at EBP to expand its manufacturing operations and serve as a new product development center.

Another example is Shell Oil's Westhollow Technology Center in Houston. During the years 1990–2002, Shell sold a number of its chemical businesses. Most of the buyers rented space these businesses had used in the technology center. Tenants included large firms such as Dow Chemical, midsized firms such as Resolution Performance Polymers (now part of Hexion Chemicals) and Kraton Polymers, and a small firm, Tomah Products. Since 2008 these tenants have moved out to their own facilities as their leases expired. Shell is building two new buildings on the Westhollow site and will be moving employees from other research locations into the expanded facility.

Rebirth of closed pharmaceutical labs

The 2003 closure of Pharmacia's Kalamazoo, Michigan, laboratory when Pfizer acquired Pharmacia provides another interesting example. The lab has reopened as a multiuser facility called the Western Michigan University Business Technology Research Park. Local financial backing, abundant local scientific talent, affordable housing and local universities are aiding Kalamazoo's effort to become a Midwest biotechnology hotspot. Life sciences service companies, drug companies and medical device firms are locating to the area, with some renting space in the once-closed laboratory.

One such company is contract research firm MPI Research. In 2008 Pfizer sold two of its empty downtown Kalamazoo laboratory buildings to MPI Research. The privately held Midwestern company provides research services to biotech, pharmaceutical, medical device, animal health and agrichemical companies. The two buildings contain 510,000 square feet of space and will house customized, state-of-the-art laboratories.

Aerial view of the North Campus Research Complex.
PHOTOGRAPH COURTESY OF THE UNIVERSITY OF MICHIGAN.

Interior view of North Campus Research Complex.
PHOTOGRAPH COURTESY OF THE UNIVERSITY OF MICHIGAN.

In 2008 Pfizer announced the closing of its Ann Arbor, Michigan, laboratory employing more than 2,700 people. This is the lab where the blockbuster heart medication Lipitor was invented and much of the development work was done. The University of Michigan (UM) moved quickly and purchased the laboratory for the bargain price of $108 million.

Renamed the North Campus Research Campus (NCRC), the facility's 30 buildings sit on a 174-acre site that contains more than 2 million square feet of space consisting of 33 percent laboratories and 17 percent laboratory support space for machine and electrical shops and other laboratory support facilities. About 14 percent of the floor space is manufacturing facilities, primarily a plant to produce quantities of new drugs for clinical trials.

UM researchers will use part of the facility and 300 of them are moving in as of early 2010.

Mary Masson of the university's service group for the site explains, "Our initial effort is to develop a critical mass of researchers at NCRC that will serve as the linchpin for an increased level of public and private partnerships and also rent some of the space to outside companies." For those companies that do locate at NCRC, Masson says, "We do expect there will be shared services such as IT, conference space, access to scientific cores, parking facilities and more." (Scientific cores provide shared services such as DNA sequencing for scientists.)

"We are not aggressively marketing NCRC to companies interested in becoming tenants," notes Masson. "Our primary goal is to provide space for innovative University of Michigan-led research projects and to attract private-sector entities that want to interact with our researchers. We have no interest in simply becoming a landlord for the sake of securing a rent check."

Is there a large laboratory in your area that might close? Or is there one that has closed and reopened and is renting laboratory space? If so, this might represent a valuable opportunity for your firm.

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SURVEY SAYS: WHAT GOES INTO BUYING A LAB GLASSWARE WASHER

Glassware washing machines are more than convenience appliances: They ensure consistent cleaning of critical labware, free up technician time for more value-added work, and provide assurance and validation in regulated industries. With the possible exception of organic chemistry labs, most labs today rely on washers.

Efficient cleaning is a function of cycle time, wash temperature, mechanical action, and cleaning agents. The ideal combination is high water throughput at relatively gentle spray pressure, sufficiently high temperature, a spray pattern that reaches the entire wash load, and selection of cleaning agents suitable for the task.

As part of our new online Lab Products Survey series, we present here results from our recent survey on purchasing a lab glassware washer. Total completed surveys: 197

If you would like to participate in our laboratory equipment purchasing surveys, please visit www.labmanager.com/surveys

Number of Lab Glassware Washers installed within labs.

None	34%
1	38%
2	17%
3	5%
4	1%
5	5%

Most widely used Lab Glassware Washer brands currently in labs.

BeliMed
Getinge
HotPack
Labconco
Lancer
Miele
Scientek
SMEG Instruments
SteelCo
Steris
Thermo Fisher Scientific
Yamato Scientific

The primary purpose for this product.

Quality Control	38%
Research	32%
Processing	10%
Clinical and Diagnostic	7%
Other	13%

Types of Lab Glassware Washers being used.

Small Capacity Washer	34%
Medium Capacity Washer	32%
Large Capacity Washer	7%
High Throughput Washer	6%
Don't know	8%
Other	13%

Lab Glassware Washer-related components being used.

Lower baskets	42%
Upper baskets	34%
Direct injection (for beakers, pipettes, flasks)	31%
Test tube baskets	19%
Slides and Petri dish baskets	10%
Don't Know	9%
Other	8%

Annual Lab Glassware Washer supplies and accessories purchasing budget for items such as detergents, baskets and inserts.

Less than $500	36%
$500 - $2,000	37%
$2,000 - $5,000	9%
$5,000 - $15,000	5%
$15,000+	1%
Don't know	12%

Satisfaction with Lab Glassware Washers being used.

Satisfied	58%
Not Satisfied	39%
Don't Know	8%

Purchasing plans for a new or used Lab Glassware Washer.

Starting the review process	7%
Plan to purchase in the next 1 to 6 months	11%
Plan to purchase in 6 to 12 months	7%
Plan to purchase in 12 + months	7%
No current purchasing plans	64%
Don't know	4%

Reasons for purchasing a new or pre-owned Lab Glassware Washer.

Replacement of current systems	35%
Setting up a new lab	25%
Addition to existing systems, increase capacity	16%
First time purchase of a lab centrifuge	16%
Other	8%

Budget range for a Lab Glassware Washer purchase.

Less than $500	22%
$500 - $1,000	21%
$1,000 - $2,500	16%
$2,500 - $4,000	9%
$4,000 - $6,000	12%
$6,000+	20%

Factors/features in the decision-making process to buy a Lab Glassware Washer rated by importance.

Consistent washing and disinfection results	88%
Low maintenance - ease of use and clean	85%
Reliability of product	85%
Value for price paid	82%
Service / Support	81%
Warranties	77%
Safety feature	73%
Energy efficient / low operating cost	72%
Ability to customize racks	67%

Respondents fields of work.

Biotechnology	14%
Environmental	12%
Pharmaceuticals	10%
Chemicals	9%
Clinical Research/Trials	8%
Energy/Petroleum	6%
Microbiology	6%
Food/Beverage	5%
Forensic	4%
Detergents, surfactants and cosmetics	3%
Instrumentation Design/Development	2%
Plastics/Polymers	2%
Other	19%

SURVEY SAYS: WHAT GOES INTO BUYING A WATER PURIFICATION SYSTEM

Water is perhaps the most utilized reagent in a laboratory and is often critical for an experiment. As instruments have become more sensitive and applications increasingly complex, the demand for high-purity water has also increased. A few years ago, parts per million (ppm) was a very small level of contamination, but now people are looking for parts-per-billion (ppb) or parts-per-trillion (ppt) levels of contamination.

There are eight commonly used methods to purify water: distillation, deionization, reverse osmosis, activated carbon filtration, microporous filtration, ultrafiltration, ultraviolet oxidation and electrodialysis. The National Committee for Clinical Laboratory Standards (NCCLS) has specified three types of water: I, II and III, as well as special-purpose water, depending on their use.

As part of our new online Lab Products Survey series, we present here results from our recent survey on purchasing a water purification system. Total completed surveys: 374

If you would like to participate in our laboratory equipment purchasing surveys, please visit www.labmanager.com/surveys

Number of Water Purification Systems installed within labs.

None	13%
1	44%
2	25%
3	9%
4	2%
5	7%

Most widely used Water Purification System brands currently in labs.

AquaSolutions
Aries Filterworks
Aurora Biomed
Elga LabWater
Labconco
Millipore
Pall Life Sciences
Sartorius
Siemens
Thermo Fisher Scientific (Barnstead)

The primary purpose for this product.

Research	50%
Quality Control	31%
Clinical	11%
Production / Processing	3%
Other	5%

Satisfaction with Water Purification Systems being used.

Very Satisfied	34%
Satisfied	42%
Don't Know	20%
Not Satisfied	5%

Feed source for principal Water Purification Systems.

Raw potable	46%
De Ionized	20%
Reverse Osmosis	13%
Di/RO	9%
Distilled	8%
Other	3%

Required purity level of ASTM Standards Lab Water?

ASTM Type I	45%
ASTM Type II	31%
ASTM Type III	12%
Other	7%
Don't Know	5%

Budget range for Lab Water Purification System accessories.

Less than $500	3%
$500 - $2,000	15%
$2,000 - $5,000	34%
$5,000 - $10,000	39%
$10,000+	7%
Don't know	2%

Water Purification System components also being used.

Storage tank	41%
UV sterilizer	30%
Water quality monitor	30%
Dispensing points	27%
Distiller	20%
Polisher	19%
Water softener	14%
Other	3%

Purchasing plans for a new or used Water Purification System.

Plan to purchase	34%
Starting the evaluation requirements	12%
Plan to purchase within next 6 months	18%
Plan to purchase in 6 to 12 months	37%
Plan to purchase in 12 + months	33%
No current purchasing plans	66%

Reasons for purchasing a new or pre-owned Lab Water Purification System.

Addition to existing systems, increase capacity	22%
Replacement of existing systems	53%
New systems – no pre-existing system capabilities	15%
Setting up a new lab	9%

Budget range for a Water Purification System purchase.

Less than $5,000	33%
$5,000 - $10,000	26%
$10,000 - $15,000	19%
$15,000 - $20,000	11%
$20,000 - $30,000	3%
$30,000+	8%

Factors/features in the decision-making process to buy a Water Purification System rated by importance.

Water quality	92%
Low maintenance - ease of use and clean	89%
Reliability of product	89%
Energy efficient / low operating cost	76%
Value for price paid	75%
Service / Support	74%
Self monitoring	72%

Respondents fields of work.

Chemicals	16%
Environmental	16%
Biotechnology	10%
Pharmaceuticals	10%
Microbiology	9%
Food/Beverage	8%
Clinical Research/Trials	7%
Energy/Petroleum	5%
Detergents, surfactants and cosmetics	3%
Forensics	3%
Other	13%

SURVEY SAYS: WHAT GOES INTO BUYING A CENTRIFUGE

Centrifuges are among a select group of laboratory instruments that are as scalable as they are configurable. Individuals who have used benchtop centrifuges that handle sub-milliliter volumes may be surprised to learn that centrifuges—some as large as rooms—are used in industrial processing.

Basic centrifuge designs are simple, consisting of an enclosed compartment inside which a rotor spins rapidly. Rotors, which can usually be interchanged, contain equally spaced openings into which sample tubes are inserted. Samples will either spin at a fixed angle relative to the rotating axis or "swing out" to perpendicular under centripetal force as the rotor speed increases.

As part of our new online Lab Products Survey series, we present here results from our recent survey on purchasing a centrifuge. Total completed surveys: 268

For such a relatively simple design, it is surprising that nearly 40 percent of respondents told us they were not happy with their centrifuges. Manufacturers, take note.

If you would like to participate in our laboratory equipment purchasing surveys, please visit www.labmanager.com/surveys

Number of Centrifuges installed within labs.

None	9%
1	15%
2	16%
3	12%
4	10%
5	38%

Most widely used Centrifuge brands currently in labs.

BD Biosciences
Beckman Coulter
Drucker Company
Eppendorf
Helmer
HERMLE
Hettich Instruments
Iris Sample Processing
Labnet International
MP Biomedicals
New Brunswick Scientific
Sartorius
Thermo Fisher Scientific
Tomy Tech

The primary purpose for this product.

Research	57%
Quality Control	26%
Clinical	12%
Production / Processing	3%
Other	2%

Types of Centrifuges being used.

Benchtop Centrifuge	29%
MicroCentrifuge	18%
Benchtop Refrigerated Centrifuge	13%
Floor Refrigerated Centrifuge	10%
Benchtop Clinical Centrifuge	9%
Floor Centrifuge	7%
Floor UltraCentrifuge	7%
Benchtop UltraCentrifuge	5%
Other	2%

Satisfaction with Centrifuges being used.

Satisfied	59%
Not Satisfied	37%
Don't Know	4%

Annual Centrifuge consumable purchasing budget for items such as tubes and rotors.

Less than $500	33%
$500 - $2,000	30%
$2,000 - $5,000	10%
$5,000 - $15,000	10%
$15,000+	3%
Don't know	15%

Purchasing plans for a new or used Lab Centrifuge.

Starting the review process	9%
Plan to purchase in the next 1 to 6 months	17%
Plan to purchase in 6 to 12 months	12%
Plan to purchase in 12 + months	12%
No current purchasing plans	49%
Don't know	2%

Reasons for purchasing a new or pre-owned Centrifuge.

Addition to existing systems, increase capacity	37%
Replacement of current systems	27%
Setting up a new lab	19%
First time purchase of a lab centrifuge	4%
Other	12%

Budget range for a Centrifuge purchase.

Less than $1,000	24%
$1,000 - $5,000	35%
$5,000 - $15,000	28%
$15,000 - $50,000	8%
$50,000+	4%

Factors/features in the decision-making process to buy a Lab Centrifuge rated by importance.

Durability of product	97%
Low Maintenance - ease of use and clean	95%
Value for price paid	93%
Reliabilty of vendor	92%
Minimal vibration	86%
Safety Features	85%
Accuracy - consistent performance	81%
Service and Support	74%
Energy Efficient / Low Operating Cost	71%
Warranties	67%

Respondents fields of work.

Biotechnology	17%
Clinical Research/Trials	13%
Environmental	12%
Pharmaceuticals	11%
Energy/Petroleum	7%
Chemicals	6%
Food/Beverage	5%
Microbiology	5%
Forensic	3%
Instrumentation Design/Development	2%
Plastics/Polymers	2%
Other	17%

TECHNOLOGYNEWS

The latest equipment, instrument and system introductions to the laboratory market

ANALYTICAL

Dispersive Raman System

RamSpec™ 1064-HR

- Features Volume Phase Grating (VPG®) as the special dispersion element and InGaAs array detector as the detection element
- Helps reduce the likelihood of human error by eliminating sample preparation and test interpretation
- Uses a fiber optic bundle or slit optics arrangement based on customer preferences
- Features self-automated wavelength calibration

BaySpec www.bayspec.com

UV-Vis Spectrophotometers

Libra Series

- Feature a color touch screen, USB connection, optional Bluetooth for data transfer and an optional built-in printer
- Includes application-based software for all stand-alone and PC-controlled instruments
- Equation Editor allows users to program specific methods that include calculations based on measured data

Biochrom www.biochrom.co.uk

PRODUCT SPOTLIGHT

LC SYSTEMS FOR ANY APPLICATION OR BUDGET

NEW LEVELS OF PERFORMANCE IN ANALYTICAL HPLC AND UHPLC

The 1200 Infinity Series of LC systems from Agilent Technologies includes three models that offer seamless integration of column technology, instrumentation and software for maximum productivity. The series features upgraded detectors, pumps and autosamplers for higher sensitivity and detection speeds, and is fully compatible with modern column technology.

The 1220 and 1260 models support a 600 bar pressure range and 80 Hz data acquisition rate, allowing for the use of sub-2 micron particle columns. The 1220 Infinity LC is well-suited to routine HPLC and advanced RRLC analyses, while the 1260 Infinity LC pushes RRLC performance even further. Both models are fully compatible with HPLC methods, ensuring risk-free replacement or upgrades of existing 1100 or 1200 Series instruments.

Dr. Michael Frank, Product Manager HPLC Systems & Solutions at Agilent, says the 1200 Infinity LC Series offers the highest flexibility. "The customer can decide… if he wants to continue running conventional LC methods or use new UHPLC methods, or both—on the same system," he said. And since the 1260 Infinity LC modules are exchangeable, "it's possible to upgrade an existing 15-year-old 1100 Series LC with a new 1260 Infinity DAD and achieve a 10-fold sensitivity gain," he added.

The 1290 Infinity LC delivers the highest performance, with a power range up to 1200 bar pressure and a 160 Hz detection speed. The 1260 and 1290 models are compatible with all Agilent 6000 Series mass detectors.

For more information, visit www.agilent.com. Dr. Michael Frank can be reached at +49 7243 602 2252.

Liquid Extraction Sample Preparation Columns

ISOLUTE SLE+

- Use a simple 3-step method: load, wait 5 minutes and elute
- Combine clean extracts with rapid work flow and ease of use that ensure reproducibility
- Suitable for use with sample volumes from 25 µL up to 10 µL
- Also available in an Array format with a modular plate design for added cost savings

Biotage www.biotage.com

Immobilized Polysaccharide CSPs

CHIRALPAK IA, IB and IC

- Allow for the use of an extended range of solvents
- All three models are based on high-efficiency 5-µm diameter spherical silica
- CHIRALPAK IC's chiral selector is based on the 3,5-dichloro-phenylcarbamate of cellulose, immobilized on 5-µm silica
- Exhibit stability to pressure drops up to 400 bar

Chiral Technologies www.chiraltech.com

Chromatography Instruments

High Performance Countercurrent Chromatography (HPCCC)

- For preparative scale chromatographers using normal or reversed phase HPLC or FC
- Fits seamlessly into workflow and provides productivity improvements in many applications
- Uses liquid stationary and mobile phases for simple and reliable scale-up

Dynamic Extractions www.dynamicextractions.com

Automatic Distillation Tester

MINDIS ADXpert

- Performs according to the D7344 standard for atmospheric distillation
- Requires as little as 6 mL of sample; a distillation run on light samples takes 15 minutes
- Features metal sample cups, which reduce consumable costs by replacing glass flasks
- Incorporates automatic rinsing, sample introduction and automatic cleaning programs

Grabner Instruments
www.petrolab.com

2D Barcode Reader

For MICROLAB STAR

- Provides advanced sample tracking functions on MICROLAB STAR liquid handling workstation
- CCD camera records barcodes in less than 0.5 seconds from a wide range of sample formats
- Supports a variety of tubes from many manufacturers, in 24-, 48-, 96- and 384-well configurations
- Ideal for high-throughput screening, sample archival and forensics

Hamilton Robotics www.hamiltonrobotics.com

MALDI-TOF Mass Spectrometer

JMS-S3000 SpiralTOF™

- Delivers a resolving power of greater than 60,000 (FWHM) over a wide mass range of m/z 10-30,000
- Features a staggered figure-8 ion trajectory of 17 meters
- Due to refocused ion packets, divergence of ions is reduced over the flight distance
- Available in four configurations

JEOL USA www.jeol.com

GCxGC with Time-of-Flight MS

Pegasus® 4D

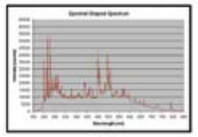
- Features a low-maintenance, consumable-free thermal modulator
- Offers a wide dynamic range (4 orders of magnitude)
- Includes a secondary oven for enhanced selectivity
- Cryo-focusing prior to release on secondary column provides up to a tenfold increase in analyte detectability

LECO Corporation
www.leco.com

Spectral Shaping Technology

Light Shaping Technique

- Balances and smoothes uneven spectral emission from UV-Vis light sources used for spectroscopy applications
- Measures light more evenly across a broader spectral region, improving signal-to-noise performance
- Useful for spectral absorbance applications where strong absorbing bands coexist with bands of low signal in the unbalanced spectrum



Ocean Optics
www.oceanoptics.com

Fluorinated By-Products Analyzer

FBA 5320

- Automatically quantifies fluorinated contaminants in process streams
- Measures total fluoride concentrations in the low parts-per-million (ppm) range
- Determines fluoride content every 2 to 3 minutes, rather than 3 to 4 hours
- No computer software is required

OI Analytical www.oico.com

Flash Point and Fire Point Analyzer

Petrotest CLA 5

- Comes ready for testing with automatic test routines, user-definable programs and self-testing/servicing routines
- Features a 5.7-inch color graphics display and Pmove® jog wheel control
- Features selectable output, either oC or oF, and a measuring temperature testing range from ambient to 400oC (752oF) without requiring any additional equipment

AMETEK www.petrolab.com

HPLC/SFC Columns

Lux®

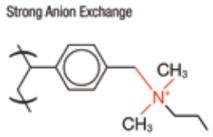
- Lux Cellulose-4 is a novel cellulose tris (4-chloro-3-methylephenylcarbamate) phase
- Lux Cellulose-3 uses cellulose tris (4-methylbenzoate) as the selector
- Deliver high loading capacity and are pressure-stable up to 300 bar
- Offered in 3 µm and 5 µm particle sizes

Phenomenex
www.phenomenex.com

SPE Sorbent

Strata-X-A

- Delivers maximum retention of anionic compounds
- Features a pH-stable base polymer that resists deconditioning
- Ideal for a variety of LC and GC applications involving acid analytes
- Offered in 1-, 3- and 6-ml tubes, 96-well plates and 12-, 20- and 60-ml tubes for large-volume applications



Phenomenex
www.phenomenex.com

Automated Gel Electrophoresis

ScreenTape®

- Consists of consumable tape (ScreenTape), TapeStation device and GeneTools software
- Delivers analyzed results in around 1 minute per sample
- System automatically distinguishes between loaded tube strips and 96-well plates
- Each ScreenTape contains a gel matrix, running buffer and electrode and is ready to use out of the box

Lab901 www.lab901.com

MALDI TOF Mass Spectrometer

AXIMA MegaTOF™

- Combines a Shimadzu linear MALDI TOF mass spectrometer with a CovalX high-mass detection system
- Detects macromolecules up to 1,500 kDa
- Detects protein interactions such as aggregation directly from formulation mixtures
- Ideal for protein complex characterization, therapeutic protein aggregates, antibody-antigen interactions and polymer analysis

Shimadzu Scientific Instruments www.ssi.shimadzu.com

HILIC Columns

Hypersil™ Gold

- Aids in the analysis of compounds that are usually difficult to retain using conventional C18 columns
- Available in 1.9 μm, 3 μm and 5 μm particle sizes
- Highly organic mobile phase contains low salt levels, making them ideal for electrospray mass spectroscopy
- Ideal for applications within drug discovery, food testing and environmental analysis

Thermo Fisher Scientific www.thermoscientific.com/columns

Zero Torque Overhead Stirrers

BCD Series

- Redesign of the BCD1850, BCD3030 and BCD6015 high-torque stirrers includes the addition of a zero torque button
- Allows the user to zero the torque at any stage of mixing, or zero out any additional overhead torque created by the mixing paddle and chuck before mixing starts

Caframo
www.caframo.com

Particle Size Analyzer

1090LD

- Features fully integrated liquid and dry dispersion
- A mouse click switches dispersion modes for simple, fast operation with no need to realign or revalidate the system
- Uses two lasers, ensuring the highest accuracy and precision from 0.04 to 500 microns
- Optical components are permanently mounted on a cast iron base plate to ensure the system is always aligned

Cilas Particle Size www.particle-size.com

BASIC LAB

Vertical Laminar Flow Cabinets

Purair

- Feature rear wall perforations which remove a small amount of air to minimize any turbulence
- Available in 36", 48" and 72" widths
- Provide a nominal filter face velocity of 0-45 m/s (90 fpm), ensuring a sufficient number of air changes to maintain cleanliness within the work zone

Air Science www.airscience.com

Repeating Pipette

HandyStep® Electronic

- Automatically recognizes the size of encoded proprietary syringe tips
- Features continuously adjustable volume selection from 1 μL to 50 mL
- Compatible with standard syringe tips from various manufacturers
- Features three operational modes: Pipette, Dispense, and Auto-Dispense, which eliminates up to 97% of repetitive motion from repeat pipetting

BrandTech Scientific
www.brandtech.com

Microspectrophotometer

20/20 Solar™

- Features fully integrated liquid and dry dispersion
- A mouse click switches dispersion modes for simple, fast operation with no need to realign or revalidate the system
- Uses two lasers, ensuring the highest accuracy and precision from 0.04 to 500 microns
- Optical components are permanently mounted on a cast iron base plate to ensure the system is always aligned

Cilas Particle Size www.microspectra.com

Portable Pipette

Pipet-Aid® XP2

- Features an advanced power source which can be charged while in use, enabling more convenient, uninterrupted operation
- Includes a powerful, ultra-quiet pump, providing greater control for aspiration and dispensing
- Each unit comes with a power supply charger, 4 extra filters and a stand

Drummond Scientific www.drummondsci.com

Evaporator Systems

EZ-2 Series

- Designed specifically for solvent removal
- Standard model (EZ-2) is suitable for water and volatile solvents
- Plus model (EZ-2^{plus}) is recommended for solvents with boiling points up to 165°C
- Envi model (EZ-Envi) is recommended for concentration of volatile solvents

Genevac
www.genevac.com

Water Baths

Aqua Plus Series

- Four models available: digital and analog controlled Unstirred Baths, digital controlled Linear Shaking Baths, and safety protected Boiling Baths
- All models are available in a variety of sizes to meet a wide range of applications
- Feature easy-to-clean stainless steel tanks, drain taps and non-drip polycarbonate lids and bases

Grant Instruments
www.grantsci.com

Volumetric Karl Fischer Titrator

AQUACOUNTER® AQV-300

- Features six built-in calculation modes to accommodate solid, liquid and gas samples
- Four files with preset conditions can be stored in memory; allows instant recall of data for up to 20 samples
- Includes a statistics package with one-touch calculations
- Features a built-in detector that monitors titration status; direct key access allows entry of titration parameters

JM Science
www.jmscience.com

Secondary Gas Dilution Module

FlexStream™ SD

- Automatically adjusts split and dilution flows to create a desired output concentration
- Features a total concentration adjustment range of 10,000:1 so that concentrations from 1ppb to 10ppm could be created using a single permeation tube
- Allows extended calibration accuracy and linearization of flow measurements

KIN-TEK
www.kin-tek.com

Vibration-isolating Leg Stands

500AP Series

- Available individually as modular mounts or as leg stands with braces and casters for optical tables
- Feature internal trifilar and quadfilar pendulum systems for exceptional horizontal vibration isolation
- Offer low natural frequencies: 1.25 Hz along horizontal axis and 1.50 Hz along vertical axis
- Able to achieve isolation efficiencies of 98% (horizontal) and 95% (vertical) at 10 Hz and above

Kinetic Systems www.kineticsystems.com

Lamp Measurement Sphere

LMS-3M

- Complies with IESNA LM-79 and LM-80 standards for accurate measurements of any lamp up to 2m linear lamps and 30cm luminaries
- Measures Total Spectral Flux, Luminous Flux, Correlated Color Temperature, Color Rendering Index and Chromaticity
- Features Spectraflect® interior coating for uniform dispersion of light

Labsphere www.labsphere.com

ADA Height General Purpose Lab Refrigerators

6CADM Series

- Features MicroSentry™ Scientific control for temperature accuracy and monitoring
- Includes a powerful compressor for faster pull-down times and quick temperature recovery
- Features positive-close hinges to reduce door ajar occurrences
- Front-vented for true integration into laboratory casework

Marvel Scientific
www.marvelscientific.com

Data Logger

OM-CP-PHTEMP2000 Series

- Logs data in real time, and offers NIST Traceable Calibration
- Features programmable engineering units, programmable start time and automatic temperature compensation
- Works with proprietary pH probes
- Ideal for measuring pH of storm water runoff or drainage

Omega Engineering www.omega.com

Benchtop Dissolved Oxygen Kit

DOB21

- Consists of a benchtop dissolved oxygen meter and an amperometric dissolved oxygen probe
- Features RS232 output, auto calibration for all parameters, salinity and barometric pressure compensation, and data logging up to 99 points
- Programming is done via a three-button keypad and stored in the non-volatile memory

Omega Engineering www.omega.com

Bead Mill Homogenizer

Bead Ruptor 24

- Designed for grinding, lysing, and homogenization of biological samples prior to molecular extraction
- Able to process volumes ranging from 0.3 mL to 5 mL
- Features a broad speed range of 2,000 to 5,000 rpm
- Brushless motor requires no cool-down period between processing cycles, allowing more samples to be processed in less time

Omni International www.omni-inc.com

Zero Grade Air Generators

Balston® UHP

- Five models produce up to 30 lpm of hydrocarbon-free air from existing compressed air supply and will service up to 66 FIDs
- Allow gas cylinder users to supply, control and automate their gas supplies
- Feature an ergonomic cabinet design, visual operational status display and 1-year warranty

Parker Hannafin Corporation www.labgasgenerators.com

Hydrogen Generator

GC Gas Station GCGS-7890NA

- Provides carrier, fuel gas and support air for 1 - 3 Flame Ionization Detectors and 1 - 3 capillary columns
- Hydrogen cell produces up to 500 cc/min of 99.99999+% pure hydrogen gas
- Zero air compartment produces up to 3500 cc/min of zero grade air
- Eliminates inconvenience and cost of helium, zero air and hydrogen cylinder gas supplies

Parker Hannafin Corporation www.labgasgenerators.com

PRODUCT SPOTLIGHT

ECO-FRIENDLY LABORATORY BATH

WATERLESS ALTERNATIVE TO CONTAMINATION-PRONE WATER BATHS

The Bead Bath waterless laboratory bath from Lab Armor™ provides excellent temperature uniformity while eliminating a major source of contamination in labs—water.

Traditional water baths must be continuously cleaned, refilled and maintained with hazardous disinfectants. Bead Bath is virtually maintenance-free, and since it's always on, users don't have to plan around warm-up times. Also, since there is no water to evaporate, there is no need to worry about burnout.

Bead Bath is designed for use with proprietary beads, which naturally hold items in place, so there is no need for racks, floats and bottleneck weights. Users can also safely incubate multi-well plates, Petri dishes and open-top samples. Lab Armor Beads are eco-friendly and can replace water in existing baths, aluminum blocks in dry baths, and they can even replace ice in ice buckets. They can also be used in containers placed in ovens and incubators, to replace sample racks.

Bead Bath's thermal uniformity is ±0.5°C at 37°C and ±1.0 at 65°C, with a temperature range of 5°C above ambient to 80°C. Lab Armor Beads support a wide temperature range of -100°C to 400°C. Bead Bath's capacity is 12 liters of beads, which are included with the device.

For more information, visit www.labarmor.com.

Temperature Control System

FTS ThermoJet ES

- Delivers controlled temperature air from -80°C to 350°C at flow rates from 5 to 20 scfm
- Able to cycle from 200°C to -65°C in less than 10 seconds
- Features an enhanced nozzle design enabling device testing at pressures as high as 70 psi
- Features a dual-stage cascade refrigeration system for high cooling capacity and heat removal

SP Scientific
www.spscientific.com

Handheld Decapping Instrument

8-Channel Decapper

- For handheld capping and decapping of multiple tubes in a 96-well microplate footprint
- Capable of uncapping a column of eight screw-top tubes in four seconds
- Each screw top cap is tightened uniformly to the same torque; secure seal minimizes sample evaporation
- Lightweight and ergonomic; can be used comfortably with either hand

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LIFE SCIENCE

Peptide Synthesizer

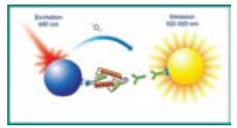
Endeavor 90-III

- Available with UV monitoring
- Includes large-capacity solvent bottles (up to 20L) and reagent bottles (up to 5L); prepares up to 200 mmoles of peptide automatically in a single synthesis
- Amino acid vessels are automatically washed after delivery of the amino acid making them ready to be filled with another amino acid

AAPPTec www.aapptec.com

Homogeneous Assay Kits

AlphaScreen



- Available in four formats: JMJD2A, JMJD2B, JMJD2C and G9a (histone methyltransferase)
- Allow a simple "mix and read" process, without requiring lengthy, time-consuming wash steps
- Suitable for AlphaScreen and AlphaLISA assay formats

AMSBIO www.amsbio.com

Cell Culture System

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- Monitors the quality of cell culture media with noninvasive optical measurement
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NanoWizard® 3

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JPK Instruments

Microplate Blowdown Station

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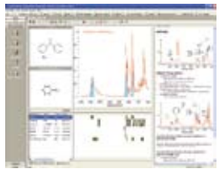

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INFLUENCE OF VESSEL SURFACE ON THE RECOVERY RATE OF PROTEINS

ABSTRACT

When biological samples are stored or incubated in standard reaction vessels more than 90 % of sample material can be lost within 24 hours due to adsorption to the plastic surface. The data presented herein show that the material of the vessel surface has a tremendous influence on sample recovery and thus affects the results of downstream experiments. Significantly larger amount of sample is recovered when using Eppendorf Protein LoBind products compared to vessels made from standard materials. The higher recovery rate, in turn, leads to better results in downstream applications, such as MALDI-TOF.

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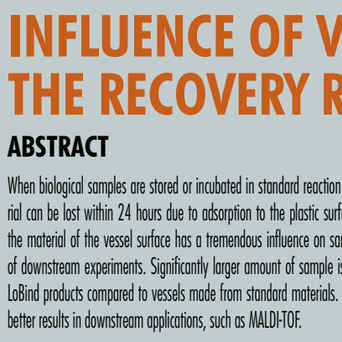
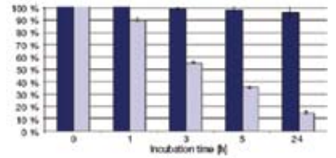
Sample preparation and sample storage (i.e., DNA, RNA, protein, viruses, cells and tissues) are key procedures in the lab and often the basis for successful experiments. In addition to high-quality sample preparation, sample recovery from its storage container is a critical component for successful assay performance—especially when working with low concentrated samples. The loss of sample due to adsorption to the vessel surface is critical, leading to faulty or ambivalent analytical results, or none at all. In this context, working with proteins presents a special challenge. Proteins consist of hydrophilic as well as hydrophobic domains, the latter being located on the inside of the globular protein structure in an aqueous environment. When the protein comes into contact with a solid surface, the three-dimensional protein structure can become modified such that the hydrophobic regions move to the surface of the molecule and seek contact with the hydrophobic surface of the container [1, 2] (Fig. 1). As a result, proteins in contact with the vessel may denature, leading to the loss of valuable sample, or, in the case of enzyme solutions, to a reduction in enzyme activity. The effect on the sample increases with decreasing sample concentration.



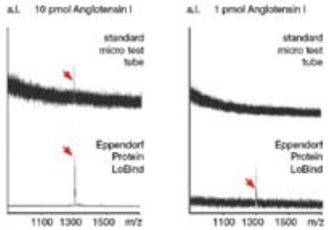
▲ *Fig.1: Schematic drawing of a globular protein. Hydrophobic chains bind to a solid surface, leading to a change in protein conformation.*

Apart from some pharmaceutical applications where protein binding to surfaces plays a role [3, 4, 5], two methods are currently used to improve sample recovery: (1) Coating of the vessels with hydrophobic substances (i.e., silicone). The downside of this technique is that coating material can leach into the sample and potentially interfere with downstream applications. (2) Addition of BSA to the sample to block the vessel surface. However, the high BSA concentrations necessary will have an adverse effect on pipetting accuracy and may also influence further analyses. (3) Eppendorf is focusing on manufacturing consumables with protein-repelling surface characteristics without the use of surface coating. These Protein LoBind tubes/plates minimize protein binding to the tube wall for maximum sample recovery (Fig 2).



▲ *Fig. 2: Comparison of protein recovery (in %) after different incubation times at room temperature. Whereas nearly 100% of the sample was recovery in Eppendorf Protein LoBind consumables (dark blue) 76% of the sample was lost after 24h incubation in standard polypropylene vessels.(light blue).*

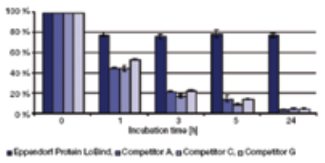
By enabling recovery of higher protein concentrations Eppendorf Protein LoBind consumables also positively affect downstream assays (Fig 3 and 7). For example, Protein LoBind tubes when used during sample preparation for mass spec analysis resulted in improved signal-to-noise ratio and a much lower detection limit compared to sample preparation in standard tubes.



▲ *Fig. 4: MALDI-TOF Mass spectrometry following storage of two different concentrations of peptide at 4 °C. (Source: Dr. S. Seeber and Dr. A. Humeny, Institute of Biochemistry, University of Erlangen-Nürnberg, Erlangen). The arrows identify the signals in each experiment.*

Additionally, a recent publication [8] describes a study in which viruses were incubated for up to 120 hours in low binding tubes from 9 different manufacturers. Whereas eight of the tubes led to considerable sample loss (reduced virus titer), nearly 100% of the viruses were only recovered from Eppendorf Protein LoBind tubes.

That not all consumables are created equal can also be seen in the benchmarking experiment presented in figure 4. Whereas most of the sample was recovered from Eppendorf Protein LoBind plates, deepwell plates from 3 other manufacturers showed significant sample losses up to 95% after 24h.



▲ *Fig. 3: Recovery rate of proteins after incubation in 384-well deepwell plates with a total volume of 200µl.*

The data show that surface-optimized consumables can prevent sample loss by minimizing adsorption to the tube/plate. The Eppendorf Protein LoBind products are exceptionally well suited for this purpose. The advantageous protein-repelling features of this product line become evident during other applications

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[7] Kersten M, Halder T. Bioscience Technology September 2004.

[8] Triliski EI, Lenhoff AM. Journal of Chromatography 2007; 1142:2–13.

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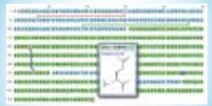

The Symyx Direct 7.0 data cartridge aims to improve R&D efficiency, project team collaboration and IP management by enabling project teams to visualize and compare macromolecular sequences and chemical structures stored in a fully searchable corporate registry system.

The software features a new storage format for chemically modified biological sequences that combines the compactness of a traditional sequence with the precision of a traditional chemical structure format.

Symyx Direct 7.0 supports natural post-translational modifications (PTM) and custom modifications, and allows both small molecule entities and biological sequences to be stored and accessed using the same applications, reducing the need for user training.

"Biologics constitute a large and growing component of the pipelines of drug companies," said Keith Taylor, Product Manager, Cheminformatics, at Symyx. "The simplicity of one repository ensures that information is not missed."

Symyx Direct 7.0 allows scientists to determine the uniqueness of a substance quickly and precisely. "This… allows the activities of chemically modified sequences to be directly compared with the properties imparted by the modifications," added Taylor.

The software's hybrid representation combines the best features of bioinformatics and cheminformatics notations and enables scientists to register and retrieve molecules, reactions and biomolecular sequences, as well as develop structure-activity correlations in sequences.

For more information, visit www.symyx.com. Keith Taylor can be reached at keith.taylor@symyx.com.

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Since the gas flow required for the separation step in gas chromatography is frequently lower that that required to optimize the detection, nitrogen is used as a make-up gas to increase the gas flow for detection. In many facilities, Zero grade nitrogen make-up gas is provided from a cylinder or tank. While this approach works, an in-house "make-up" gas generator can provide the desired nitrogen with a higher level of purity than bottled nitrogen. In addition, the use of an in-house make-up gas generator can provide a considerably safer, more convenient and less expensive approach to supply the required gas.

DESIGN OF AN IN-HOUSE ZERO-AIR GENERATOR

Zero grade nitrogen for make-up gas can be readily obtained from laboratory compressed air using an in-house generator (Parker Hannifin FID MakeUpGas Generator) that includes a heated catalytic converter in which a proprietary catalyst blend is combined with Platinum to remove all hydrocarbons by converting them to CO2 and water vapor. The convertor is followed by a hollow fiber membrane separator which preferentially allows oxygen and water vapor to quickly permeate the membrane wall while nitrogen travels through the hollow fiber out the end (Figure 1). The hollow fiber has a small internal diameter and thousands of fibers are bundled together to provide a large surface area to provide the desired flow of nitrogen. The makeup gas generator can provide nitrogen with purity of better than 99.9999 % with respect to hydrocarbons (< 1 ppm) and greater than 99 % with respect to oxygen.

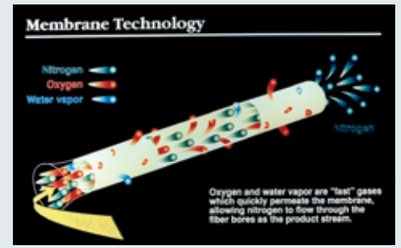
PERFORMANCE

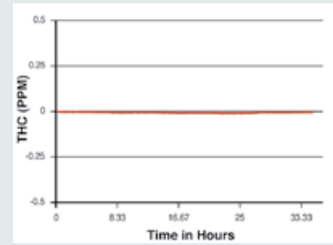
A chromatographic comparison of the ntrogen that was produced by the MakeUpGas generator and gas that was obtained from bottled fuel air from a commercial supplier is shown in Figure 2. The gas generated by the MakeUpGas generator is much purer than that from bottled fuel air; and provides an extremely flat baseline with essentially no signal due to hydrocarbons, while the zero grade bottled air provided an irregular baseline with a significant level of hydrocarbons, which could impact the analysis.

CONCLUSIONS

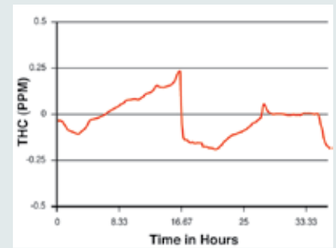
In addition to the extremely high level of purity provided by the generator, the use of an in-house generator provides benefits in safety, cost and convenience. When a MakeUpGas generator is employed, only a small amount of nitrogen is generated at a given instant and a leak would lead to a negligible change in the composition of the laboratory air. In contrast, a leak from a full tank could cause problems. When an in-house generator is employed, gas is available on a 24/7 basis

and the possibility of injury or damage during the transportation and installation of a heavy gas tank which can become a guided missile if the valve on a full tank is compromised during transport is eliminated. In addition to the significant safety and convenience benefits, there is an economic benefit from using a MakeUpGas generator. The running cost of operation maintenance of the MakeupGas generator is extremely low; as the raw materials to prepare the required gas are air and electricity.





▲ *Baseline*
MGG-2500NA Makeup Gas Generator



▲ *Baseline*
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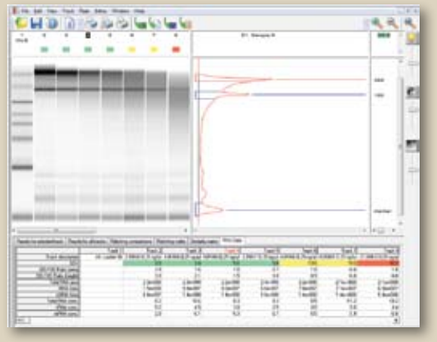
Reproducible RNA Characterization and Quality Control

Problem: Many genomic techniques such as microarray and qRT-PCR analysis require the use of high-quality, intact RNA to ensure that reproducible and meaningful data are generated. Traditional RNA quality control (QC) methods have employed agarose or capillary gel electrophoresis to measure RNA degradation. This process, however, can be quite time consuming, leading to inefficiencies within the lab. When performed using capillary electrophoresis, the micro fabricated chips commonly require priming with gel, gel staining solutions and vortexing prior to the initiation of sample migration. The experimental set-up is therefore lengthy, occupying a considerable amount of a researcher's time. The chips are often a 'single use' consumable, resulting in significant waste when flexibility in sample number processing is required.

Solution: As with many laboratory applications, RNA QC procedures can be streamlined through automation. Lab901's ScreenTape® R6K system is a fully automated solution which has been specially developed for efficient and reproducible RNA characterization and quality control. This system removes time-consuming steps such as gel reagent preparation, chip priming and vortexing, to make the process faster and easier. With walk-away operation, the ScreenTape system is comprised of: the TapeStation®, which performs the liquid handling, electrophoresis and imaging steps; ScreenTape—a consumable that contains pre-cast and pre-packaged gel and buffer in 16 channels; and its bespoke GeneTools® software for the analysis of sample data. Users simply load their RNA samples and the data is generated within one minute per sample, resulting in improved throughput and efficiency.

Unlike chip-based systems, Lab901's ScreenTape consumable can be used more than once. A single sample can be run cost-effectively each time, preserving the rest of the available channels for future experiments. This removes the need to batch samples together or throw away unused portions of the consumable, which improves the RNA QC workflow and helps laboratories reduce associated consumable costs. In addition, sample carryover issues are eliminated since ScreenTape R6K uses an individually sealed micro-gel for each sample analysis to improve reproducibility and data quality.



▲ *ScreenTape R6K analysis of total RNA from HepG2 cells. This GeneTools screen grab shows the gel image, electropherogram and tabulated data containing the colour-coded SDV value for total RNA, the 28S/18S ratio, and the peak areas and volumes.*

▼ *Lab901's ScreenTape R6K enables rapid RNA sample quality control*

ScreenTape R6K automatically delivers an objective quality metric for total RNA—the ScreenTape Degradation Value (SDV)—prior to highly sensitive and time-consuming experiments such as DNA microarray and qRT-PCR. The GeneTools software will display the clearly defined small RNAs, and automatically identify and annotate the 18S RNA and 28S RNA ribosomal subunit peaks. As total RNA degrades, the less stable 28S peak rapidly disappears, followed by a more gradual deterioration of the 18S peak, while degraded material emerges between the 18S and small RNA peaks. Derived from a mathematical model that calculates a quantitative measurement of RNA degradation, the SDV therefore represents the ratio of the average degradation peak signal to the 18S peak signal. Thus, a higher SDV corresponds to a greater level of RNA degradation. A recent study carried out by LGC (the UK's leading independent testing laboratory) compared the SDV with another integrity metric, the RNA integrity number (RIN*)[1]. The resulting data demonstrated that the SDV is comparable to the RIN in providing reproducible and reliable data as well as in distinguishing different levels of degradation, while differentiating more degraded RNA samples into distinct populations.

For further information, visit www.lab901.com.

**RIN is a software tool from Agilent Technologies*

1. Wilkes TM, Devonshire AS, Ellison SLR et al. Evaluation of a novel approach for the measurement of RNA quality. BMC Research Notes 2010; 3: 89.

Easing the Strain of Centrifuge Rotors

Problem: As one of the most important and commonly used research procedures in the laboratory, centrifugation is incorporated into many protocols—each with their own set of requirements and experimental challenges. As a result, selecting a suitable centrifuge model requires careful consideration of the specific applications and sample types to be processed. Separation speed and sample volume are key factors in the decision-making process. Previously, centrifuge rotors offered little choice in regards to these factors, but the use of carbon fiber rotors has now addressed this, while providing many long- and short-term benefits to all in the laboratory.

Centrifuge rotors are typically made of 'lightweight' aluminum and titanium metals, yet these often present a unique lifting hazard in the laboratory. Conventional floor model centrifuge rotors can weigh up to 70 lbs (~30 kg) when fully loaded and are awkward in shape. In order to control the ergonomic hazards associated with lifting centrifuge rotors, it is recommended that a second person always assist with the removal of the rotor from the centrifuge and that a cart be used for transport. However, this is not always practical.

In addition, metal rotors are susceptible to corrosion and pitting from moisture, chemicals, alkaline solutions such as sodium hydroxide or other salts in the laboratory, weakening a rotor's structural integrity. Additionally, substantial load or stress, as a result of high rotational speeds and repeat cycles, can also threaten metal rotor structure by causing it to stretch and change size, limiting rotor life or even leading to rotor failure. Metal rotor failures due to stress corrosion can cause catastrophic damage to the centrifuge, incur costly repairs for the laboratory and—more importantly—put laboratory personnel at risk.

Solution: Advances in the material technology of centrifuge rotors have led to the introduction of carbon fiber composite materials. Thermo Scientific's Fiberlite carbon fiber rotors are up to 60 percent lighter than equivalent metal rotors. Lightweight carbon fiber rotors feature improved ergonomics for a safer work environment and minimize the risk of damage to centrifuge equipment. Many of the large volume carbon fiber rotors are even designed with a lifting handle, allowing users to transport the rotor in and out of the centrifuge with less force and bending, reducing the risk of lower back injury. These lightweight properties also result in faster acceleration/deceleration rates for shorter run times and decreased wear to critical centrifuge drive components.

Superspeed Fiberlite family.

Conical tube cross-section.

Carbon fiber composite rotors are also corrosion-resistant, eliminating the ever-present hazard from the exposure of moisture, chemicals or alkaline solutions. These rotors are safe to use with most laboratory detergents and solutions, ensuring easy rotor care and maintenance, and are autoclavable for sterile use. Additionally, carbon fiber is exceptionally resistant to fatigue, minimizing the threat of elongation and deration for extended run cycles.

For maximum support, Fiberlite rotor cavities are molded to the exact shape and tolerances of many disposable bottles and conical tubes. In addition, patented cap support is designed to relieve high g-forces. This reduces processing times while improving efficiency as labware can be spun at maximum speeds without risk of damage. Coupled with improved ergonomics and lightweight design, carbon fiber composite rotors offer the ideal solution for laboratories wishing to move away from the challenges associated with heavier metal rotors.

For more information, visit www.thermoscientific.com/fiberlite

ADVERTISER INDEX

Marketplace

PARTING POINTS

Takeaways from this month's issue:

SCIENCE & THE PUBLIC TRUST

Scientific communications researchers say that outreach communications are in a transitional phase that recognizes the complexity of social and scientific interactions and attempts to address the problem of assigning responsibility. Some tips for lab managers from Bruce Lewenstein, professor of science communication, Cornell University:

- Collaborate and pool resources to hire a professional communicator to work with local schools, museums and media
- "Don't cite the idea you are in a social world. Recognize it and work with it."

MANAGING EXPECTATIONS

The key to cooperation between departments in an organization is managing expectations. You all need to be on the same page, focusing on what you can do to work well with each other. Here's how:

- Identify key departments; conduct a baseline customer satisfaction survey
- Identify expectations and plans to meet them, then implement changes
- Reassess internal customer satisfaction
- Fine-tune and recommit

SIMULATION-BASED PLANNING

A simulation-based planning system can be used in a lab to predict the load on staff and equipment, using scenario testing for shift changes, campaign size, test mix and volume changes. At the J&J Alza facility in Vacaville, CA OpStat's Lean simulation models were used. Here are some of the results:

- Operational results were reduced cycle times and improved equipment utilization and scientist effectiveness
- The simulation provided needed understanding of the real capacity of the laboratory and insights on the drivers of capacity utilization and service level
- The OpStat simulator was a vital tool in understanding and driving process performance improvement

THE FIRST ANNUAL LABORATORY SAFETY SURVEY

The results of the first annual Laboratory Safety Survey, completed by more than 400 *Lab Manager Magazine* readers and LabX users, show that many of you are adhering to policies and are serious about lab safety, but some areas need improvement. Here are some of the numbers:

- 83% of respondents agree or strongly agree that periodic inspections are performed by lab staff
- 96% keep fire extinguishers accessible and ready to go
- 98% of respondents use protective gloves to prevent skin contact with chemicals
- Only 52% have proper signage in areas containing compressed gas cylinders

RECYCLING CLOSED LABORATORIES

Instead of spending scarce capital to purchase or build a laboratory, firms can rent facilities in one of the large laboratories closed as a result of corporate mergers and acquisitions, allowing small and midsized companies to rent first-class laboratory space at relatively modest cost. Here are some additional benefits:

- The process of obtaining government emission permits usually can be eliminated when leasing space because the permits already exist
- Janitorial and other services can be shared by the tenants, reducing the cost to each tenant

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