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Show me the Money

So far, nearly 5,000 grants totalling over \$1 billion have been awarded by NIH. Most have been awarded to research labs at large universities and small colleges, while some have been awarded to small, privately owned research and product development companies. This month's feature article looks at how grant funding as well as venture capital investment is impacting research efforts.

**Richard Daub** 



Lab manager Larry Decker's TestAmerica environmental lab in Connecticut is where he and his staff analyze thousands of soil, wastewater, and monitoring well samples each month. One key to the lab's success is a management team that "works on training every individual to be reactive and ready to go if the person is needed in a different department."

Sara Goudarzi



#### **LEADERSHIP & STAFFING**

#### **Honing Your Interviewing Skills**

For most laboratories, turnover is low and tenures are high, so the opportunity and necessity to conduct interviews is limited. But, when it's necessary, the author argues that "behavioral event interviews" work best because the questioning format requires on-the-spot self-analysis that is difficult to prepare for except through life experiences. Ronald B. Pickett

#### 22 Training on a Budget

In tough economic times many companies slash their training budgets, thinking that training is expendable. This, according to the author, is ill-advised. Training is not an expense to be minimized; it is an investment that pays dividends by helping workers do their jobs more effectively so that they can positively impact a company's bottom line.

Brian C. Smith, Ph.D.

#### **TECHNOLOGY & OPERATIONS**

#### **Biological Sample Storage and Management**

This author highlights some of the shortcomings in the use of cold-temperature-based sample storage, describes new technologies available that mitigate these shortcomings, and offers suggestions on the convergence of these technologies in meeting the global challenge to be faced as bio-specimen collection increases in research labs as well as in bio-banks.

**Omoshile Clement** 

#### 30 **BSC Ergonomics and ADA Compliance**

Because of the increased incidence of work-related musculoskeletal disorders among laboratory workers, the principles of ergonomic design and compliance with the Americans with Disabilities Act (ADA) are becoming increasingly important topics in the design of the biological safety cabinet (BSC). David S. Phillips

#### **BUSINESS MANAGEMENT**

#### 46 Outsourcing

Outsourcing laboratory work is usually done on the assumption that another laboratory is able to perform the work more cheaply and/or more rapidly while maintaining adequate quality of the results. Laboratory managers must study other laboratories to determine if this assumption is correct before outsourcing work to them. John K. Borchardt

#### 50 When Growth Stalls

Sales and revenue growth are stalled at many companies in a variety of industries. As a result, these firms have frozen or reduced laboratory budgets and in some cases have reduced laboratory staffing levels. There are several ways laboratory managers can effectively respond to these situations in order to maintain laboratory productivity. John K. Borchardt

SURVEY SAYS: In our recent Lab Manager Magazine First Annual Business Management Study, we asked our readers to identify the management skills they found most effective in running their labs. "Open and honest communication with staff and management" ranked most effective at 58.4 percent; "Being approachable and visible" ranked second at 45.4 percent; and "Empower staff to take ownership, get involved and make positive contributions to the organization" and "Be a good listener" shared the third spot at 44.3 percent.



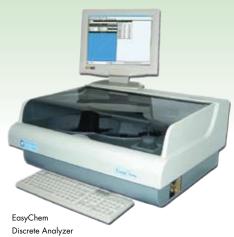






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#### **EDITOR'S NOTE**



#### Money, money, money

This month's cover story, with its nod to the 1996 movie "Jerry Maguire," calls attention to the challenges, uncertainty and frustration involved in securing research funds these days. Author Richard Daub examines how NIH, for one, has responded to the overwhelming amount of American Recovery and Reinvestment Act (ARRA) grant applications and how delays in fund allocation is damaging some labs—particularly in terms of hiring and firing. Daub also looks at the current state of venture capital funding for start-ups and what kind of research, if any, is receiving those dollars.

Talking about money or the lack thereof, but from a management point of view, John Borchardt in this month's Business Management feature (page 50) offers up a variety of recession recovery scenarios and suggests ways for managers to maintain laboratory productivity when sales and revenue growth stall. Of particular interest is the idea of "failing cheap" by lowering the cost of experiments through investment in simulation software or increasing the pace of decision making.

On the technology front, October is all about biosafety cabinets and fume hoods. We start by looking at advanced design concepts incorporated into Class II BSCs to make them usable to more diverse populations as well as reducing musculoskeletal demands for high-productivity users (Technology & Operations, page 30). Our Focus on Biosafety Cabinets on page 38 provides an overview of the class distinctions, characteristics, and design advances in this same category. Lastly, on page 60, the Safety Guys discuss the basic design principles and operation of chemical fume hoods.

In addition to pointing out other important articles in this month's issue, from outsourcing to the role of independent labs, I would like to provide a heads up to a new editorial feature we're planning for 2010—the value of which will depend directly upon you. In our new monthly feature, "Ask the Expert," author Tanuja Koppal will enlist a variety of experts to answer questions on specific topics—from "Setting up a HTS Lab" to "How to Choose RNAi Reagents." On our website we will provide the first six "Ask the Expert" topics for 2010 and a mechanism that will allow you to begin submitting questions you would like that expert to answer. The goal is to tailor this new feature exactly to what you, our readers, want to know most. Please look for that soon and begin submitting questions.

I would be remiss if I didn't mention the recent and terrible news from Yale University. Beyond a random act of senseless violence, the story reminds us all that safety and security are not to be taken for granted. I think the case is most shocking because of where it occurred, a respected academic research institution, presumably the safest of places. Our thoughts are with Annie Le's family and friends.

Kind regards,

Pamela Ahlberg Editor-in-Chief

Note: In the July/August Product Focus on Microscopy, comparisons made between TTP LabTech's Acumen eX3 and the other highlighted microscopes were not appropriate, given the vastly differing roles they represent.

Aluhan



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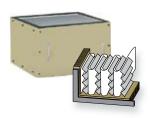
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Of the \$787 billion in stimulus funds to be allocated by the American Recovery and Reinvestment Act (ARRA) passed earlier this year, \$8.2 billion has been designated as extramural funding to the National Institutes of Health (NIH) for the advancement of scientific research.

"WITH AN ALREADY EXISTING ANNUAL BUDGET OF \$30 BILLION TO FUND SCIENTIFIC RESEARCH, AN ADDITIONAL \$1 BILLION ABOVE THE PRIMARY FUNDING THESE INSTITUTIONS ALREADY RECEIVE IS NOT HAVING A SIGNIFICANT IMPACT ON THE SCIENTIFIC COMMUNITY."

So far, nearly 5,000 grants totaling over \$1 billion have been awarded by NIH. Most have been awarded to research labs at large universities and small colleges, while some have been awarded to small, privately owned research and product development companies. With an already existing annual budget of \$30 billion to fund scientific research, an additional \$1 billion above the primary funding these institutions already receive is not having a significant impact on the scientific community.

In fact, NIH is experiencing a logiam in its efforts to review and process the overwhelming amount of applications they have received, which in some instances has caused delays in the processing of the regular grants that many institutions depend on as their main source of funding.

Dr. Joan Slonczewski is a biologist at Kenyon College in Gambier, Ohio who runs a small laboratory that focuses

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on bacteria research, specifically *E. Coli* and pH regulation in *bacillus subtilis*. She manages five to six undergraduates who work at the lab part-time during the school year and full-time in the summer, and also employs one full-time graduate assistant manager who works year-round.

"I think that we'll be hearing later perhaps about the regular grant request that I had put in because there has been so much more work reviewing all these new grant opportunities," she says. "It's a huge burden to process so many grants so quickly, but I think they have been handling it the best they can, and in a very sympathetic way."

Acting Deputy Director for Extramural Research at NIH Dr. Sally Rockey says that a major analysis of its peer review system has just been completed to not only make it more efficient, but also to allow for the funding of more diverse types of projects and to help NIH become more adaptable to the rapidly evolving nature of contemporary scientific research. Some of the specific changes to this process include more streamlined electronic applications, a new scoring system, and a reduction in the amount of re-submissions that can be made by project applications that have already been rejected.

## "DELAYS IN FUND ALLOCATION CAN BE VERY DAMAGING TO A SMALL LABORATORY."

"We are always striving to make the process as efficient as possible for the applicants and the review community," Dr. Rockey says. "Although the basic division between applied and basic research remains constant, we have evolved to support more multidisciplinary and transformative science in recent years. NIH has to be flexible to

adapt to changing science so that the most relevant and high quality research can be supported to improve public health and advance science."

Delays in fund allocation can be very damaging to a small laboratory, but fortunately for Dr. Slonczewski, things worked out very nicely. Although her regular funding was delayed (she typically receives between \$100,000 and \$150,000 per year through the NIH Academic Research Enhancement Award), she was granted an extension for her primary grant and awarded an additional \$68,000 grant that came directly from the ARRA, which she was not expecting. These extra funds enabled her not only to employ her students, they also enabled her to purchase a new fluorescence microscope, which in turn created a sale for the microscope manufacturer.

"IN TERMS OF THE SHORT RUN, WE'RE ACTUALLY BENEFITING FROM THE STIMULUS IN A VERY POSITIVE WAY. OUR CONCERN IS WHAT HAPPENS NEXT YEAR, BECAUSE NEXT YEAR THERE WON'T BE ANOTHER STIMULUS."

"In terms of the short run, we're actually benefiting from the stimulus in a very positive way," Dr. Slonczewski says. "Our concern is what happens next year, because next year there won't be another stimulus."

It is this concern about tomorrow that has created an air of conservative caution and has caused lab managers to hold back on purchasing new equipment, which ultimately hurts their vendors. They had gone into survival mode long before the ARRA was signed into law, and while these stimulus funds have had plenty of small success stories, they have done very little to allay the fears of what the economy is going to do down the road.

In addition to halting equipment purchases and finding other ways to reduce operating costs, many lab managers have been forced to reduce salaries, and some have had to make the very painful decision to lay off employees. As for companies who are doing well enough to consider hiring or have received some of the larger grants that have been awarded, they are reluctant to do so for fear that they would have to let these new hires go as soon as the money runs out.

Dr. Richard Greenwald is founder and president of Simbex LLC in Lebanon, New Hampshire, a research and

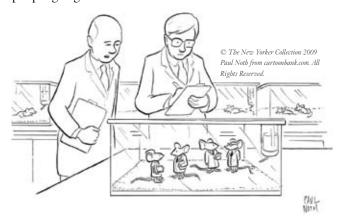
development company of sixteen employees that focuses on injury prevention research and product development. Simbex already receives most of its funding through the NIH Small Business Innovation Research (SBIR) program, and it recently received an \$11,000 supplemental grant through the ARRA that enabled Dr. Greenwald to hire an intern for the summer.

In the midst of a recession that began in December 2007, Dr. Greenwald could not afford to wait for the government to bail them out. Survival was going to have to come from within, and the necessary steps for doing so were taken long before lawmakers even started talking bailouts.

"You could see that there was the possibility and likelihood of some kind of recession coming, and we scaled accordingly," he says. "We didn't leverage ourselves to the hilt like a lot of people did. I think good management and a little bit of restraint, staying within your means, allow a laboratory to weather any kind of financial storm."

By the time he finally received his ARRA grant, it was nowhere near enough to have any significant impact.

"The only reason it's had a little impact because it was just a little bit of money," he says. "If it had been a bigger amount, then it would have had a significant impact. The challenge, of course, is if you get money through this Act and then you go and staff up, two years from now that money goes away. And if there's no additional funding, you're kind of back to square one, and you may have to let people go again."



"O.K., let's slowly lower in the grant money."

Dr. Raymond Thompson, founder and manager of Vista Engineering and Consulting in Birmingham, Alabama, is in a similar position. Vista employs nine people at its lab, which is working on the development of a technology that grows diamonds from methane gas to use as a coating for biomedical implant devices.



In addition to his regular grants, Vista received \$10,000 from the ARRA to develop technology for nanotechnology-enabled temporomandibular joint prosthesis. Dr. Thompson says this grant has had very little impact on his business, which typically receives around \$250,000 per year in grants, but it did allow him to hire two undergraduate engineer students to work for him for ten weeks this summer.

# "THE CHALLENGE, OF COURSE, IS IF YOU GET MONEY THROUGH THIS ACT AND THEN YOU GO AND STAFF UP, TWO YEARS FROM NOW THAT MONEY GOES AWAY."

"Obviously, a \$10,000 grant over the summer doesn't make a big impact on our bottom line, but it makes a big impact on those two students," he says. "From a business standpoint, it's more community involvement for us than it is to help pay our bills."

Despite how grim the economy looked at the end of 2008 and the first half of 2009, recent signs a recovery is underway is providing a glimmer of hope for lab managers.

"We're trying to figure out how to accelerate out of this thing," Dr. Greenwald says. "Let's take advantage of these opportunities that are out there. You have a lot of people who are unemployed. That means there are a lot of smart people out there—go find the best ones. And people are willing to do work. If you're dealing with a machine shop, they need business. So you can go and say, 'Hey, do this business, but don't charge us an arm and a leg.' I think everyone's in the mood to be lean and mean and fight for opportunities. For those people who are willing to get their head out of the sand, it's a good time."

Dr. Thompson, meanwhile, does not believe the recession will have any long-term effects on his business beyond the slowdown in its growth.

"I expect us to do fine long-term," he says. "I don't think it's a good time to bring out the crying cows or start waving white flags around. I think that when industry starts to come back and there is a need for the materials testing and specification development things we do on the engineering side of the house, we can start hiring people again."

While the biggest impact of the recession on existing firms has been cost reduction, perhaps the biggest impact on the scientific community as a whole has been the lack

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of new companies being formed, which has always been a major source of new jobs. Without a fresh crop of startups, many highly qualified people are currently out of work fighting over a very small number of job openings.

In the meantime, venture capitalists have been waiting on the sidelines cautiously sitting on large piles of cash to make sure that their existing ventures will have the money they need to operate. Very few are funding new ventures, but some may be starting to feel the itch to get back in the game. In order for these firms to put money into new companies, however, they need to be assured that any ventures they invest in are low risk/high reward.

Dr. Ian Mehr is a Managing Director at Golden Pine Ventures in Research Triangle Park, North Carolina, a "venture creation" firm that specializes in providing seed capital for the establishment of biotechnology companies. Dr. Mehr says the recession hasn't had much of an impact on the six companies in their portfolio, although their funding sources have changed to some degree from traditional venture capital methods to loan financing and grants.

"The classic venture capital roots are not drying up, but they certainly aren't as available as they once were," he says. "The rhetoric I've heard from the overall venture investment community has been towards looking for things in the biosciences that are less risky—later stage medical programs, medical devices and so forth. They are steering away from early pre-clinical stage research projects."

"DESPITE HOW GRIM THE ECONOMY LOOKED AT THE END OF 2008 AND THE FIRST HALF OF 2009, RECENT SIGNS A RECOVERY IS UNDERWAY IS PROVIDING A GLIMMER OF HOPE FOR LAB MANAGERS."

Dr. Michael Powell is a general partner with Sofinnova Ventures in Silicon Valley, which manages a fund of \$375 million invested in 20 different startup life science and technology companies. While most of their companies saw staff reductions over the past year (some of them as drastic as half the company being laid off), Dr. Powell is cautiously optimistic that things are starting to turn around.

"We're on the back side of it now," he says. "I'm starting to see signs of improvement. I don't want to sound too optimistic because I still think there's still quite a long way to go, but I think people are going to start hiring sooner rather than later."

Meanwhile, gone are the days of freewheeling venture capitalists throwing millions of dollars at mere ideas. Startup firms looking for capital are finding it very difficult to find a willing partner. And, while Dr. Powell acknowledges how much more difficult the fundraising environment has become, he says it's not impossible, although it now takes a much more detailed and eye-popping business plan to produce results.

"The bar is significantly higher right now," he says. "We're asking for things today that we would not have asked for two or three years ago, i.e. a business model even more validated than two guys in a garage kind of thing. We'll ask for more and more data. Instead of, 'Here's a clinical plan that I think would work', we'd ask them to validate it with a group of experts. We might ask for a budget audit. A lot of these things that in the old days I used to just work out on the fly real-time, now I want to see the whole picture all lined up right now."

To business owners pitching their ideas, Dr. Powell explains the principle of arbitrage. Venture capitalists are no longer receptive to someone who comes in and says they can take a dollar of their money and produce dollar's worth of product; capitalists are looking for someone who can come in and say that they can take a dollar of their money and produce five dollars worth of product.

Presentation is also important. With sources of funds having become so scarce, many firms have resorted to producing business plans that are generic enough to be sent to as wide an audience as possible.

"I see a lot of companies, especially in times of desperation, resort to essentially spamming and just trying to find anybody that will talk to them," says Dr. Mehr. "That's pretty obvious when that happens. These mass general emails—'To Whom It May Concern'—just aren't going to get looked at.

"Know who you are contacting. Crafting personal messages to people has always been a critical facet in promoting your business. Always has been and always will be, but perhaps even more so now than ever."

Richard Daub is a freelance journalist based in New York City who writes for trade publications in a variety of different industries. Richard can be reached by phone at 917-657-6532 and by email at rdaub82@gmail.com.



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Independent labs are a service industry that provides answers or verification of answers in an evolving and increasingly complex world. A loose definition of an independent laboratory is a person or group that provides independent verification or testing to identify something, determine performance characteristics, or confirm attainment of specifications. Reasons why an independent laboratory is used include:

- 1. IN-HOUSE CAPABILITIES ARE UNAVAILABLE
- 2. RESULTS ARE NEEDED FASTER THAN CAN BE ACCOMPLISHED WITH INTERNAL CAPABILITIES
- 3. INDEPENDENT ANALYSIS IS REQUIRED BY CUSTOMER OR GOVERNMENT
- 4. CONFIRMATION OF INTERNAL FINDINGS IS NEEDED

The decision to use an independent lab is based on financial, technical, and/or regulatory points. Deciding which lab to use is based on that lab's ability to service the customer's needs and the relationship the lab builds with the customer.

#### **Evolution of independent labs**

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The evolution of independent laboratories in many ways follows the course of man's evolution. Testing has always been a component of the scientific process. The caveman that first captured fire and tested his invention by sticking his hand in it, and the clan in the next cave that confirmed that fire burns but can also be used as a tool for survival, are similar to the inventor or corporation that develops a product and the independent lab that confirms the material or performance specification. Initially, and in some cases still to this day, the consumer is the ultimate independent lab, although unwittingly at times.

# "THE COST OF ADDING THE EQUIPMENT AND TECHNICAL STAFF TO ANSWER VARIED AND CHANGING QUESTIONS MAY NOT MAKE FINANCIAL SENSE."

As man evolved, the thinking and questions grew more complex. The questions grew even more complex with the aid of accountants, lawyers and, of course, the government. The inventors/corporations began asking: Does this fill a need, and what are its limitations? Does the product meet the customer's specifications? Will the product hurt the consumer or the environment? How do we improve the product? Why is our competitor's product better? How do we protect our intellectual property? Is our competitor infringing on our patent? The consumers began asking: Did we receive what we paid for? If the component we bought meets specifications, why is our product failing? Could this product be the cause of a problem? The need to answer these questions before the product reached the end user, led to the growth of independent labs. And the primary driving force for the need for independent labs today is the cost of answering all these questions.

While some testing, such as process quality control, is still best performed in-house, the cost of adding the equipment and technical staff to answer varied and changing questions may not make financial sense to the inventor/corporation. Business philosophy has also changed from a focus on fully integrated systems to a focus on core competencies and the use of competent contractors. Also, trust is not always a given in human interactions, and lack of trust creates the opportunity for an independent lab to act as an impartial third party acceptable to both sides of the issue.

#### Challenges to independent labs

The ability to service these needs presents some unique and not-so-unique business challenges to an independent lab. An independent lab has the same financial needs as any business: to balance the breadth of capabilities required to meet the majority of the market needs, control costs, and provide a return on investment. As with any service business, the quality of the product (in this case the data), the ability to meet time lines, communication with the customer, protection of confidentiality, and any value-added services define the lab and determine its success as a business.

"LACK OF TRUST CREATES
THE OPPORTUNITY FOR AN
INDEPENDENT LAB TO ACT AS
AN IMPARTIAL THIRD PARTY
ACCEPTABLE TO BOTH SIDES OF
THE ISSUE."

One unique management challenge is staff selection. While the quality of the data must be unimpeachable, the ability to communicate with and understand customer needs before, during, and after delivery is not always the forte of technically oriented scientists and engineers, but it is just as important to the success of the independent lab. In addition, the technical staff needs to fit the type of testing performed by the laboratory. The repetitive, high-throughput testing performed at many independent laboratories requires the right individuals to perform the tests with the same quality over time. Project-based laboratories need staff who can change focus and grasp the quality and technical needs quickly. Many labs may have both activities and require just the right mix of staff. In all cases, the combination of technical expertise and the ability to multitask, listen, and communicate is essential.

Another unique management aspect for independent labs is the selection of markets. As with most businesses, independent labs need to know their core competencies, markets, and limitations. The equipment and staff may have capabilities over a variety of markets, but customer needs may vary widely, making it difficult for the business to be successful across multiple market segments. An example would be environmental chromatography and pharmaceutical chromatography. The instrumentation and techniques are similar, but the documentation and performance requirements for each market are quite different. At the same time, knowledge of closely related markets and the ability to serve them may become an advantage or a necessity if one's primary market has a downturn.

Independent labs can be found servicing just about every industry. Some service a specific industry, such as consumer products, automotive, aerospace, pharmaceutical, food, or agriculture. Others may cover a material, such as petroleum, plastics, rubber, coatings, or metals, over several industries or in a specific niche such as fuels, lubricants, or plastic medical devices. Still others may focus on a type of testing, as in environmental, electrical, fire, or acoustical performance.

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# INDEPENDENT LABS

Independent labs often have some form of accreditation. The accreditation may be a requirement for some customers and markets and may help a lab acquire new business. Unfortunately, the cost and time it takes to add new methods to the scope of accreditation tends to limit the responsiveness of the lab to changing customer needs. In some cases, the lab may be able to perform an inter-laboratory study or gauge R&R study with the customer's internal lab to demonstrate capability, instead of or along with accreditation activities. Accreditation can also increase the cost to enter and therefore limit entry into a market. Starting a new lab in a market requiring accreditation may require additional financing to carry the business for several months or even a year or more until accreditation can be completed.

#### "PROJECT-BASED LABORATORIES NEED STAFF WHO CAN CHANGE FOCUS AND GRASP THE QUALITY AND TECHNICAL NEEDS QUICKLY."

#### Academic and in-house labs

Independent labs may seem to compete with academic and in-house industrial laboratories, but in reality, they fill a different role and may even work with other labs. The academic labs often have unique capabilities that cannot be found routinely in the commercial market. Although they may have routine testing capabilities, their service profile is usually different from that of a commercial independent lab. Some states legally limit them from competing with commercial entities. Typically, the commercial independent labs have the advantage in service and accreditation.

When a company outsources testing, industrial labs may feel that independent labs are competing with or taking away their work. However, there are areas of testing that are best performed by an in-house lab and some that are better performed by an independent lab.

Sometimes researchers perform their own testing within an industrial lab. However, depending on the circumstances, it may be more efficient to have an independent lab perform the tests and free up the research staff to concentrate on new product development.

Independent labs are sometimes developed from inhouse industrial labs to leverage the investment in the equipment and staff. In most cases, the lab is set up as

a separate entity to ensure separation for confidentiality while still allowing support for the parent company's testing needs. This is a particularly unique challenge, depending on the structure of the lab prior to separation and the need to develop new systems prior to or immediately following launch. Excellent document controls, access control, and education of the staff on maintenance of confidentiality are critical to making customers, sometimes including former competitors, feel comfortable using the lab's services.

In the current down economy, there are opportunities for and threats to independent labs. An independent lab can fill the testing needs of companies experiencing cutbacks in internal capabilities or deciding to outsource their testing. However, if the lab is positioned in a down market segment, the lab may need to make its own business decisions on cutbacks or re-position to work in other market areas.

# "THE COST AND TIME IT TAKES TO ADD NEW METHODS TO THE SCOPE OF ACCREDITATION TENDS TO LIMIT THE RESPONSIVENESS OF THE LAB TO CHANGING CUSTOMER NEEDS."

As mentioned earlier, independent labs are a service business that thrives on the need to perform quality testing services to answer a variety of customer questions. Successful labs protect their customers' confidentiality; meet their time lines; act as the independent third party; and build relationships based on service, trust, and anticipation of the customers' needs.

As a result, independent labs fill a need in the market. There is a need for all three types of labs. Some of the most successful companies use independent labs as well as in-house and academic labs to further their success. Take a look at the independent labs that service your industry. If you are not using one already, you may want to take a closer look and start building a relationship with one or more. There may come a time when you need their service to answer a question, and a good independent lab may make all the difference.

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# HONING YOUR INTERVIEWING SKILLS TIPS AND TECHNIQUES FOR IDENTIFYING THAT PERFECT ADDITION TO YOUR TEAM by Ronald B. Pickett

Across from you sits someone you just met. Oh, you've read their resume, so you know something about who they are, but everybody knows what people put in their resumes. She brings a first-class educational background—you wish you had done as well in school—and her extracurricular activities are impressive. Now, your challenge is to sort out how well she will fit into the position you have open and how well she will mesh with your team.

"FOR MOST LABORATORIES, TURNOVER IS LOW AND TENURES ARE HIGH SO THE OPPORTUNITY AND NECESSITY TO CONDUCT INTERVIEWS IS LIMITED."

For most laboratories, turnover is low and tenures are high so the opportunity and necessity to conduct interviews is limited. Many of the applicants for the positions you have available may have more extensive and more recent experiences being interviewed than you have of conducting interviews. Furthermore, many may have taken courses on being interviewed as part of a job search training program. So, YOU can take a course, read a book, or hone a few key skills.

#### **Behavioral interviewing**

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The most successful interview techniques today are behavioral event interviews. The essence of behavioral interviewing is asking someone to describe a situation they have personally experienced—how did they behave in response to a set of circumstances that they faced? There are two reasons to use behavioral interviews. First, the best indication of future performance is past behavior. Second, the questioning format requires an "on-the-spot self- analysis" (Falcone, pg. XV.) It's hard to prepare for this type of interview except through life experiences.

There are several legal traps you can fall into while interviewing so, to better understand which questions are illegal, see your HR staff or Chapter 18 of "96 Great Interview Questions to Ask Before You Hire." <sup>1</sup>

#### Here are the most important skills you'll need:

- 1. Get applicants talking
- 2. Listen carefully to what applicants say
- 3. Trust your gut

#### Get applicants talking

Begin with a few simple questions. It is surprisingly easy to get people talking about themselves—the bigger problem usually is to get them to stop. This is a strong statement about the thirst we have for being taken seriously, for having someone pay attention to us as an individual, to focus on us, and to listen carefully to what we have to say. Asking people to talk about themselves, to respond to a particular question about their lives, then paying close attention to the responses, usually brings out a flood of useful information. Select the questions you use with care and with the intention of eliciting specific types of information.

#### "LEARN TO LET THE SECONDS TICK BY AND CURB THE URGE TO INTERRUPT A PERIOD OF SILENCE—MAKE THE CANDIDATE FILL IN THE GAP."

Don't ask questions that have answers that are easy to get via other sources unless you want to relax and establish a relation-ship with the candidate.

The first step in interviewing someone is to decide what you want to know: Is working on a team important? If so, ask them to describe their experiences in working

on teams. If initiative and follow-through are important, ask about completed projects. If you want to know about leadership or management experience, ask about specific roles they have played, the jobs they have done, and their reactions to being in a leadership role.

Here's are some general lead-ins for a behavioral event question: "Think of a time when..." or "Think of a situation in which you were..."

For candidates with limited experience outside of the educational environment, ask about clubs, group memberships, and team projects in school.

Once they are talking, pay close attention to what

#### Listen carefully to what applicants say

they are saying and what is being left unsaid. This takes concentration and focus. Look for excitement and involvement—passion while reliving the events being described. Use nonverbal clues to encourage the telling of the story, and ask questions to elicit greater detail. Give

ask questions to elicit greater detail. Give them time to think, and give them time to respond. A good interviewer knows how to let silence be their ally. Learn to let the seconds tick by and curb the urge to interrupt a period of silence—make the

candidate fill in the gap.

Peter Drucker has said, "The most impor-

tant communication skill is listening to what *isn't* being said."

Caution: Don't give away the answer! We often encourage the kind of response we are looking for through our body language, our sounds of agreement, and the points at

which we take notes. You are not in the finals of the World Series of Poker Championship, but try to maintain that same level of interest, eye contact, and active listening throughout the interview.

#### A conversation or an interrogation?

Having a prepared list of questions can be a big help and can ensure you cover the important topics. However, if you aren't careful, it can turn the interview into an oral exam rather than a friendly chat. Remember that your goal is to find a mutually satisfying match, not to "fail" a candidate. This could be the first hour of a long-term relationship so looking for a healthy, positive connection may be far more consequential than the facts that you might uncover.

#### A team interview or one-on-one?

It may be too time-consuming to conduct interviews by a team of potential peers if there are a number of candidates. However, for the final four or six, it's a great idea to include interviews by staff members who are

going to be co-workers of the selected candidate.

These interviews really work well when they are done by small groups. (You may be surprised and learn a lot about your staff by the questions they ask and their ranking of the finalists.) While it is unusual, think about the other parts of the organization that are instrumental to your success. Including other

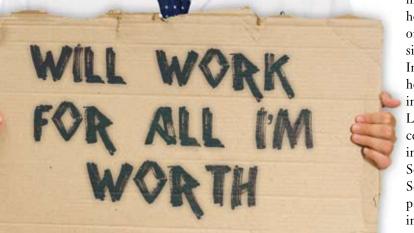
departments in the interviews can be a positive way to build and strengthen those relationships.

October 2009

What applicants do off the job

Hearing about activities people are involved in during their personal time can be both rewarding and informative. Worry about someone who takes too

much work
home with them
or has no outside activities.
Involvement in
hobbies, coaching a Little
League or soccer team, helping with Boy
Scouts or Girl
Scouts, and even
participating
in quite exotic



activities are usually signs of a well-rounded, happy and healthy person. You may be surprised at some of the things people are involved in; I certainly have been.

**Have a grading scale** (but don't be afraid to change it) Start with a good idea of what kind of person you are looking for and the importance you give to each of the characteristics being considered. Then, as the process goes on, think about whether your first set of criteria was correct. While conducting interviews, interviewers frequently discover that their initial job requirements need to be modified based on what they are hearing.

"TRY TO MAINTAIN THE SAME LEVEL OF INTEREST, EYE CONTACT, AND ACTIVE LISTENING THROUGHOUT THE **INTERVIEW.**"

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#### Trust your gut

Am I suggesting that you trust your emotional response to the person? Yes! First realize that your emotional reaction is often based on an unconscious reading of body language, and body language is much more reliable than the words people use. Second, you will have developed a set of emotional expectations, such as thoughts, reactions, and specific things you do and don't want to hear. This happens involuntarily as you develop the position description, think about the experiences you have had with other new hires, and review resumes. If something doesn't sound right or feel right, trust your gut!

#### **"YOUR GOAL IS TO FIND A MUTUALLY SATISFYING MATCH,** NOT TO 'FAIL' A CANDIDATE."

Caution: We have a tendency to evaluate people who are similar to us more highly than those who are different—gender, race, size, age, ethnicity, etc. This is understandable, and can be hard to guard against. This very human characteristic may cause you to miss just the kind of person you need to have on your staff to spur change and to confront and challenge long-held practices.

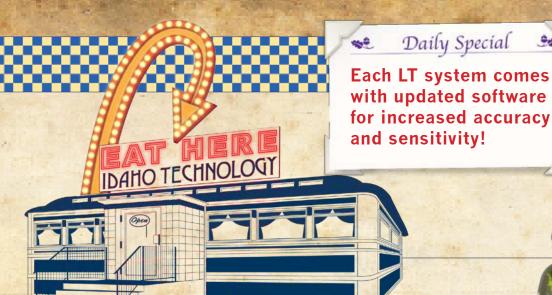
Interview skills come in handy in many situations beyond assessing candidates for employment. Investigations into the facts surrounding a particular event, getting information from observers, assessing attitudes, etc., can all be improved through the use of these techniques. The most transferable skills are active listening and encouraging others to speak.

Interviews can be fun, especially if you adopt the mindset that you are really interested in getting to know this person. Your curious nature will stand you in good stead when you are conducting interviews. Furthermore, this is a very important opportunity for you to make a strong statement about the kind of organization you desire, and to work toward defining, reinforcing, and achieving your vision.

#### References

1. Paul Falcone, "96 Great Interview Questions to Ask Before You Hire," AMACOM, New York, 2009.

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# TRAINING ON A BUDGET MAXIMIZING YOUR TRAINING DOLLARS IN CHALLENGING ECONOMIC TIMES by Brian C. Smith, Ph.D.

In tough economic times many companies slash their training budgets, thinking that training is expendable. This is, in my opinion, corporate suicide. Training is not an expense to be minimized; it is an investment that pays dividends by helping workers do their jobs more effectively so that they can positively impact a company's bottom line. Anything that improves profitability should be pursued, particularly when times are tough and profit is hard to come by.

This article will address the importance of continuing to spend money on training when times are tough, what training options are available, and how to maximize what you get for your training dollars.

#### How training saves labs money

I have made my living for more than 17 years as an independent trainer through my company, Spectros Associates. In that time, thousands of people have attended my lectures, and I have seen many examples of how training has helped companies save money or how timely and appropriate training *would have* saved money had it been pursued. Below are a few examples:

#### "IN TOUGH ECONOMIC TIMES, ANY ACTIVITY THAT MAKES A LAB RUN MORE EFFICIENTLY SHOULD BE PURSUED."

I once taught a course at a facility that was using a sample preparation technique that was time-consuming and destructive to the sample. I introduced the facility to a faster and easier method of sample preparation that was nondestructive. I heard from the company later that it had saved \$20,000 in person-hours and material costs in the first month by adopting the new sampling technique. Thus, the training paid for itself in less than four weeks. How's that for a return on investment?

In another example, a course attendee's company had recently purchased \$150,000 worth of analytical equip-

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ment for use on a specific project. However, the company was having difficulty getting any usable data from its samples. After we discussed the company's problems, it became apparent that the instrument it bought was not sensitive enough to yield the information the company desired. Ultimately, the instrument was mothballed and the people were reassigned to other projects. This wasted not only the \$150,000 spent on the instrument but also six months of workers' time. If the workers had received the right kind of training *before* the company spent all that money, things would have turned out differently.

#### A final anecdote to prove my point

An analytical lab was trying to develop a quantitative spectroscopic method to measure the concentration of a molecule in a new product. Hundreds of man-hours were spent trying to obtain a reproducible and accurate calibration—a goal that was never achieved. Manufacture of the new product was delayed for several months as a result. When I was called in to give an on-site training course, I discovered that because of the sample preparation technique being used, the path length of the samples was not controlled. If you are familiar with Beer's law, you know that the path length must be known in order to achieve reproducible concentration measurements using absorbance spectroscopy. Ultimately, a better sample preparation technique that controlled path length was used, the desired calibration was obtained, and manufacture of the new product began. The cost of hundreds of man-hours spent futilely trying to develop a quantitative method was considerable, not to mention the loss of sales from the delay in introducing the product. Some training in the fundamentals of spectroscopy would have prevented this problem.

These stories are not unusual; they are commonplace. In tough economic times, any activity that makes a lab run more efficiently should be pursued, perhaps even more so than when times are flush, because there are so few ways in a down economy to positively impact the bottom line. Training is one of these opportunities. Another reason to continue to fund training is that as

workers are laid off, those left behind have new and unfamiliar job responsibilities thrust upon them. The only way to get these workers up to speed in their jobs quickly and efficiently is through training.

#### "THE ONLY WAY TO GET WORKERS UP TO SPEED IN THEIR JOBS QUICKLY AND EFFICIENTLY IS THROUGH TRAINING."

#### Getting the most from your training dollars

Now that I have convinced you to continue spending money on training in these tough economic times, the question is how to get good training at a good price. There are advantages and disadvantages to each of the key training delivery methods—online training, on-site training, and public training:

#### **Online training**

Online training is also referred to as Internet training or webinars. In this type of training, users log on to a website where they can view an instructor's PowerPoint® presentation. The instructor and attendees talk to each other over a conference call or the Internet. Typically, the instructor can add text and graphics to slides while lecturing, as if using a blackboard, and can show attendees screen views of websites of interest or other programs running on his or her computer. Attendees can communicate with the instructor by speaking, using an Internet chat function, or activating an icon similar to raising one's hand. Anyone with a telephone line and a high-speed

Internet connection can participate in online training.

The beauty of online training is that there are no travel costs. Attendees do not have to travel to the instructor and the instructor does not have to travel to the attendees, saving thousands of dollars. This type of training also makes great sense if there are attendees at scattered locations, because none of them has to travel. Online training is also convenient; it can be done from the comfort of your own office. Lastly, no travel time is needed to take online training, freeing up lab workers for more important pursuits and increasing lab efficiency. For these reasons, online training is good at stretching training budgets during tough economic times.

Despite the many advantages of online training, it is not perfect. Online training is new and the technology is still evolving. As an online training instructor, I have encountered a number of technical glitches while teaching, including completely losing contact with my class. Online training is also new to many people, so they may be reluctant to take a risk on what they consider an untried training delivery method. After talking to attendees who have attended both online and in-person training courses, I can report that some people's learning styles are not well suited to online training and they prefer to be in the same room as the instructor. As an online training instructor, my biggest frustration is the lack of human interaction. I find that no matter how hard I try, people ask fewer questions and are less interactive online than they are in person. Opportunities to ask questions and impart knowledge are thus lost. Additionally, I miss being able to see the faces of my attendees, which frequently tell me who understands what I am saying and who is lost. This makes it more difficult to adjust the content and pace of a lecture to a group's needs.



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#### Live training

The advantages of live training are that it has been around for a long time and people are comfortable with it. Having everyone in the same room means that handson instruction is available, which is impossible over the Internet. Live training also has the advantage of the most effective interactive training tool ever developed... raising the hand. Because the instructor and attendees can see and hear each other, the opportunities for interaction, and thus the exchange of information, are maximized. The disadvantages of live training are the inconvenience and expense of the travel it requires. I divide live training into two categories: on-site training and public training.

"ANY ON-SITE TRAINER
WORTH HIS OR HER SALT
WILL SIT DOWN WITH YOU
TO TALK ABOUT YOUR
INSTRUMENTATION, TYPES
OF SAMPLES ANALYZED,
APPLICATIONS, AND THE
EXPERIENCE LEVEL OF
ATTENDEES."

#### **On-site training**

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On-site training entails the instructor traveling to a company location to train a group of people. The beauty of on-site training is that it can be customized. Any on-site trainer worth his or her salt will sit down with you to talk about your instrumentation, types of samples analyzed, applications, and the experience levels of attendees. A good trainer will then put together a customized on-site training course that caters to your needs. On-site training also minimizes the cost of training per attendee. The cost of training 5 or 25 people at your site is about the same, so the more people who attend, the lower the cost per person. In my experience, on-site training makes economic sense if there are three or more people at a given location who need training.

On-site training is also convenient because the sessions are normally held somewhere proximal to the attendees' workplace. On-site training enjoys the advantages and suffers the disadvantages of live training discussed above. A unique disadvantage of on-site training is that since people are close to their workplaces, they can

become easily distracted by e-mails and voice mails, or they may be pulled away from the course to work on other business. These situations prevent attendees from learning important material that may be critical for their jobs and waste the money being spent on training. A solution to this problem is to hold on-site training courses away from the workplace, such as at a hotel or conference center.

#### "TRAINING GIVES YOU THE KNOWLEDGE TO AVOID COSTLY MISTAKES AND CHANGE PROCEDURES TO IMPROVE OPERATIONS."

#### **Public training**

Public training sessions are open to whoever pays tuition and are typically held in hotel meeting rooms. There is frequently diversity in the knowledge and experience levels in a group like this, and it gives attendees the opportunity to learn from each other in addition to learning from the instructor. Another advantage of public courses is that, since they are held away from the workplace, there are fewer distractions to interfere with the efficient transfer of knowledge from the instructor to attendees. A drawback of public courses is that, due to the diversity of the people in attendance, they are not customized. Also, public courses involve paying tuition and travel costs for one or more individuals, which actually increases the cost of training per head. However, if only one or two people need training, public courses are still a viable option. Public courses enjoy the advantages and suffer the disadvantages of live training discussed above.

No worker or analysis is perfect, and in any given lab costly mistakes are going to be made.

However, training gives you the knowledge to avoid costly mistakes and change procedures to improve operations. Particularly when budgets are tight, you can't afford to continue to make mistakes. Training is a good investment of a company's money in any economic climate, but it is particularly valuable in a down economy.

**Dr. Brian C. Smith** is president of Spectros Associates, a laboratory training and consulting firm. He can be reached at bcsmith@spectros1.com or 508-579-6514.



## BIOLOGICAL SAMPLE STORAGE AND MANAGEMENT

NEW APPROACHES PROMISE FINANCIAL AND ENVIRONMENTAL COST SAVINGS WHILE ADDRESSING THE CHALLENGE OF INCREASED BIO-SPECIMEN COLLECTION By Omoshile Clement

#### Introduction

A key aspect of biological research revolves around the gathering and collection of samples and their preservation for examination and analysis at a future date. Since time elapses between when a sample is collected and when it is analyzed, and biological samples often degrade over time, it is imperative to have a process of storage (short and long term) that is efficient and preserves sample integrity over time. Today, billions of biological specimens and samples collected by researchers in academia, research institutes, hospitals and commercial organizations are often stored in cold environments (refrigeration @ ~40C, low- and ultralow-temperature freezers @ -50C to -800C, and liquid nitrogen @ -1700C).

"THERE ARE CURRENTLY OVER A BILLION SAMPLES COLLECTED AND WAREHOUSED IN THOUSANDS OF RESEARCH LABS AND BIO-BANKS GLOBALLY."

This article will highlight some of the shortcomings in the use of cold-temperature-based sample storage, describe the new and innovative technologies available today that mitigate these shortcomings, and offer suggestions on the convergence of these technologies in meeting the global challenge to be faced as bio-specimen collection increases in research labs as well as in bio-banks.

### Current best practices of cold storage of biological samples

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In the United States alone, there are more than 40,000 individual research laboratories located on university

campuses that are advancing the field of biological and biomedical sciences. Researchers within these laboratories have assembled a very large collection of biological samples from clinical and field studies, some irreplaceable, all representing enormous scientific and financial value for the researcher and the organization (universities, research institutes, biotechnology/pharmaceutical companies, biobanks, etc.). The cost per sample collected can range from a few dollars up to \$10,000.¹ There are currently over a billion samples (DNA, RNA, cells, clones, tissue organs, blood, buccal swabs, etc.) collected and warehoused in thousands of research labs and bio-banks globally. These samples are of high value to researchers, and current research trends are driving growth of these collections at an escalating rate.

To preserve these important research assets, organizations and individual researchers engaged in biological and biomedical research invest a huge sum of money in capital equipment purchases and maintenance of cold storage facilities to stabilize and store their large inventory of samples. However, there are increasing disadvantages to this method. For example, cold refrigeration/freezers produce hydrofluorocarbons, which are some of the most potent greenhouse gas pollutants² with a deleterious impact on the environment. Quantitatively, according to a report in *The Economist* (www.economist.com), the typical ultra-low-temperature freezer consumes about 7,665 kWh per year while releasing 54,805 pounds of carbon dioxide. This is equal to the emission from about four cars.³

### Additional challenges to the use of cold storage are highlighted below:

- Cold packing and shipping produce a large amount of waste materials.
- Purchase costs, maintenance costs and energy costs of cold refrigerators/freezers add up as sample collection

grows, and accelerate as the cost of energy increases.

- Heat generated from refrigerators/freezers further adds demands to facility requirements, costs and planning to stabilize environmental conditions at lower temperatures than would be required without the equipment.
- Freezers take up an increasingly large amount of lab space, potentially inhibiting current and new facility/ research space needs.
- Multiple freeze-thaw cycles can lead to sample quality degradation.
- Cold freezing, especially of bio-tissues, can lead to cell membrane damage.<sup>3</sup>
- Power failure or freezer failure can place samples at risk for degradation and loss.

# "NEW TECHNOLOGIES DEVELOPED FOR THE STABILIZATION AND STORAGE OF BIOLOGICAL SAMPLES AT ROOM TEMPERATURE HAVE GARNERED A LOT OF ATTENTION."

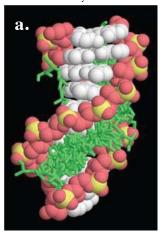
### New approaches to bio-sample storage and archiving

In recent years, new technologies developed for the stabilization and storage of biological samples at room temperature have garnered a lot of attention.<sup>4</sup> While these technologies differ in their implementation, the overall paradigm remains the same—provide room temperature stabilization, storage and archiving of biological samples. A leading innovator in room temperature bio-sample storage is San Diego, California—based Biomatrica Inc. (www.biomatrica.com).

Biomatrica's room-temperature sample stabilization and storage technology is based on extremophile biology that allows some organisms to survive in a dry state (anhydrobiosis) for >100 years.<sup>5</sup> Anhydrobiotic organisms can protect their DNA, RNA, proteins, membranes and cells for long-term survival in a dried state and later be revived by simple rehydration. The method transfers the natural molecular principles of anhydrobiosis to a synthetic chemistry—based stabilization science that works by forming a thermo-stable barrier around the sample, protecting it from degradation during storage at room temperature (see Figure 1). Sample recovery is as simple

as rehydrating the mixture, making the sample ready for use in a wide range of downstream applications such as microarray analysis, DNA/RNA sequencing, end-point PCR, cDNA synthesis, reverse transcription, etc.

The ability to stabilize, transport, store and archive biological samples at ambient conditions now offers possibilities of increased sustainability for managing biological research in the life science industry. A recent collaboration between the Sorenson Molecular Genealogy Foundation (SMGF) and Biomatrica involved the application of Biomatrica's SampleMatrix® roomtemperature storage technology to archive SMGF's current DNA samples and the long-term storage of all newly collected samples.6 In addition, SMGF plans to move its collection of previously archived samples from cold-temperature freezers to room-temperature storage. According to Scott Woodward, executive director of SMGF, "Biomatrica has developed a product that we feel addresses our concerns in a very practical, economical and secure way."



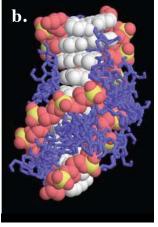


Figure 1  $\triangle$  A molecular-level view of the process of sample preservation by Biomatrica's SampleMatrix (a) by mimicking the process of anhydrobiosis (b).

### Are the benefits to room-temperature storage achievable?

A number of advantages have been ascribed to room-temperature sample storage over the current cold-temperature-based storage. Perhaps the most significant benefit is in the area of increased sustainability of biological research when samples are transitioned from cold freezers to ambient room temperature. This process should lower energy consumption, reduce the carbon footprint (CO, emission), lower the costs associated with

equipment purchase and maintenance, lower material costs, and provide better utilization and optimization of lab space gained by retiring the cold freezers.

"THE ABILITY TO STABILIZE,
TRANSPORT, STORE AND
ARCHIVE BIOLOGICAL SAMPLES
AT AMBIENT CONDITIONS
NOW OFFERS POSSIBILITIES OF
INCREASED SUSTAINABILITY
FOR MANAGING BIOLOGICAL
RESEARCH IN THE LIFE SCIENCE
INDUSTRY."

In order to demonstrate the associated benefits of the transition from cold-temperature sample storage to room-temperature storage, a university in California conducted a pilot study as part of a campus-wide energy sustainability initiative. The study involved 12 laboratories within the university, representing a broad range of research areas and lab sizes, and about 60,000 samples out of the nearly 1 million identified as transferable from cold freezers to room-temperature storage.<sup>7</sup>

The major goal of the study was to better understand the financial and environmental cost savings associated with a move away from cold storage to ambient roomtemperature technology. A sophisticated forecast model was developed using information from the pilot group,

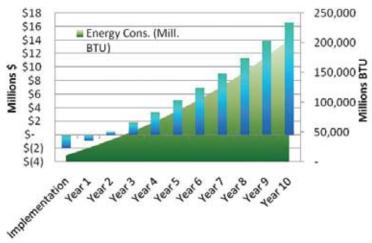


Figure 2  $\triangle$  Projected savings in energy (BTU) and cost (\$) over 10 years by switching from cold-freezer storage samples to room-temperature storage (data from Ref 7).

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data from the university, and industry trends in order to estimate the potential campus-wide benefits to increased sustainability via the adoption of this technology.

The final report provided 10-year projections for maintaining the current cold storage freezers at ~564,000 MBTU of energy consumption at an energy cost of ~\$70 million, while generating >50,000 metric tons of CO, emissions.6 These findings are clear demonstrations of an unsustainable path with current storage systems, especially when the industry projects a significant increase in the collection of bio-specimen samples. In contrast, over the same 10-year time frame, the study projects (see Figure 2) that transitioning from cold storage to room-temperature storage solutions for all identified samples in the university laboratory freezers would generate cost savings between \$11 million and \$20 million and energy savings of ~160,000 MBTU, prevent 17,000–20,000 tons of greenhouse pollutant (CO<sub>2</sub>) from entering the environment, and recoup the initial storage transfer costs within five years.7

"THE INCREASING DIVERSITY AND SIZE OF BIO-SPECIMENS ROUTINELY COLLECTED WILL REQUIRE A HIGHLY SCALABLE, COST-EFFECTIVE AND ENVIRONMENTALLY FRIENDLY STORAGE, STABILIZATION, TRANSPORT AND ARCHIVAL SYSTEM."

Studies such as those described here clearly suggest a robust solution to sample storage, with significant and measurable benefits to adoption of this technology. The increasing diversity and size of bio-specimens routinely collected will require a highly scalable, cost-effective and environmentally friendly storage, stabilization, transport and archival system such as is offered by room-temperature sample storage technologies.

#### **Conclusions**

Can biological samples be safely stored at room temperature for long periods without the risk of sample degradation? That is a question that has been easily answered by the new technologies emerging from such companies as Biomatrica and amply demonstrated from

collaborative research studies, some of which have been described in this article.

As sample collection grows as anticipated for a wide range of biological and biomedical research, storage and archiving of these important research assets will be critical. Will the future of sample storage remain at the status quo, i.e., cold storage, or will the clear advantages offered by new technologies such as room-temperature storage and archiving assume a more central role? The energy sustainability pilot study and its findings clearly demonstrate significant benefits in adopting room-temperature storage solutions as a viable alternative to or replacement for cold-storage systems.

In summary, ambient room-temperature storage offers an eco-friendly and highly sustainable process to manage biological samples, enhance lab space conservation via freezer retirements, provide a more efficient and cost-effective transportation of samples, and reduce the risk to sample loss from vulnerable freezer-dependent issues such as fire, temperature fluctuations or other acts of nature.

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# BSC ERGONOMICS AND ADA COMPLIANCE

ACCOMMODATING THE USER FOR ENHANCED PRODUCTIVITY By David S. Phillips

Because of the increased incidence of work-related musculoskeletal disorders among laboratory workers, the principles of ergonomic design and compliance with the Americans with Disabilities Act (ADA) are becoming increasingly important topics in the design of the biological safety cabinet (BSC). Ergonomics and ADA compliance have not yet been described in a thoughtful or meaningful way for users of the machine and therefore are not well understood.

# "WORK-RELATED MUSCULOSKELETAL DISORDERS ACCOUNT FOR ONE-THIRD OF ALL REPORTED OCCUPATIONAL INJURIES AND ILLNESSES."

This article seeks to provide guidance to users on setting up the BSC for the height and reach of the various people who will be using it. The user will have a better understanding of what to look for when selecting an ADA-compliant BSC and of how the Thermo Scientific BSCs compare to other commonly used BSCs in terms of ergonomics and ADA compliance.

#### Ergonomics and work-related injuries in the lab

In the case of BSCs, most designs attempt to address ergonomics and ADA compliance through options and accessories that allow the height of the cabinet work surface to be adjusted. While these accessories may offer the user greater flexibility with the BSC, there is little to no information available to guide the user in properly setting up an ergonomic workspace.

Work-related musculoskeletal disorders account for onethird of all reported occupational injuries and illnesses and constitute the largest job-related injury and illness problem in the United States.<sup>1</sup> In August 1996, the National Institute for Occupational Safety and Health (NIOSH) conducted a healthhazard evaluation of two in vitro cell-line screening project laboratories and found that 46.5 percent of the product-laboratory employees met the NIOSH case definition for potential work-related upper-extremity musculoskeletal disorders.<sup>2</sup>

The study concluded that there are several ergonomic hazards associated with using traditional BSCs that can cause

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upper-extremity musculoskeletal disorders, including working in a static, extended posture for long periods of time; limited visibility at the sight line; leaning forward to see work; and lack of knee/leg space under the cabinet. User discomfort leads to fatigue and risks the user's safety and productivity.

The relative value of BSC ergonomics to an individual user will certainly vary. The NIOSH health-hazard assessment was conducted with laboratories whose workers experience 6,000 to 11,000 repetitive motions per day for two to three hours at a time. Heavy users of BSCs have a greater potential risk for work-related injury than do users who work in their BSCs less often with fewer repetitive motions.

BSC users who are at greater risk for work-related upper-extremity musculoskeletal disorders will find value in newer, more advanced BSC designs. As a result, modern laboratories should evaluate their current work processes and installed base of BSCs to assess the value of newer ergonomic BSC designs that improve employee productivity and reduce workplace injuries.

#### **Optimizing the BSC workstation**

Most of the findings within the NIOSH report relate to the proper seated working position in front of the BSC. For this reason, a portion of this article is devoted to optimizing the setup of the complete BSC workstation, which consists of cabinet, chair and footrest.

Assessing the fit of a BSC must begin by describing a typical user. The anthropometric database published by the U.S. military compiled data on the sizes of more than 4,000 men and women and is used as the basis of this analysis.<sup>3</sup> The average body dimensions of the male and female with average height and of the male and female with heights two standard deviations above and below the average are used.

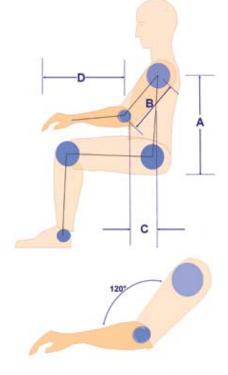
Currently, most BSC designs require the use of an adjustable chair and footrest for proper seated posture. The lowest height settings for the most commonly available BSCs provide work surface heights from 29 to 30 inches above the floor. For our calculations, we will use a BSC work surface height of 30 inches above the floor. A comfortable reach into the cabinet is assumed to be ideal where the angle of the upper arm and forearm does not exceed 120°.

Using the dimensions from the anthropometric database

as illustrated here, ideal ergonomic position and chair height setting can be assessed by analyzing the individual's distance from seat to shoulder while in a seated position. Assuming the maximum comfortable reach forward of 120°, seat height can be calculated for six different user types in four commonly used BSCs (Table 1).

With the BSC work surface height at 30 inches above the floor, and the seat heights set as above, the reach onto and over the work surface can be estimated when reaching into the cabinet at the arm extension of 120°. Generally speaking, the farther a person can reach into the BSC without awkward positioning, the greater flexibility and access that person has to the interior workspace.

These guidelines on proper seat adjustment, while relating to only one aspect of BSC ergonomics, will allow



Maximum Comfortable Extension

the user to optimize the work height of the cabinet in order to maximize reach and usability of the BSC. The Thermo Scientific BSC, when optimized as a complete workstation, will accommodate one of the farthest reaches into the working chamber of any BSC offered today.

	Female			Male			
	4' 9"	5' 4"	5'9"	5' 4"	5' 9"	6' 2"	
Distance from seat to shoulder (A)	21.4"	22.9"	24.5"	23.3"	24.9"	26.2°	
Distance from shoulder to elbow (B)		13.2"	14.3"	13.3"	14.5"	15.5°	
Vertical distance to elbow with 120° extension (B,*)	10.5*	11.4"	12.4"	11.5"	12.6"	13.4"	
Distance from seat to bottom of arm $(A - B_y)$	10.9"	11.5*	12.1"	11.8"	12.3"	12.8"	
Height of Access Opening							
Thermo Scientific Herasafe KS or 1300 Series A2	32.0° 31.9°		32.0" 31.9"				
BSC "A"							
BSC "B"	31.1"			31.1"			
Resulting Seat Height							
Thermo Scientific Herasafe KS / 1300 Series A2	21.1"	20.5"	19.9"	20.2"	19.7"	19.2"	
BSC "A"	21.0"	20.5"	19.8"	20.1"	19.6"	19.1"	
BSC "B"	20.2"	19.6"	19.0"	19.3"	18.7"	18.3"	

Table 1 Recommended seat height for six different user types in front of four commonly used BSCs.

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<sup>\*</sup>The cosine of 30° is 0.866, which is the ratio of vertical distance from shoulder to elbow at a 120° extension to the distance from shoulder to elbow.

	Female			Male		
	4' 9"	5' 4"	5'9"	5' 4"	5' 9"	6' 2"
Distance from abdomen to midbody (C)	4.3"	4.4"	4.6"	4.4"	4.7"	4.8"
Distance from shoulder to elbow (B)	12.1"	13.2"	14.3"	13.3"	14.5"	15.5*
Horizontal distance from shoulder to elbow at 120° (B,*)	6.0"	6.6"	7.2"	6.6*	7.2"	7.8*
Distance from elbow to fingers (D)	16.0*	17.4"	18.6"	17.5"	19.0°	20.3*
Distance from abdomen to fingers (reach)( $B_h + D - C$ )	17.8*	19.6"	21.2"	19.8"	21.6*	23.2"
Span from BSC front to Worksurface Thermo Scientific Herasafe KS or 1300 Series A2		6.5"			6.5*	
BSC "A"	6.2"		6.2*			
BSC "B"	8.5*			8.5*		
Resulting reach over worksurface						
Thermo Scientific Herasafe KS / 1300 Series A2	11.3"	13.1"	14.7"	13.3"	15.1"	16.8"
BSC "A"	11.5"	13.4"	14.9"	13.5"	15.3"	17.0"
BSC "B"	9.2"	11.1"	12.6"	11.2"	13.0"	14.7"

Table 2 Calculated reach into BSC for six different user types in four commonly used BSCs. \*The sine of 30° is 0.500, which is the ratio of borizontal distance from shoulder to elbow at a 120° extension to the distance from shoulder to elbow.

#### Raising the bar on ADA compliance

BSC ergonomic attributes and ADA compliance are often associated with one another in terms of appropriate settings for BSC work surface height. According to the U.S. Department of Labor, "The Americans with Disabilities Act (ADA) prohibits discrimination against people with disabilities in employment, transportation, public accommodation, communications, and governmental activities." Many institutions are interested in designing laboratories that will effectively accommodate all users, and they seek out BSC designs that facilitate this.

The label "ADA compliant" has been applied to many products, including buildings, benches and Web sites. What most buyers of lab equipment do not fully understand is that the ADA is applicable not only to impairments in physical mobility, but also to hearing, vision, mental and emotional impairment. The term "ADA compliant" as it relates to BSCs is most often promoted to address only the concerns of individuals in wheelchairs.

True BSC compliance with the ADA should offer benefits to employees with impairments in physical mobility, sight and hearing. For example, an employer's provision to offer wheelchair-accessible BSCs to a person with visual impairment would not be helpful in complying with the requirements of the ADA.

This article looks at the accessibility and usability of BSCs from three different manufacturers for wheelchair-bound users. These attributes are assessed and compared in relation to ADA compliance criteria. The ADA requires the establishment of design criteria, or ADA Accessibility Guidelines (ADAAG), for the construction and alteration of facilities covered by the law. While ADAAG is not directly applicable to biosafety cabinet design, it does provide helpful guidance regarding what

features are important for accommodating a variety of users.

There are three elements described in ADAAG that apply to biosafety cabinet usefulness for individuals in wheelchairs: forward reach, clearance underneath the cabinet, and access to the controls and display.

Forward reach – Section 4.2.5 states that the maximum high forward reach allowed shall be 48 inches (1,220 mm) and the minimum low forward reach is 15 inches (380 mm). The applicable guidance for a BSC would be:

• The space under the biosafety cabinet must be greater than or equal to the desired reach distance in the work area. If the reach from the forward bottom

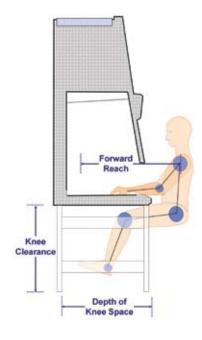
edge of the BSC is 25 inches, the space underneath it must extend at least 25 inches back from the forward bottom edge. (See Figure 5(b) in ADAAG).

- The maximum reach from the forward bottom edge of the BSC is less than or equal to 25 inches (635 mm).
- The maximum reach height for BSC controls on the front of the cabinet should be 48 inches (1,220 mm).

Knee clearances – Section 4.32.3 states that knee spaces should be at least 27 inches (685 mm) high, 30 inches (760 mm) wide and 19 inches (485 mm) deep. The applicable guidance for a BSC would be:

- The space under the BSC must be at least 27 inches (685 mm) high.
- The space under the BSC must be at least 30 inches (760 mm) wide.
- The space under the BSC must be at least 19 inches (480 mm) deep.

Height of tables or counters – Section 4.32.4 states that the tops of accessible tables and counters shall be from 28 inches to 34 inches (710 to 865 mm) above the floor or ground. The applicable guidance for a BSC would be:



• The BSC work surface must be from 28 inches (710 mm) to 34 inches (865 mm) high.

For the most commonly used BSCs, a manual or electric-powered adjustable stand provides maximum flexibility for setting the height to accommodate the wheelchair in the space under the cabinet. The advantage of using an electric adjustable-height stand in the lab is that the working height

		Thermo Scientific Herasafe KS	Thermo Scientific 1300 Series A2	BSC "A"	BSC "B"
Knee Space	≥ 30" wide	Yes	Yes	Yes	Yes
	≥ 27" deep	Yes (w/ WS at 30.25"			Yes
	≥ 19" deep	Yes	Yes	Yes	Yes
	As deep as work area	Yes	Yes	No	No
Work Area	Available work surface height within 28 to 34"	Yes	Yes	Yes	Yes
	Max reach ≤ 25"	Yes	Yes	No	No
Controls and Display	Max reach height less than 48"	Yes	No	No	No

of the cabinet is infinitely adjustable (within the minimum-maximum range) with the touch of a fingertip at any time after the cabinet is installed.

In the case of the Thermo Scientific electric adjustable stand, memory settings in the controller allow lab personnel to set their own optimum working height at first use, minimizing the inconvenience of having to set the proper height at each work sitting. This is a significant advantage over the more commonly used manual adjustable-height stands, where height adjustments cannot be made without the use of a mechanical lift that supports the weight of the cabinet.

When BSCs are assessed for other parameters such as knee space, reach, and accessibility of controls, the Thermo Scientific BSCs offer significantly greater range of motion for the physically impaired.

In seeking to bring the benefits of the Class II BSC to the largest number of disabled users, the design of the Thermo Scientific Herasafe KS delivers a contained and clean workspace with maximum flexibility in controls and information display. First, the display is placed on the rear wall of the workspace and does not require the user to change his or her working position or posture to see any displayed information on BSC status or performance.

The easy-to-clean display is positioned 15.75 inches (400 mm) above the work surface to avoid disruption to airflows or product safety. Second, the unique handheld controller completely liberates the location of the BSC controls from the cabinet and allows the user to place the BSC controls wherever it is easiest for the user to manage. Users with limitations in reach can carry the controller with them. Left-handed or right-handed users can use whichever hand they are most comfortable with.

Users in wheelchairs do not need to roll all the way up to the cabinet to open the window and then back to collect their supplies. They can use the controller from a comfortable distance to open the window and bring the cabinet to its operational state and collect their supplies to begin work. The Thermo Scientific Herasafe KS brings unparalleled flexibility to disabled users of BSCs.

In conclusion, as advanced design concepts are incorporated into the design and development of Class II BSCs to make them usable and accessible to more diverse populations, it is important to note that the same features that accommodate disabled users will serve to help nondisabled users as well. The benefits of flexible work surface height, easily viewed display and easily accessed controls will help to reduce musculoskeletal demands for high-productivity users. Modern labs considering investment in equipment should give careful consideration to ergonomics, as these features benefit everyone.

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#### SCIENCE MATTERS

LATEST TRENDS SHAPING THE SCIENTIFIC WORKFORCE By Rich Pennock



### CONSIDER DOING SOMETHING DIFFERENT IN THE PHARMACEUTICAL INDUSTRY

It's been an interesting year for scientists employed in the pharmaceutical industry. To date, we've experienced a year of mega-mergers with six of the top pharmaceutical players combining forces to become three major contenders

#### "THERE ARE SOME SIGNALS WITHIN THE SCIENCE INDUSTRIES THAT CAREER OPPOR-TUNITIES FOR HIGHLY-SKILLED INDIVIDUALS EXIST."

What does this mean for the affected employees and managers alike? Well, believe it or not, it can lead to employment opportunities and personal successes that otherwise may not have been considered.

Ponder this. According to the *Los Angeles Times*, nearly 35,000 pharmaceutical positions may be eliminated in 2009<sup>1</sup> due to the industry's "mega-mergers."

Pharmaceutical employees, like many other employees, are knowledgeable, hard working and determined individuals. When a position is eliminated, it's important to remember the old adage, "When one door closes, another one opens." This is exactly what is happening in the pharmaceutical field.

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#### **New opportunities**

In many instances, displaced pharmaceutical employees are starting their own companies, by utilizing their industry knowledge and experience. Many of these start-up companies are meeting niche market needs as the economy continues to shift and redefine business methods today.

Other employees are choosing to relocate to another area of the country to pursue an opportunity within the pharmaceutical—or related—industry. While this may be something that they would not have considered prior to having their current position eliminated, they may find that the new location, combined with a new employment opportunity, is a refreshing and challenging change.

#### "IN MANY INSTANCES, DISPLACED PHARMA-CEUTICAL EMPLOYEES ARE STARTING THEIR OWN COMPANIES."

#### Industry growth

While newspaper headlines continue to report significant job losses, there are some signals within the science industries that career opportunities for highly-skilled individuals exist. According to a recent report by the United States Bureau of Labor Statistics, private-sector pharmaceutical positions in the Silicon Valley areas of San Francisco and Santa Cruz increased by 32 percent from 2001 to 2008, while private scientific research positions also increased by 26 percent during the same time period.

#### Growth areas to watch include:

- •Research and Development Pharmaceutical companies are devoting more time and money to bringing new drugs to market in a more efficient manner
- Regulatory and Drug Safety As more and more strict regulations are being put into place, experienced scientists are needed in the areas of regulatory affairs, quality control and validation
- Manufacturing Including biopharmaceuticals, the development and manufacturing of biotech drugs
- Pharmacogenomics Predicting how patients will respond to a specific drug based on their genetic make-up
- Positions that combine drugs and devices
- Regardless of where they land, employees are learning to be more flexible as they work in a global environment. Positions today may include global travel, overnight emails and videoconferences with other team members

#### **Accepting culture change**

While it's true that mergers may lead to some job losses, mergers can also improve organizational culture. As merged organizations work to outperform competitors, managers and their employees have an opportunity to rise above their own expectations in order to not only maintain their current positions, but also help the merged organization prosper for years to come.

"REGARDLESS OF WHERE THEY LAND, EMPLOYEES ARE LEARNING TO BE MORE FLEXIBLE AS THEY WORK IN A GLOBAL ENVIRONMENT."

### Preparing for new company culture

After a merger, your company's culture may change entirely as the values and practices of the merged company's employees may not match your company's employees. Often times, a merger leads to a cultural shock as employees of each company are not prepared for a change in values and practices. In order to reduce

shock levels during a merger, managers must understand the values and practices of the other company and the ways in which their company will be affected by the merger.

By being prepared, managers and their employees will be better able to accept the cultural change that can lead to higher employee morale and performance. Employees of both companies will be more equipped to adequately work together if there is an understanding of each company's culture. Through open communication, employees will not only have a more positive understanding of their future with the organization, but they will also be able to work with new team members more efficiently.

Through effective communication and positive outlooks, managers can work with their team to not only "survive" a merger, but thrive during the change as well.

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Rich Pennock is vice president of Kelly Scientific Resources, a leader in scientific staffing solutions. For more information, visit www.kellyscientific.com. Follow Rich on Twitter at http://twitter.com/richpennock.

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# A PRODUCT CATEGORY IN TRANSITION by Gloria Metrick

LIMS (Laboratory Information Management System) products have been around for decades. Like most products, they began with someone writing software to meet a company's specific needs. Some of those homegrown products grew and became commercial, and an industry was born.

# "LIMS PRODUCTS OFTEN INCLUDE FEATURES THAT DO NOT FALL INTO THIS SIMPLE MODEL, BUT THAT SEEM TO BE NATURAL EXTENSIONS OF THE WORK BEING DONE."

LIMS products vary from software for small laboratories to systems for enterprise-class distribution, where large implementations can cost millions of dollars and encompass licensing, training, validation and all the other services required. As with other software products, there are many ways to implement and purchase a LIMS, from boxed software to commercial licenses for COTS (Commercial Off-the-Shelf) to open source to SaaS (Software as a Service). Possibilities vary greatly regarding the choices appropriate and available for the specific type of laboratory where the LIMS will be implemented.

#### What is a LIMS?

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Minimally, a LIMS manages the laboratory's samples, tests and results. It manages and coordinates the work, performs calculations and stores data. It indicates how much work has been finished on a sample and provides many other related features. LIMS products often include features that do not fall into this simple model, but that seem to be natural extensions of the work being done.

Additionally, some LIMS offer features that you might find available for purchase as standalone software. A few common examples are the features to manage instrument cali brations and preventative maintenance, or features to manage drug dissolution testing. Although features such as these are available separately, there are certain situations in which it is appropriate to do this work directly in the LIMS.

It is important to note that a LIMS and an ELN (Electronic Laboratory Notebook) are not the same thing. An ELN is a literal replacement for your paper laboratory notebook. As such, it is a place to enter and keep your laboratory notes and get signoff; you use it just as you would use a paper notebook.

The confusion between LIMS and ELN occurs partly because there is some overlap between them. Additional confusion arises now that some LIMS include ELN features, some ELNs contain LIMS features, and some products combine LIMS and ELN. Beyond the LIMS/ELN question, there are yet other products that sound like they might be a LIMS but have different names. There are still other products that are called "LIMS" but do not appear to be like anything that has just been described.

#### "IT IS IMPORTANT TO NOTE THAT A LIMS AND AN ELN (ELECTRONIC LABORATORY NOTEBOOK) ARE NOT THE SAME THING."

#### Why you cannot just go buy a LIMS

Selecting and buying a LIMS takes effort and time in advance of the actual purchase for the following reasons:

- 1. The functions and distinguishing factors among available products are always changing.
- Right now, LIMS is in a period of especially high transition as LIMS and ELN software continue to converge. Things might become even more confusing before this period is over.

3. Even before LIMS, ELNs and other products took on some of the functions of each other. Now the types of LIMS available are somewhat overwhelming. There are Environmental LIMS, general-purpose LIMS, Webonly LIMS, PC-only LIMS, R&D-focused LIMS, QCfocused LIMS and Forensic LIMS—to name just a few. Products have been developed for specific industries, company sizes and specific technical solutions as well.

"RIGHT NOW, LIMS IS IN A PERIOD OF ESPECIALLY HIGH TRANSITION AS LIMS AND ELN SOFTWARE CONTINUE TO CONVERGE."

#### Watch for transition

As our laboratory informatics industry continues to change, I recommend that you ignore the labels and look closely for the features that meet your needs. We can watch the progress of the transition, but whether products will be combined into one-size-fits-all solutions or kept separate remains to be seen. Today, we have both types of solutions because different customers need and desire different solu-

tions. It is quite possible that we will see the same split continue in the market. Ken Rapp of VelQuest, whose product combines LIMS and ELN features, explains, "VelQuest believes that the GMP-ELN and LIMS layers contain very different functionality. However, market pressures are forcing a "convergence" of the requirements into a fully integrated Commercial Off-the-Shelf (COTS) solution available either from one solution provider or as a best-of-breed integrated solution." At Thermo, where an integration plan is used to turn specialized products into a single solution, Informatics marketing director, Susan Najjar, says, "...from a usability perspective, if users are working with a well-integrated solution, the merging of these technologies becomes irrelevant"

#### **Finally**

What all this means is yet more choices for you to consider. But even though more choices may make the selection process lengthier, there is an increased likelihood that the best solution for your laboratory will be out there and readily available.

Gloria Metrick is owner of GeoMetrick Enterprises (www.geo-metrick.com), which provides consulting services for laboratory informatics projects. She can be reached at 781-365-0180 or Gloria@GeoMetrick.com.

LIMS suppliers

Baytek International	Corpus Christi	TX	281-218-8880	www.baytekinternational.com
Bio-Rad Spectroscopy	Hercules	CA	800-424-6723	www.bio-rad.com
Chemware	Raleigh	NC	919-855-8716	www.chemware.com
H&A Scientific	Greenville	NC	252-752-4315	www.hascientific.com
Joven Technology	Atlanta	GA	678-585-9520	www.joventech.com
Labsoft	Tampa	FL	800-767-3279	www.labsoftweb.com
Labtronics	Guelph ON	Canada	519-767-1061	www.labtronics.com
LabVantage Solutions	Bridgewater	NJ	888-346-5467	www.labvantage.com
LabWare	Willington	DE	302-658-8444	www.labware.com
McLane Advanced Technologies	Temple	TX	800-988-5428	www.mclaneat.com/products/gentian.aspx
Novatek International	Montreal PQ	Canada	514-668-2835	www.ntint.com
Sapio Sciences	Baltimore	MD	443-759-3204	www.sapiosciences.com
STARLIMS	Hollywood	FL	954-964-8663	www.starlims.com

For more information on lab products, please visit www.labmanager.com and click on Lab Product News. There you will find more lab products and a complete list of suppliers.

# NOT YOUR DADDY'S FUME HOOD by Angelo DePalma

Biological safety cabinets (BSCs) are specialized work areas that provide protection to users/operators and/or samples. BSCs are categorized as Class I, Class II or Class III, depending on their construction, airflow characteristics and exhaust systems. These classifications are based on each BSC's suitability for samples at various biosafety levels. Class I and Class II cabinets handle Biosafety Levels 1, 2 and 3 (low to moderate risk), while Class III BSCs are intended for use with Biosafety Level 4 agents (high risk).

# "A DISTINGUISHING COMPONENT OF BSCs IS THEIR USE OF HIGH-EFFICIENCY PARTICLE AIR (HEPA) FILTERS."

BSCs are distinct from other safety enclosures. Laboratory fume hoods pull air over the work item and out into the environment through a vent, whereas controlled atmosphere glove boxes are completely enclosed, protecting both users and samples through an airtight barrier. A distinguishing component of BSCs is their use of high-efficiency particle air (HEPA) filters, which scrub effluent between 99.5 percent and 99.99 percent of airborne particles, or at least 99.97 percent of particles larger than 3 microns.

#### **Class distinctions**

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Class I BSCs protect personnel and the environment only. Samples are vulnerable because workspace air is swept over them before filtration and venting. Class II cabinets represent a broad category, with varying capabilities that are further subdivided into categories A1, A2, B1 and B2. The main differentiator between Class I and Class II BSCs is that Class II cabinets employ a HEPA-filtered, vertical, unidirectional airflow within the work area. Class III BSCs, which provide the highest level of protection to both workers and samples, are reserved for highly contagious or virulent biological samples.

Class II A2 cabinets are by far the most common BSCs in use today, comprising about 95 percent of installations, ac-

cording to David Phillips, technical applications specialist at Thermo Scientific (Asheville, N.C.).

Class II cabinets have open fronts. Workers are protected by the steady vertical airflow. An ongoing controversy for specifying certain Class II cabinet types involves NSF Standard 49, which states that Class II A2 and B2 cabinets are designed to handle "minute" amounts of toxic chemicals and radionuclides. "But nobody has defined the term 'minute' quantitatively," admits Phillips, who works on the NSF joint committee that determines BSC specifications.

#### "CLASS III BSCs, WHICH PROVIDE THE HIGHEST LEVEL OF PROTECTION TO BOTH WORKERS AND SAMPLES, ARE RESERVED FOR HIGHLY CONTAGIOUS OR VIRULENT BIOLOGICAL SAMPLES."

To satisfy whatever that requirement might be, and to err on the side of caution, most laboratories automatically specify the use of Class II B2 cabinets, which Phillips describes as "complex, infrastructure sensitive and 10 times trickier to run" than Class II A2 cabinets. "A lot of people get stuck with B2s, but half of them should never have been installed. Users would be much better served by canopied A2 cabinets."

Jim Hunter, senior project engineer at Labconco (Kansas City, Mo.), suggests using B-type cabinets in situations where workers are consistently working with volatile toxic agents, isotopes or anticancer drugs that you don't want coming back into the lab. Otherwise, the acquisition and operating costs are simply not worth it. "B cabinets cost a lot of money and use a lot of energy. Unfortunately, architects assume a B cabinet is always better because it's more expensive or because the letter 'B' comes after 'A' in the alphabet. All too often they simply override a customer's decision on which type of cabinet to purchase," says Hunter.

Lab Manager October 2009 labmanager.com

As a former certifier of BSCs, Phillips has a unique perspective on the evolution of these cabinets. In the past, he says, cabinets were commodities that barely differed as one considered the product offerings of numerous vendors. "They basically all looked like battleships," he says. Beginning in the 1990s, cabinets began incorporating ergonomic designs that allowed operators to move forward and backward in comfort. Enclosures became brighter and air-handling systems quieter (through the adoption of DC motors and computer-controlled airflow compensation). "Cabinets evolved from being cookie- cutter-type products to having more choices and options. It's a really fun time to be in this industry," says Phillips.

# "IN THE PAST, [BSCS] WERE COMMODITIES THAT BARELY DIFFERED AS ONE CONSIDERED THE PRODUCT OFFERINGS OF NUMEROUS VENDORS."

One improvement affecting both operating costs and the environment is energy consumption. Older-model BSCs were energy hogs, but today's units are downright miserly. Phillips recalls an event at the University of Michigan, where one of his Thermo Fisher colleagues was accused of low-balling the power consumption of a Thermo Fish-

er BSC. The assembled scientists were forced to eat their words after they tested the product and measured its en-

# "OLDER-MODEL BSCS WERE ENERGY HOGS, BUT TODAY'S UNITS ARE DOWNRIGHT MISERLY."

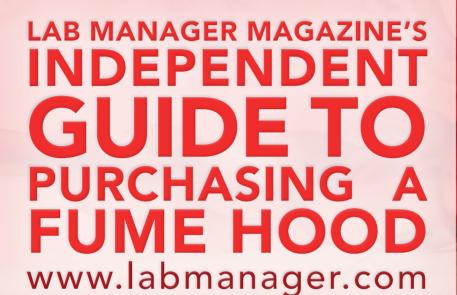
ergy usage. The result was a paper you can find at http://bit.ly/N9bwz.

Environmental concerns have become a huge factor in BSC purchases, according to John Peters, assistant marketing director at Nuaire (Plymouth, Minn.). "Customers look for energy efficiency as well as total cost of ownership, the life of HEPA filters and the types of motors used to drive the air handlers," he explains. Unlike many other laboratory products, purchasers of BSCs must perform their own due diligence, as no third-party organizations provide energy-efficiency ratings for cabinets.

Angelo DePalma holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. A full-time freelance writer for more than 20 years, Angelo has written nearly 2,000 trade magazine articles on pharmaceuticals, biotechnology, materials and supporting industries. You can reach him at angelo@adepalma.com.

#### **Bio Safety Cabinets**

Air Science USA	Fort Myers	FL	239-939-0432	www.air-science.com
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Erlab	Rowley	MA	800-964-4434	www.greenfumehood.com
Esco	Hatboro	PA	215-441-9661	www.us.escoglobal.com
Hemco	Independence	МО	816-796-2900	www.hemcocorp.com
Labconco	Kansas City	МО	816-333-8811	www.labconco.com
Microzone	Ottawa ON	Canada	613-831-8318	www.microzone.com
Misonix	Farmingdale	NY	800-694-9612	www.misonix.com
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MISONIX AURA Portable Ductless Fume Hoods have been the quality leader in the market for 40 years. The new design AURA 30, AURA 42, AURA 54 features ASHRAE Certification, UL Listing, Filter Performance verified by FTIR. The MISONIX 3-2-1 Warranty, Filtrak filter locking system and new full width sash openings compliment the powder coated aluminum chassis and head section and offer a quiet, truly portable solution that will provide years of reliable performance and service. Our in house chemical engineers will evaluate your application free of charge. "When you only want to buy it once, buy MISONIX". www.misonix.com



New from NuAire, the CellGard ES NU-480 Class II, Type A2 Biological Safety Cabinet utilizes DC ECM motor technology ensuring a low total cost of ownership. Over-sized HEPA filters with more filter media equal longer filter life; HEPEX Zero Leak Airflow System and an optimally determined forward-curved fan reduce noise and vibration. TouchLink Electronic Control System monitors, displays, and controls real-time airflow. The Ergonomic design reduces fatigue; front hinged panel opens 30° for increased cleanibility, along with DECON-101, NuAire's exclusive decontamination kit. CellGard ES provide long-term reliability; outstanding performance; superior quality; with cost saving technologies. http://www.nuaire.com/cellgard-es/biological-safety-cabinet.html

DUCTED FUME HOODS in the past were the only option available to labs and account for only one component of a total lab ventilation system, which includes a series of ducts, blowers and filters running through the entire building. However, choosing the right fume hood enclosure for inside your lab space is very important.

CONVENTIONAL DUCTED FUME HOODS often describes the traditional, less elaborate fume hoods that have a constant air volume. Face velocity is inversely proportional to the sash height unless a by-pass is in place. The by-pass helps direct airflow and reduces the increase in face velocity as the sash closes. The by-pass enables the hood to have a more constant volume of exhaust air. This provides general protection to the lab worker.















VARIABLE AIR VOLUME DUCTED FUME HOODS maintain a constant face velocity regardless of the sash position by employing a closed loop system that is constantly measuring and adjusting the amount of air being exhausted. In many hoods, inaccurate face velocities will sound audible and visual alarms, which in addition to the constant face velocity, greatly increase the protection of the lab worker. This also reduces the total volume of supply and exhaust air needed, which in turn lowers total energy costs.















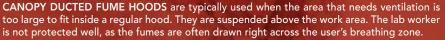


















### LAB MANAGER MAGAZINE'S INDEPENDENT GUIDE TO PURCHASING A LAB FUME HOOD

Purchasing the correct Fume Hood for your laboratory is a very important, long-term decision and your choice in lab ventilation systems will affect future lab planning, flexibility and safety. There are three main questions you should ask before proceeding through this guide: What level of protection will the lab worker require? What is the face velocity needed for the experiment? What materials are going to be used under the hood? You should also take into consideration the space you have available for the fume hood. This guide will introduce the four main fume hood types available. Read about each one and then proceed to the appropriate sub categories where you will find an unbiased list of all the models from all manufacturers that may suit your needs.

DUCTLESS FUME HOODS are single enclosed units that require no duct work or fixed installation. They remove fumes, vapors and particles from both the experiment and the lab worker by filtering them through a combination of HEPA and

BENCHTOP DUCTLESS FUME HOODS offer a very convenient alternative to traditional ducted fume hoods as they can be placed on rolling carts and moved around the lab as required, or permanently mounted to a bench. The lab worker is protected as the fumes are drawn back, up and away while clean air is recirculated back into the lab after being filtered.







































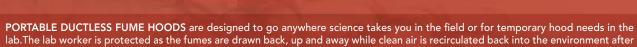


DOWN FLOW WORKSTATIONS direct air in the opposite direction as most other hoods; they push it down. The air containing powders or chemicals with high molecular weights are swept into the base of the workstation, protecting the lab worker by removing



















of BSC's available: Class I, II and III; some with additional sub-class levels. These classes are designated by the National Sanitation Foundation.

CLASS I BIOLOGICAL SAFETY CABINETS have an un-recirculated airflow away from the lab worker that, after going through a HEPA filter, is vented into the atmosphere. They provide the lab worker adequate protection but do not protect the samples in the cabinet from contamination.



































BIOLOGICAL SAFETY CABINETS provide effective containment for lab workers working with human pathogens. There are three separate classes

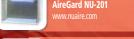
working with microorganisms in containment levels 2, 3 and 4 labs. They are divided into two types, A and B, dete rmined by their construction, airflow velocities, patterns and exhaust systems. They protect the lab worker, samples and the external environment.

CLASS II BIOLOGICAL SAFETY CABINETS are used when





creating clean air spaces.









LAMINAR FLOW HOODS provide clean air via a HEPA filter to the

prevents surrounding room air from entering. The air flowing out

of the hood also suspends and removes contaminants and particles

HORIZONTAL LAMINAR FLOW HOODS bring in external air through

a pre-filter, and HEPA filter then push it in horizontal lines outward

from particle contamination, these hoods are not intended to protect

from the back of the hood workspace. While this protects the samples

lab bench space and a constant air flow out of the work area, which

PCR ENCLOSURES are designed specifically to provide a Class 5 work space for PCR experiments by moving HEPA filtered air downward. What makes them unique is a UV light that eliminates DNA and RNA contaminants.





















VERTICAL LAMINAR FLOW HOODS move air down from the top of the unit in a vertical line through a HEPA filter to the bottom intake. A blower then pushes the air back up to a HEPA filter exhaust. While this protects the samples from particle contamination, these hoods are not intended to protect the lab worker.





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carbon filters and exhausting them safely back into the lab air.











































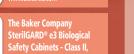
CLASS III BIOLOGICAL SAFETY CABINETS have both HEPA-filtered supply and exhaust air and are totally enclosed and gas tight while work is performed using long sleeved gloves. The cabinet is kept under negative pressure of at least 120 Pa while an exterior exhaust system maintains airflow. This protects the lab worker, the samples and the external environment.











# NO SHORTAGE OF METHODS; THE CHOICE DEPENDS ON THE SAMPLE

by Angelo DePalma

Milling and grinding are common operations in the manufacture of foods, chemicals, materials, and other products, and equally important at the laboratory scale. Benchtop devices that reduce particle size are essential for maximizing a sample's surface area, and thus a lab's ability to extract or quantify analytes.

#### "BENCHTOP DEVICES THAT REDUCE PARTICLE SIZE ARE ESSENTIAL FOR MAXIMIZING A SAMPLE'S SURFACE AREA."

Grinding may seem low tech, but engineers have still not fully characterized it mathematically, as exemplified by three grinding equations (based on particle size): Kick's Law (for particles larger than 50 mm in size); Bond's Law (about 50 mm down to 0.05 mm); and Rittinger's Law (below 0.05 mm).

## Common laboratory grinder/miller types include:

- Ball grinders, which use metallic or ceramic spheres to reduce sample size
- Cutting mills (similar to kitchen blenders), popular for preparing biological materials
- · Jaw crushers, useful for brittle materials
- Colloid mills, in which samples are sheared and ground between two teeth (one stationary, the other rotating at high speed)
- · Disk mills, which rely on pressure and shearing forces
- Roll mills, for testing polymers
- · Centrifugal mills, used for soft to medium-hard fibrous materials
- Cyclone, cryogenic, and jet mills, described here in detail

#### Look Ma, no media!

Sample prep milling is big in the feed and grain industries, where producers check lots for moisture, protein, macro-

and micronutrients, herbicide and pesticide residues, and natural contaminants like aflatoxin. One customer of sample preparation specialty firm UDY (Fort Collins, Colo.) grinds dry alfalfa pellets and tests them for protein, moisture, neutral detergent fiber (NDF), and acid detergent fiber (ADF). Wheat is similarly tested for protein, moisture, and gluten.

"The idea of milling is to get a sample that is homogeneous in terms of content and particle size," says company president Bill Lear. "People who do near infrared (NIR) analysis, for example, use our grinders to get consistent particle sizes."

Like most grinders, UDY's Cyclone mill is versatile in its handling of pharmaceuticals, detergents, fertilizers, plastics, coal, wood chips, and friable materials, as well as with the company's specialty (grains and forage crops). The mill uses high-speed air and an impeller rotating at 13,000 rpm to project particles into a grinding ring. Particles remain inside this chamber until impact with the impeller, chamber, or other particles renders them small enough to squeeze through a screen of desired mesh size. Holes range in size from 0.2 mm to 3 mm. Material exiting through the screen is collected in a sample bottle.

#### "THE IDEA OF MILLING IS TO GET A SAMPLE THAT IS HOMOGENEOUS IN TERMS OF CONTENT AND PARTICLE SIZE."

Maintaining sample integrity is a recurrent theme in milling and grinding, particularly with mechanical milling. "People try coffee grinders from Wal-Mart and don't understand the mechanics of it, the heat they impart to samples," notes Lear.

Jet mills also use no grinding media. Size reduction occurs through high-energy collisions between the particles themselves, which are propelled around the sample chamber at nearly the speed of sound. Jet Pulverizer's (Moorestown, N.J.) Micron-Master® jet energy mill recirculates oversized

particles. As the particles progressively lose mass, they migrate toward a discharge port, which allows precise control over and classification of particle size. Since jet mills use no moving parts or screens and generate little heat, they work exceptionally well with heat-sensitive materials.

#### Deep freeze

Cryogenic grinders, also called freezer mills, process materials that are first rendered brittle at low temperature and then pulverized. Freezing of samples before milling maintains chemical integrity. SPEX SamplePrep (Metuchen, N.J.) offers two models, the Freezer/Mill® 6770 and 6880, which handle samples of up to 5 grams and 100 grams, respectively.

#### "MAINTAINING SAMPLE INTEGRITY IS A RECURRENT THEME IN MILLING AND GRINDING."

Freezer mills create powders from virtually any material, including such intractable substances as rubber bands and cotton. SPEX has a video on YouTube (see http://bit.ly/3J5JaT) that demonstrates how leather can be reduced to a talc-like powder. Samples placed in disposable sample

vials along with a metal impactor are first immersed in a liquid nitrogen chamber, and the impactor is driven magnetically back and forth into the sample.

Applications include biotechnology, materials, chemistry, geology, extraction of DNA from rocks, plant research, and pharmaceuticals. According to SPEX sales manager Keith Tucker, Freezer/Mills are a favorite with forensics labs. "The FBI has 30 of our instruments," he says. One academic customer used the Freezer/Grinder to prepare samples from the bones of Tsar Nicholas of Russia, who died 90 years ago. The grinder has similarly been used to identify crime victims, analyze moon rocks, and prepare bone tissues for surgical transplantation.

A cryogenic grinder costs somewhat more than a typical laboratory ball mill but, says Tucker, "They allow you to grind the ungrindables. What good is a \$200,000 analytical instrument if you can't prepare a decent sample to put into it? Think of cryogenic grinding as the last resort in particle size reduction."

Angelo DePalma holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. A full-time freelance writer for more than 20 years, Angelo has written nearly 2,000 trade magazine articles on pharmaceuticals, biotechnology, materials, and supporting industries. You can reach him at angelo@adepalma.com

#### Milling/Grinding Suppliers

BioSpec Products, Inc.	Bartlesville	OK	800-617-3363	www.biospec.com
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E.A. Fischione Instruments	Export	PA	724-325-5444	www.fischione.com
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FOSS in North America	Eden Prairie	MN	952-974-9892	www.foss.dk
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SPEX SamplePrep/Certiprep	Metuchen	NJ	732-549-7144	www.spexcsp.com
Spectrum Chemicals & Laboratory F	Products	Gardena	CA	800-772-8786 www.spectrumchemical.com
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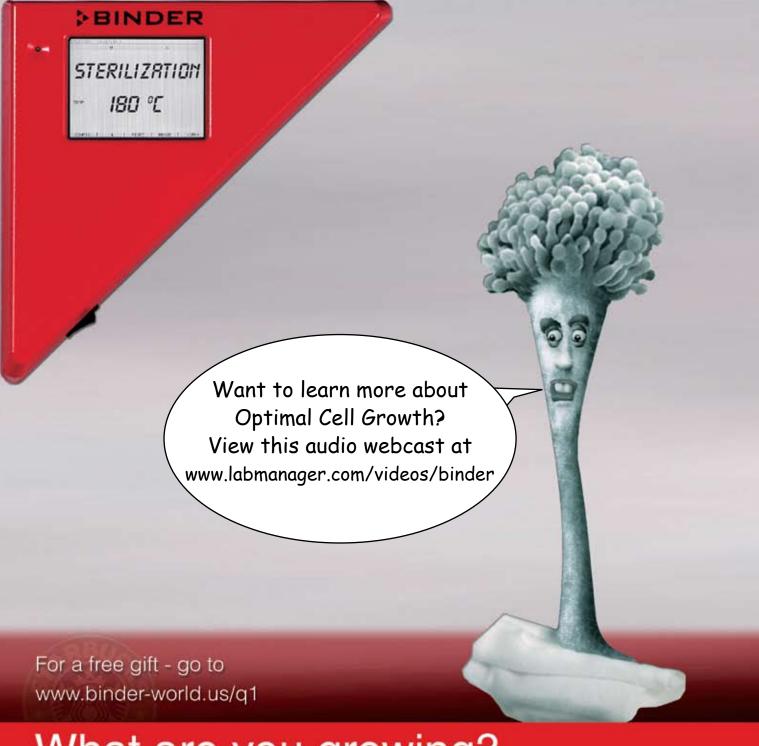
Initially, Kinetex columns are available in two particle sizes: 2.6- and 1.7-micron; and three chemistries: C18, PFP and HILIC. Methods developed with either 2.6- or 1.7-micron Kinetex columns are scalable and can be transferred to any LC system using the 2.6-micron column, regardless of the instrument's pressure capability.

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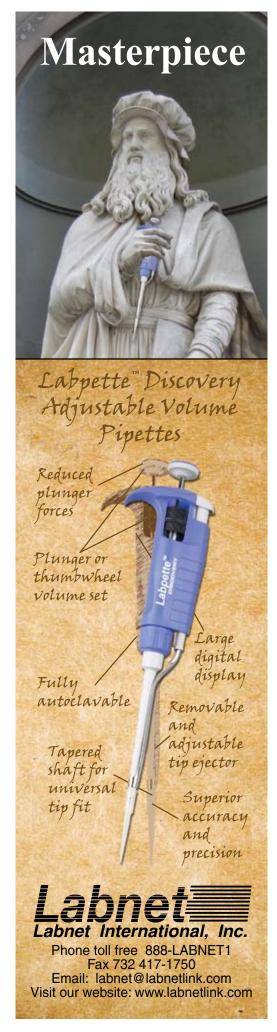
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# **OUTSOURCING**

FACTORS TO CONSIDER WHEN DECIDING WHETHER TO OUTSOURCE LABORATORY WORK by John K. Borchardt

Outsourcing has long been a hot-button issue for lab managers. When deciding whether or not to outsource a project or type of work, laboratory managers have to consider issues such as amount and quality of work required, staffing levels, staff attrition, cost/benefit analyses, and the cost and time required to effectively manage the business relationship with the company to which work has been outsourced. There is also the issue of the effect of outsourcing on lab staff morale to be considered. Outsourcing laboratory work is usually done on the assumption that another laboratory is able to perform the work more cheaply and/or more rapidly while maintaining adequate quality of the results. Laboratory managers must study other laboratories to determine if this assumption is correct before outsourcing work to them.

"OUTSOURCING LABORATORY
WORK IS USUALLY DONE ON THE
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MORE RAPIDLY."

However, before discussing outsourcing it is worth-while to review some definitions. Many regard the terms "outsourcing" and "offshoring" to be synonymous. Such is not the case. For the purposes of this discussion, "outsourcing" occurs when the laboratory manager chooses an outside organization to do work rather than performing it in his or her own laboratory. The communication of instructions and deadlines and the receipt of results are processes that must be carefully managed. Offshoring is the transfer of work from one country to another.

To simplify the discussion below, the outsourcing laboratory is the one *from* which the work will be outsourced. The receiving laboratory is the one *to* which the work will be outsourced.

#### **Factors to consider**

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The most critical question for the laboratory manager of the outsourcing laboratory to consider is whether outsourcing a piece of work—a particular procedure or analysis or an entire project—will reduce costs or accelerate progress toward the laboratory's goals. If neither of these requirements is met, the work should remain in-house.

Another factor to consider is whether the outsourcing will "hollow out" the laboratory's capabilities to pursue important projects in the future. Initially, outsourcing may involve routine, repetitive work that allows personnel at the outsourcing laboratory to focus on more critical, challenging research. However, it is the tendency at some outsourcing laboratories to increasingly outsource more sophisticated work. The laboratory manager needs to consider both short-term and long-term aspects of outsourcing more sophisticated work. For example, their most accomplished staff members may leave the laboratory for more challenging work with another employer if challenging R&D work is outsourced. Thus, outsourcing can negatively impact a laboratory's ability to work on sophisticated, challenging projects.

The decision about whether or not to outsource a particular activity may vary from company to company. This decision depends on the following key considerations:

- What is the ability of the receiving laboratory staff to do the needed work? This is the most important question for the outsourced work should be performed by experienced, capable scientists and technicians with up-to-date skills. In the case of overseas laboratories in rapidly developing countries, sometimes the age of the laboratory provides a clue to that staff's experience level. New laboratories may be staffed largely by recent graduates with little professional experience. Complicated assignments with complex requirements should not be performed by inexperienced personnel.
- The outsourcing laboratory manager needs to monitor the work to be sure it meets quality requirements and is completed in a timely fashion. When the outsourcing is unsuccessful the work may need to be repeated, with a consequent loss of time.
- Another consideration is the extent to which the outsourcing laboratory manager can establish an effective working relationship with the receiving laboratory manager and staff. Effective communications with them are essential (see below).

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#### **Outsourcing options**

The receiving laboratory performing the outsourced work may be located in the outsourcing laboratory's country or in another country. Geographic proximity offers several advantages when outsourcing. Travel between the two laboratories is faster, more economical and often less complicated than when traveling to another country, going through customs, etc. Of course the telephone, e-mail, text messaging and videoconferencing can eliminate the need for much business travel.

Time is related to distance. Laboratories in the lower 48 states of the U.S., Canada and Mexico are separated by four time zones at most. So there is a substantial overlap of their workdays and little inconvenience is involved in conducting a videoconference or conference call. However, the workdays of U.S. laboratories and those in India, China and some other Asian countries do not overlap. Arranging a conference call means that one party has to participate during what is to them the middle of the night.

Language barriers are seldom an issue when the laboratories are in the same country. The same is not true when the laboratories exist in two different countries. Even when personnel at both laboratories speak English, accents and colloquialisms can complicate communication.

# "GEOGRAPHIC PROXIMITY OFFERS SEVERAL ADVANTAGES WHEN OUTSOURCING."

In the last decade pharmaceutical companies have increasingly used laboratories and organizations in India to conduct process development work, contract manufacturing and clinical trials. Basic drug discovery research is increasingly being performed in India. A growing amount of chemical research and product development is being outsourced to laboratories in China. Companies doing this outsourcing have to deal with the problems outlined in the two previous paragraphs.



Sometimes the same company owns the offshore receiving laboratory and the laboratory doing the outsourcing. In this case the information exchange between the two laboratories can be on a deeper and more complete level than if the two laboratories are owned by different organizations.

Costs of performing offshored work are usually lower when the work is performed in a low-wage country than when the work is performed in a laboratory located in the same country as the laboratory outsourcing the work. However, productivity of the receiving laboratory in the same country may be greater due in part to the greater ease of communication of the two laboratories.

Choosing the laboratory to which you will outsource work requires assessing its ability to perform the specific work involved. The quality of the receiving laboratory staff, equipment and instruments available is critical. Test methodology used by the two laboratories must be the same. Receiving laboratory staff members may have a higher assessment of their own capabilities than

is justified. This may lead them to accept assignments beyond their capabilities. Hence, lab managers need to be careful in determining just what these capabilities are. They must continually monitor the quality of the work results they receive to ensure that a receiving laboratory that initially delivered adequate quality work does not allow its standards to decline. One possible cause of a decline in work standards is staff turnover in the receiving laboratory. Hence, laboratory managers should continuously monitor just who is performing the work being outsourced. Should names of report authors change, the laboratory manager should determine why and ensure

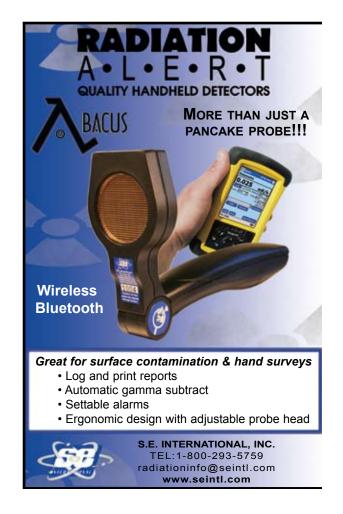
#### "TO FULLY EMBRACE EMERGING TECHNOLOGIES, SCIENTISTS ARE INCREASINGLY RELIANT ON OUTSOURCING TO CONTRACT TECHNOLOGY PROVIDERS."

that work quality has not declined.

This assessment is essential, but alone it is not enough. It is important to conduct an in-depth review of candidate receiving laboratories to determine if their goals and business practices are compatible with those of your laboratory. Differences in corporate culture can make business relationships difficult, and disagreements are more likely to arise when there isn't a good match between workplace cultures. When work is offshored, language barriers can hinder communication and lead to incorrectly performed work and wasted time and money. It is always important to make sure that receiving laboratory staff thoroughly understand your requirements and deadlines. This must be done with particular care if the native language of the receiving laboratory staff is different than that of your own staff. In an effort to be pleasant, in some countries laboratory staff will indicate they understand your requirements when they actually do not. Laboratory managers will need to use open-ended questions to verify whether this understanding actually exists.

#### A different rationale for outsourcing

Outsourcing solely to cut costs is an appealing transitional tactic to meet quarterly profit numbers. However, outsourcing based on this rationale is only sustainable if wages remain low in countries where this outsourced



work is done. Such is not the case for countries that currently are the most popular destinations for offshored R&D work, such as India and China where salaries are increasing more rapidly than in the U.S. and Canada.

What can be a sustainable outsourcing model is to outsource to laboratories that have capabilities your own laboratory lacks, such as expensive instruments and highly trained personnel to operate them, or proprietary technology that allows work to be done more cost effectively than in your own laboratory. For instance, according to life scientists Franz Pichler and Susan Turner (University of Auckland), "The rapid development of ever more complex and expensive technology coupled with the increasingly competitive environment in the life sciences is changing both how we access technology and how we conduct research. It is no longer possible to expect every technology to be readily available within a research institution, let alone a laboratory, yet access to such technology is often the difference between success and failure within today's competitive funding models. To fully embrace emerging technologies, scientists are increasingly reliant on outsourcing to contract technology providers (CTPs). In this context, CTPs are companies or institutes that conduct partial or entire experiments on a commercial basis."2

One example of this approach is an R&D venture established by Eli Lilly and Versant in 2001, Chorus.<sup>3</sup> To reduce the costs of new drug development, Chorus scientists attempt to fail drug candidates early in the drug development process rather than later, after large amounts of money have been spent. Claims have been made that Chorus scientists can reduce the time for certain drugs to reach proof of concept by 12 to 18 months, resulting in major cost as well as time savings.

#### **Cost/benefit analyses**

In determining the costs of outsourcing, the cost of the laboratory manager's time spent determining outsourcing requirements, assessing receiving laboratories' capabilities, and establishing the business relationship and signing contracts must be included.

Results in the information technology (IT) sector indicate that management and administrative costs of outsourcing have been much higher than initially projected. Studies indicate it can be quite difficult to capture all costs associated with outsourcing. Therefore, laboratory managers should decide to outsource work only after careful thought and study.

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# INTELLECTUAL PROPERTY CONCERNS ASSOCIATED WITH OUTSOURCING

#### By John K. Borchardt

According to an R & D Magazine 2007 survey of its readers, about 84 percent of U.S. outsourcing had been to other U.S.-based organizations while Asian and European organizations are taking an increasing share of U.S. outsourcing work. With an increasing number of U.S. companies outsourcing part of their R&D to laboratories located in other countries with different patent laws and different philosophies regarding intellectual property, laboratory managers need to be concerned about the risks this outsourcing involves with regard to protection of their intellectual property.

Steps that firms can take to protect their intellectual property include patenting inventions in the countries where they outsource R&D work and dividing R&D work into segments outsourced to different laboratories. Using this strategy, one laboratory does not have detailed knowledge of all the "pieces" of an invention.

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# WHEN GROWTH

**RECESSION RECOVERY SCENARIOS AND WHAT** MANAGERS SHOULD DO IN THE MEANTIME

Sales and revenue growth are stalled at many companies in a variety of industries. As a result, these firms have frozen or reduced laboratory budgets and in some cases have reduced laboratory staffing levels. There are several ways laboratory managers can effectively respond to these situations in order to maintain laboratory productivity.

#### Alignment

Laboratory managers must work with their staffs to be sure that each work group's goals and each individual's work goals are clearly linked to the broader strategic goals of the organization. This is more critical than ever when growth stalls. These goals can change in the wake of staff reductions and company reorganizations. So laboratory managers should reassess their staff members' goals to be sure that they are still consistent with the changed overall goals of the laboratory and organization. All employees need to understand the company's strategy and objectives, as well as how their contributions will help the company meet its goals.

If you need to rebuild work teams after some members have lost their jobs, follow the advice in Reference 1.

#### Morale and communications

In uncertain economic times and especially after staff reductions, laboratory staff members want and need strong leadership. To be effective, leadership must be seen. So spend time with your work groups and staff members. Effective leadership has a powerful effect on staff morale. Low morale can devastate productivity.

Low morale immediately after the announcement of bad news such as staff reductions or a salary freeze is natural. Be sure that your own behavior isn't the cause of low morale. Giving recognition for excellent performance can improve morale. Even sincerely saying "good work" or "excellent" after hearing a report from a staff member or work group can be beneficial. However, avoid giving overly frequent, insincere thanks.

Clear communications are essential to effective leadership. People's listening skills are often less effective in stressful situations, so managers may need to explain some things more than once. They need to communicate some things both in writing and orally. In particular, they should carefully explain any laboratory reorganization and the rationale behind it. They should share their expectations for staff performance and progress on projects. Coaching employees is more important than ever. Some employees will procrastinate on assignments out of a fear of making mistakes. Coaching can reduce this problem.

Laboratory managers should be sure that they are concentrating on the important tasks and not merely time-consuming ones. They need to streamline work processes and eliminate lessimportant, time-consuming staff duties. They should reexamine the metrics they are using to be sure that they are measuring what is important and not merely what is easy to measure.

#### Other strategies

Scott Anthony, president of the consulting firm Innosight, advises companies to learn how to "fail cheap."<sup>2</sup>



Lowering the cost of experiments is one way to do so. For example, increased investment in computer software to simulate manufacturing processes and product behavior can reduce costs, compared to performing extensive physical research aimed at optimizing manufacturing processes and product performance. (Of course, actual physical testing shouldn't be eliminated entirely.) The time required to build staff expertise in simulation may make outsourcing this work an appropriate option.

Another way to "fail cheap" is to increase the pace of decision making. This can reduce the amount of time spent on projects that are not achieving the desired goals.

#### The recession

This recession probably will not be one of short duration.<sup>3</sup> The depth of the economic downturn means that it will take years to eat up the slack created by the recession. Nearly half of the 54 economists surveyed by the *Wall Street Journal* forecast that it will take three to four years to close the output gap, while more than a quarter say it will take five to six years.<sup>4</sup> Daniel Vasell, CEO of pharmaceutical company Novartis, commented that he anticipates it will take the U.S. and European economies "two to three years to come out of this."<sup>5</sup>

# "LABORATORY MANAGERS SHOULD REASSESS THEIR STAFF MEMBERS' GOALS TO BE SURE THAT THEY ARE STILL CONSISTENT WITH THE CHANGED OVERALL GOALS OF THE LABORATORY AND ORGANIZATION."

The nature of the business recovery can have a major effect on the best strategies to use in managing your laboratory. According to a July 26, 2009 *Wall Street Journal* article, economists have developed five different basic economic scenarios for the coming months.<sup>4</sup> They all present laboratory managers with challenges and opportunities. These scenarios are discussed in the following sections.

#### The jobless recovery

In this scenario, the recession (in terms of gross domestic product decline) ends soon, probably before the end of 2009. The scenario is the most widely held

view among the 54 economists that the *Wall Street Journal* surveyed.<sup>3</sup> They forecast a long, slow business recovery. Employers will be slow to hire due to uncertainty about the strength of this recovery.<sup>4</sup> Jobless recoveries have become common since World War II. For example, unemployment rose for more than a year after the 1990-1991 recession. A jobless recovery is, of course, very bad news in terms of hiring students and out-of-work scientists, engineers and technicians.

# "[MANAGERS] SHOULD REEXAMINE THE METRICS THEY ARE USING TO BE SURE THAT THEY ARE MEASURING WHAT IS IMPORTANT AND NOT MERELY WHAT IS EASY TO MEASURE."

Both consumers who are worried about their own job security and those who are unemployed will continue to restrict their spending. Companies producing goods and services that even unemployed people need to survive and the laboratories that support these companies are more likely to do well in a jobless recovery than are companies producing discretionary spending items. For example, companies that produce food and household cleaning and maintenance items are more likely to do well than are companies producing vehicles, furniture and other costly discretionary items. Firms that manufacture raw materials and ingredients for products seen as necessities are also more likely to do well. For example, firms supplying electronic chemicals and rare metals may do well, as people are increasingly dependent upon mobile communication devices such as cell phones. Cheaper alternatives to costlier products are also selling well. For instance, inexpensive, highly portable netbook computers are selling briskly despite current business conditions.

Several industries will probably face lingering adverse effects from the recession that will show up in their laboratory budgets. For example, pharmaceutical companies will likely face increased competition from less expensive generic drugs. Another factor that could depress drug sales is that many people who have lost their jobs have also lost their medical benefits and may cease taking their medications. U.S. gasoline and diesel fuel consumption has declined. Lower oil prices have greatly depressed refinery margins, and laboratories serving oil

refineries have less work. Lower oil and natural gas prices have substantially reduced well drilling, particularly in North America. As a result, companies selling chemicals, equipment and services to the oil and gas industry have seen their revenues sharply decline and have reduced laboratory budgets and staffing.

Laboratory managers serving industries that are recovering nicely from the recession and seeing their workloads increase can more effectively make the case for increased budgets to support overtime work. While top management may still be reluctant to hire new laboratory staff members until they become more certain of economic trends, these laboratory managers may be able to make the case for funds to support outsourcing or hiring temporary laboratory staff.

#### The V-shaped recovery

The so-called V-shaped recovery is a rapid growth of sales and profits to prerecession levels, followed by continued economic growth. This is the kind of economic recovery everyone hopes to see and is the second most common prediction of the *Wall Street Journal* panel of economists.<sup>3</sup> While growth rates will vary from one sector to another, laboratory managers could see their budgets return to prerecession levels fairly quickly, giving them the flexibility to hire new staff members. However, one issue they could face may be becoming victims of their own success in managing to maintain good progress with a smaller staff. If a laboratory manager is able to maintain new product commercialization rates and



technical service levels with a reduced staff and budget, it may be difficult to convince top level management that additional laboratory staff members and an increased budget are needed.

#### **Hyperinflation**

The huge budget deficits in the U.S., Europe and Japan caused by economic bailout programs could result in hyperinflation.<sup>3</sup> To pay their debts, the governments of these countries may print more money, further fueling inflation. In this case, prices would rise and the purchasing power of consumers and businesses would decline. Hyperinflation could substantially raise interest rates and make borrowing funds needed to expand businesses more difficult. Firms that borrowed heavily to finance mergers and acquisitions could benefit by paying off their loans with these inflated dollars.

As their money is worth less, consumers purchase smaller amounts of goods and services. This could lead to a W-shaped economic curve, in which gross domestic product first increases as a result of economic recovery; hyperinflation makes further business expansion more difficult, and then the gross domestic product declines as the nation again slips into recession. This scenario results in a long-lasting second recession on the heels of the first.

An increase in commodity prices means that the companies that produce those commodities (and their laboratories) will do well. These companies include those producing food and other agricultural products, as well as oil companies and oil field services firms.

The impact on laboratories is the same as the jobless recovery. Laboratory managers who increase spending levels and hiring during the recovery phase could find themselves in difficulty when the economy turns down again. It could become necessary to again reduce laboratory spending and staffing levels. Having a second staff reduction, even a small one, within months of the first can have a very negative impact on laboratory staff morale, engagement and productivity.

#### **Deflationary spiral**

Deflation is an increase in the value of money. With decreased demand associated with a recession, companies may have excess production capacity for many products. They reduce their prices to promote sales.<sup>3</sup> Justin Lin, the World Bank's chief economist, has said, "Significant excess capacity has built up, and unless this is addressed, we will face a deflationary cycle and the

[economic] crisis will become protracted."6

Consumers and companies, and their laboratories, may delay purchases, expecting that prices will decline further or business conditions and their profits will improve.

#### Decoupling of U.S. and foreign economies

Decoupling of the U.S. domestic economy and rapidly growing economies such as those in China and India could mean that countries could recover from the recession at greatly different rates.<sup>3</sup> One such scenario has the U.S. recovery lagging those in some other countries. Currently, China and India still have growing economies, although the rate of expansion is substantially lower now than in the first several months of 2008. Rising incomes in China, India and some other countries could promote sales of U.S. agricultural products and equipment companies that make products that improve farming efficiency.

Each of these economic scenarios will affect laboratory budgets, hiring, and instrument and equipment purchases differently. Effects will vary for laboratories serv-

ing different industries. Special factors such as corporate indebtedness also can intensify or mitigate the degree to which these scenarios affect individual companies' laboratories. These scenarios will also affect venture capital availability, an important consideration for laboratories associated with start-up companies.

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# LAB DIRECTOR, LARRY DECKER, JUGGLES A WIDE ASSORTMENT OF TASKS TO KEEP HIS LAB RUNNING SMOOTHLY

by Sara Goudarzi

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In order to protect the natural environment, namely air, water and land, the federal government and each individual state have set environmental regulations. If a plot of land is to be developed or a site is being monitored by state or federal agencies, contracted firms will take samples of the soil and water to find out what kinds of hazardous sub-

stances, if any, are on the property.

Those samples are then sent to environmental laboratories for analyses. TestAmerica Laboratories, Inc. is one such environmental testing firm.

"We have clients that sample monitoring wells or do all sorts of drilling into the soil, then send us samples to determine the level of contamination," says Larry Decker, the lab director of the Connecticut facility.

The clients may install monitoring wells that need to be watched for years. Decker and his team analyze and report any pertinent analytical information related to samples from the wells. These results are needed to remediate the property.

For instance, if the land is a brown-field—an abandoned property previously used for commercial or industrial purposes and potentially having levels of contamination—and the owners want to sell it, they need to make sure it's free of any environmental contamination before it's placed on the market.

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TestAmerica will analyze components of the land, water and air so its clients can decide what should be done with the property.

"All of our results are not just numbers," Decker says. "We have to have supporting documentation and quality control, what we call a 'data package,' which is a lot of the background information on the calibration and the methodology that is defensible in court."

By far the largest environmental lab company in the nation, TestAmerica has 37 environmental testing labs and 29 service centers. The company specializes in air, aquatic toxicity, explosives, specialty organics, dioxins, drinking water, sediments and tissues, emerging contaminants, radiochemistry, and

mixed-waste testing.

"[In the Connecticut location] we analyze soils, wastewater [and] monitoring wells," Decker says.

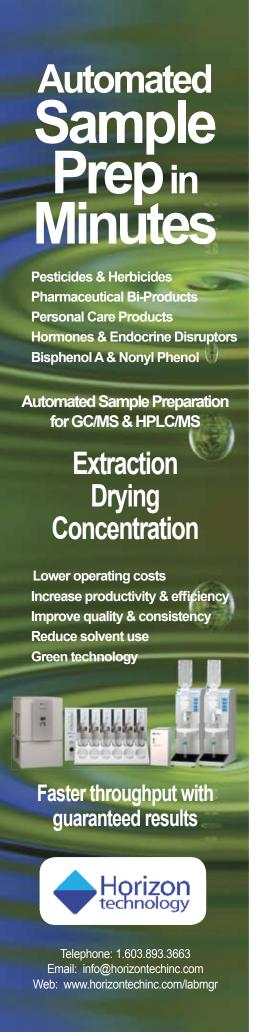
"[OUR CLIENTS] LOVE
THE FACT THAT THEY
HAVE A COURIER WHO
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"However, if it's a test that's not performed on location, the client can send sample to the Connecticut lab and the staff [will] move it to another TestAmerica location with that specialty."

"This type [of] project management keeps the analytical data seamless for the client—one-stop shopping."

Decker's lab, one of the smaller ones in TestAmerica's network, processes thousands of samples each month and serves eight states—Connecticut, Maine, New Hampshire, Vermont, New York, New Jersey, Rhode Island and Utah. Clients can use either overnight shipping or the lab's courier service to get their samples to his team.

"We have vans that go out to about a two-hour radius picking up samples," Decker says. "If they are beyond that distance, we have sister laboratories in Edison, New Jersey, and Westfield, Massachusetts, that will assist Connecticut with logistics.



"The courier service may sound trivial, but when your clients are out in the field sampling all day long, at the end of the day they want to get as much time in the field as they can without worrying about securely packing the samples and finding a convenient overnight shipping facility," Decker says.

Additionally, some samples must be collected in glass bottles and stored in a cooler with ice, which makes breakage very likely during shipping if samples have not been packed properly.

"So [our clients] love the fact that they have a courier who takes their samples on a van, out of their hands so they don't have to worry about it," Decker explains. "I have been told by some very happy clients that the couriers are a welcome sight around quitting time."

To strengthen its local presence even more, TestAmerica has strategically placed service centers in Albany, New York, and Boston, Massachusetts. These service centers are staffed with seasoned experts in the environmental field, capable of assisting clients with project management.

#### Lab structure

With an area of 16,000 square feet and about 40 staff members consisting of scientists and support personnel, the Connecticut facility is equipped to provide services such as RCRA waste characterization and groundwater monitoring, among others.

The laboratory consists of seven departments: sample control, classical chemistry department, extractions laboratory, gas chromatography (PCB and pesticides/

CT-ETPH and DRO), semi-volatile department, volatiles department and metals department.

"When samples come into the laboratory, they have to be entered into our Laboratory Information Management System (LIMS)," Decker says. Sample control takes care of the staging, assigning a job number to each project and allocating a unique identification to each sample. Once the sample is in the LIMS system, all groups that might need to start work on the project can retrieve the necessary information.

"The tests required are usually worked out ahead of time with the client and project managers, but any given sample may have an extended list of requirements," Decker explains.

"THE TESTS REQUIRED ARE USUALLY WORKED OUT AHEAD OF TIME WITH THE CLIENT AND PROJECT MANAGERS, BUT ANY GIVEN SAMPLE MAY HAVE AN EXTENDED LIST OF REQUIREMENTS."

For example, a sample may need to be analyzed for a full list of metals and mercury. It may also need to be run for PCBs, pesticides, semi-volatile and volatile compounds, and an extended suite of classical chemistry analyses.

Once the chemists from various departments review what is logged into the LIMS system, each department assigned to work on a sample knows how to prepare it, the methodologies required and the instrumentation needed for analysis.

"Each project is unique, and special instructions are very valuable to the analysts," Decker says. "We have managers responsible for each department. I've got about eight direct reports and a couple of indirect ones such as IT and Health and Safety."



📤 Organic Extractions, Tim Failla

The expertise of the staff, most of whom have bachelor's degrees in the sciences, ranges from chemistry to biology to environmental sciences.

"We have a wide range of employees here—[people with] anywhere from high school diplomas to master's degrees," Decker says. "We [also] employ students currently in college and others taking courses for science degrees. Believe it or not, we have people here with a major in philosophy, but it all depends on where in the lab they are and their skill sets."

Although the educational background of each staff member is very specialized, Decker's management team works on training every individual to be reactive and ready to go if the person is needed in a different department. This helps ensure that the lab has enough people to handle the overall flow if one department needs additional staffing.

#### Inventory, maintenance and hiring

Like many other types of labs, Decker's lab consists of several inventory categories such as chemical supplies and reagents and items like glass bottles, beakers and coolers.

Clients collecting samples in the field receive a cooler on-site stocked with empty bottles. "That's an inventory we have to hold," Decker says. "You [also] have all your consumables, standards and chemicals that you have to have in a laboratory, which are very expensive."

There are also consignment inventories—items and equipment that Decker's staff keeps on-site but that are owned by the supplying company.

# "DECKER'S MANAGEMENT TEAM WORKS ON TRAINING EVERY INDIVIDUAL TO BE REACTIVE AND READY TO GO IF THE PERSON IS NEEDED IN A DIFFERENT DEPARTMENT."

To maintain the inventory, most managers place their orders through the general system, which goes into the corporate ordering form. Decker checks every order, but the managers have to keep an eye on their supplies and needs in each department.

"I have to check every order," he says. "In this day and age you have to



make sure you keep a lean inventory and you're ready to react if there is an increase in your backlog."

Instruments such as ICP/MS, ICP, mercury analyzers, GC/MS, ion chromatography, pH meters and autotitrators, among others, are regularly used in Decker's lab. For maintenance, he and his analysts try to resolve any issues themselves but rely heavily on the seasoned employees, who have been around for many years and possess high skill levels. If the issue is something the staff can't take care of in-house, they depend on their maintenance contracts.

#### "IN THIS DAY AND AGE YOU HAVE TO MAKE SURE YOU KEEP A LEAN INVENTORY AND YOU'RE READY TO REACT IF THERE IS AN INCREASE IN YOUR BACKLOG."

Hiring in Decker's lab is taken care of by human resources, Decker and department managers. When management recognizes that additional staff is needed, Decker will notify corporate human resources about posting the position on the company Web site. Candidates are interviewed by all the aforementioned before any decision is made.

"I'd like to meet everybody who comes in for an interview," Decker says. "I may not do the actual interviews, but I will go at least meet them and sometimes sit with them for a while and get a feel for [the candidates]."

At the moment, however, due to the state of the economy, Decker is seeing more stability in terms of turnover.

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## "AT THE MOMENT, HOWEVER, DUE TO THE STATE OF THE ECONOMY, DECKER IS SEEING MORE STABILITY IN TERMS OF TURNOVER."

"In the future, when the economy rebounds and people are finding more jobs, I think turnover will be higher, obviously," he says. "It's part of our job to try and do what we can to keep the career path on track so [our staff] enjoys their work."

### Management challenges and solutions

Decker admits that his biggest challenge is ensuring that he and his staff are giving each client a competitive edge in a tough economic marketplace.

"[Our clients] are bidding on projects all the time, and years ago there'd be maybe two or three consulting companies out there bidding on a project in their area; now they may be [up] against 12 consulting companies on a project they weren't even going after before," Decker says.

"It's a bigger field out there for them. So it's very competitive, and we have to make sure that we are on our game and we give them not only a fair price but the data and technical support and superior service, each and every time."

Luckily, Decker's employees really understand the needs of TestAmerica's clients. "The staff continues to find creative solutions to all challenges that are thrown our way," he says. "When we need help, we also have a phenomenal network of sister laboratories that can support our clients."

At times Decker's clients need re-

sults in 24 hours or less. In such cases, Decker once again relies on his organized and dedicated team.

"Unfortunately, we don't always get the schedule when they're sampling, so we rely on people who work overtime and work second shifts," he says. "I have to admit I really have a great group of people here, and we've been fortunate for many years with [this] group."

An important aspect of the job, Decker indicates, is morale. "We have to come in here and we have to enjoy what we do, love what we do, embrace it and move forward."

"It is a lot like playing a game; you have to enjoy playing the game. You're always looking ahead a few steps, trying to figure out what you're going to do next, and you have to be sure; you can't just sit around and wait. You have to really have constant improvement in a laboratory at all times."

In order to achieve this, Decker holds an operations meeting every morning to review the backlog, evaluate how each department is doing, pinpoint any issues, decide where they need to pull labor and identify the problem of the day. Decker and the managers then try to even out the load as best they can and also make sure that they can get results out to their clients in time.

Additionally, every month Decker spearheads a meeting that covers major achievements, in order to make people realize that there are some great things going on and



that there is no need to dwell on the problems.

"Communication is the buzzword," he adds. "We try to make sure that everybody understands what's going on with various projects. We must emphasize why the sampling project is so important for the client. Basically, we make sure that

everybody's on board with what's going on and [that] all the necessary information is disseminated throughout the groups within the lab," Decker explains.

Decker and his management team also organize events such as wellness fairs, picnics and luncheons for jobs well done during the course of a month—all attempts to make and keep the staff happy with their jobs.

All this is due to Decker's dedication to his job, a task that he makes a part of his life, whether he is in the lab or not.

"My day starts when I leave work," Decker says. "After my kids go to sleep and my wife is reading, I will usually log on and see what's going on with emails, just to keep track of them so I shouldn't have more than a few emails in the morning. [That's when] I like to get around and visit the lab, see what's going on in the laboratory, get a feel for it."

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A while back, in response to a reader's question regarding storage inside the exhaust cabinet, we wrote about the fundamentals of chemical fume hoods. In that article, we discussed the basic design principles and operation of chemical fume hoods. (If your memory is like ours and needs refreshing or you require another copy, just let us know.)

#### "EXHAUST HOODS ARE AMONG THE MAJOR EXPENSE ITEMS FOR RESEARCH LABORATORIES."

Since exhaust hoods are among the major expense items for research laboratories and have a huge impact on continuing operational costs, we've decided to provide you with information on some of the newer hood designs that offer good performance and energy conservation.

Laboratory exhaust systems fall into three main classes: chemical fume hoods, for working with corrosive acids and bases, volatile solvents, and other hazardous chemicals; biological safety hoods, which can be designed to protect the work (clean-air bench) or the worker (true biosafety cabinet);

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and standard exhaust hoods, typically used in mechanical or machine shops and their production areas. We are going to limit this discussion to the first category, the chemical fume hood, since this is the cornerstone of most research laboratories.

Laboratory fume hoods are designed to protect the worker by containing and exhausting harmful or toxic fumes, gases, or vapors emitted by chemicals used in the hood. A typical fume hood has an exhaust blower mounted so that air from the room is pulled into and through the hood, creating directional airflow. The "pull" at the hood opening is termed "face velocity" and usually is measured in feet per minute (fpm).

Proper face velocity of the hood is critical to the protection of the worker. Too little flow allows currents or disturbances in the laboratory air to overpower the hood and draw contaminants into the room. Too much flow can result in turbulence and eddies that also can lead to contaminants escaping the hood. Baffles and other aerodynamically designed components determine how air moves into and through the hood. Contaminants inside the hood are diluted with room

air and exhausted to the outside via the hood's duct system, where they are dispersed.

The volume of air exhausted by the hood depends on a number of factors, the most important of which are hood size and design. With the average chemical fume hood exhausting around 750 to 1,000 cubic feet per minute of conditioned air, you can see how hoods put a large load on the laboratory's heating, ventilating and air-conditioning (HVAC) system, thus impacting operational costs. Let's look at some of the different chemical fume hood designs available, along with their pros and cons.

#### Constant air volume (CAV)

There are two basic types of laboratory fume hoods: conventional and bypass. Conventional hoods consist of a basic enclosure with a movable sash (or window). Since the face velocity, or "pull," is a function of the total volume divided by the area of the sash opening, closing the sash on a conventional CAV hood will increase the face velocity. The conventional hood's performance depends primarily on sash position.

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However, as the sash is closed, velocities can increase to the point where they disturb instrumentation and delicate apparatuses, cool hot plates and slow reactions, or create turbulence that can force contaminants into the room.

to limit the openings; sash position and airflow sensors that can control mechanical baffles; small fans to create an air-curtain barrier in the operator's breathing zone; and refined aerodynamic designs and variable dual-baffle systems to maintain laminar (undis-

### "THE CHEMICAL FUME HOOD...IS THE CORNERSTONE OF MOST RESEARCH LABORATORIES."

Bypass hoods contain openings above the sash, in addition to an airfoil sill that will redirect the airflow as the sash is closed. The bypass openings reduce changes in face velocity to a narrow range by keeping the area for airflow equal (within the limits of the bypass) as the sash is moved up or down. Therefore, face velocities do not reach the detrimental levels often seen with conventional hoods. For this reason, bypass hoods hold a major share of the market today.

Recent models of bypass hoods, called high-performance or "low-flow" hoods, display improved containment and safety features as well as energy-saving designs. These design features vary by manufacturer but generally have one or more of the following: sash stops or horizontal-sliding sashes

turbed, nonturbulent) flow through the hood. Although the initial cost of a high-performance hood is slightly more than that of a conventional bypass hood, the improved containment and flow characteristics allow these hoods to operate at a face velocity as low as 60 fpm, which can translate into \$2,000 per year or more in energy savings, depending on hood size and sash settings.<sup>1</sup>

#### Reduced air volume (RAV)

In laboratory settings where the tasks may be very specific and unchanging, the reduced air volume hood (a variation of the low-flow hood) is an option to consider. This design incorporates a bypass block to partially close off the bypass, reducing the air volume and thus conserving energy. Usually, the block is combined with a sash stop to limit the height of the sash opening, ensuring a safe face velocity during normal operation while lowering the hood's air volume. By reducing the air volume, the RAV hood can operate with a smaller blower, which is another cost-saving advantage.

One downside to the RAV hood is that its restricted sash movement and

# "THE CONVENTIONAL HOOD'S PERFORMANCE DEPENDS PRIMARILY ON SASH POSITION."

reduced air volume also constrain its flexibility and narrow the realm of tasks that can be performed. Another major caution to note is the potential to override or disengage the sash stop. If this occurs, the face velocity could drop to an unsafe level. To counter this condition, operators must be trained never to override the sash stop while in use, and only to do so when loading or cleaning the hood. In addition, an airflow monitor is always recommended.

### "BYPASS HOODS HOLD A MAJOR SHARE OF THE MARKET TODAY."

#### Variable air volume (VAV)

The newest generations of laboratory fume hoods vary the volume of room air exhausted while maintaining the face velocity at a predetermined level. Variable air volume hoods change the exhaust volume using different methods, such as a damper or valve in the exhaust duct that opens and closes based on sash position, or a blower that changes speed to meet air-volume demands. Most VAV hoods integrate a modified bypass-block system that ensures adequate airflow at all sash positions. They are connected electronically to the laboratory building's HVAC, so hood exhaust and room supply are balanced. In addition, VAV hoods feature monitors and/or alarms that warn the operator of unsafe hood-airflow conditions.

Although VAV hoods are much more complex than traditional constant-volume hoods, and correspondingly have higher initial costs, they can provide considerable energy savings by reducing the total volume of conditioned air exhausted from the laboratory. Since most hoods are operated the entire time a laboratory is open, this can quickly add up to significant cost savings.

1. How to Select the Right Laboratory Hood System, Labconco Corp., Kansas City, Mo., 2003.

Chemical Fume Hood Handbook, Northwestern University, Chicago, Ill. Last revision, May 2007. http://www.research.northwestern.edu/research/ors/labsafe/hoods/index.htm

National Research Council Recommendations Concerning Chemical Hygiene in Laboratories, U.S. Department of Labor, Occupational Safety and Health Administration, Washington, DC. http://www.osha.gov/pls/oshaweb/owadisp.show\_document?p\_table=STANDARDS&p\_id=10107

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Vince McLeod is a certified industrial hygienist and the senior industrial hygienist with the University of Florida's Environmental Health & Safety division. He has more than 20 years of occupational health and safety experience in academic research, with a focus on the research laboratory. His specialties are hazard evaluation and exposure assessment.

# HOW IT WORKS O

# MULTIPLEXING TECHNOLOGY TO INCREASE THROUGHPUT IN LC/MS ANALYSIS

Problem: The popularity of mass spectrometers (MS) in the food, clinical research and pharmaceutical markets has pushed labs to seek ways to improve the speed of their liquid chromatography (LC), thus increasing the throughput of their MS. As mass spectrometers are used for a wider array of applications, labs are also seeking ways to improve the flexibility of their LC. Even while striving for the two above mentioned improvements, most labs are under budget constraints and have little or no more money to spend. This customer demand has driven suppliers to develop new products and techniques to help customers achieve their goals.

**Solution:** An innovative technology for increasing throughput is multiplexing. Multiplexing is the ability to simultaneously run multiple LC systems into a single mass spectrometer. This novel technique takes advantage of the time a MS typically spends idle by time-staggering the LC methods so that each one elutes in succession. The MS is dedicated to each LC elution, thus providing the same quality data as a single LC/MS method. A typical LC/ MS method using multiplexing will gain a two- to four-times throughput increase while still using a single MS. Therefore, productivity is increased substantially, cost increase is low and there is no negative effect on data quality. Note that some multiplexing products do not time-stagger the samples into the MS. These LC systems alter the pump pressure or sample the eluting stream. Both result in poor chromatography or reduced data.

A leading pharmaceutical company recently approached vendors in an attempt to find a solution to increase the throughput of their LC/MS. Their expected chromatography and analysis time was about 85 seconds, a throughput of 42 samples per hour. The company required increased throughput without any loss in data quality and without purchasing more mass spectrometers. Using the Thermo Scientific Transcend LX-4 system, they were able to quadruple the throughput to 168 samples per hour using a single MS/MS. An initial test run was setup and 6912 samples were run unattended over the weekend in 41 hours.

Some of today's multiplexing systems provide an additional benefit to complement their increased throughput. When each of the LC systems is individual and separate, they can be run simultaneously to increase throughput (as mentioned above) or each system can be set up and validated to a separate assay, allowing a scientist to choose which method to run without any change-over or set-up. With advanced multiplexing software now available, an LC/MS method can run on a single chan-



↑ The Thermo Scientific Transcend Multiplexing System

nel while another is started on any of the remaining LC systems. Even though the methods are started at different times, the multiplexing software will take advantage of the idle time of the MS and dynamically time-stagger the newly introduced method with the existing method(s) to achieve maximum throughput. Advanced multiplexing software can make dynamic decisions how to order samples to the MS to maximize throughput by priority status, time or system availability. For example, one option provides optimal performance for multimethod runs by starting the new samples as soon as the MS data collection window

allows. Another option completes all the samples in a batch with multiplexing before proceeding to multiplex the next batch.

The ability to run multiple methods on a two- or four-channel parallel system provides flexibility to meet today's demanding lab workflows. Demonstrated on a Transcend™ TLX-2 system, a method for simultaneous analysis of opiates and benzodiazepines for forensic toxicology testing was set-up. The system was used to run two LC-MS/MS methods, one for each class of compound. While different analytical columns were used for each method, the system utilized one set of solvents and one MS. Using Thermo Scientific Aria operating software, multiplexing technology and data windowing was used to enable these methods to be run simultaneously and robustly, leading to increased throughput with minimal operator intervention. Along with multiplexing, these methods also utilized Thermo Scientific TurboFlow technology for automated sample preparation allowing direct injection of the biological matrices into the LC/MS system.

Multiplexing products can help customers to substantially increase their LC/MS throughput without any loss in data quality and with a single MS. The technology also allows customers the flexibility to validate multiple methods on a single LC/MS multiplexing system, allowing scientists to choose and run completely separate methods without any change-over or set-up on their MS. These separate methods can be started at different times and will still run simultaneously to increase throughput.

By John Fink, Product Manager, Liquid Chromatography Systems, Thermo Scientific

For more information, please visit www.thermo.com/transcend.

# HOW IT WORKS O

VISCOMETER/RHEOMETER-ON-A-CHIP

Problem: Understanding the viscosity is a crucial aspect of manufacturing operations in many industries worldwide. In order to fulfill customer demands of product consistency and quality, viscosity measurement becomes even more important. Viscosity is the resistance to flow by definition. Numerous technologies or methods have been developed and used to measure the resistance. Those are spindle-rotation, acoustic, falling ball, and glass capillaries to name a few. These methods simply give "index" rather than measuring "the true viscosity" for non-Newtonian liquids for which viscosity changes with shear rate (or flow rate). This is because most of these technologies are designed for simple Newtonian liquids. However, non-Newtonian liquids comprise most liquid products in the world. Different methods measure different indexes for the same liquids. which make cross referencing extremely difficult. To measure true viscosity, users have to resort to more sophisticated rheometers. However, these instruments are expensive and require lengthy time and higher level of training for use.

Additional problems are that current viscometers require larger amount of sample volume and limited to narrow shear rates. Larger volume requirements make viscosity measurement very difficult for precious samples and even larger volume of cleaning solution needs to be consumed after test. Limited (or no) shear rate accessibility from these viscometers makes it impossible to characterize properly the liquid flow behavior during fast processes such as printing, coating, inkjetting, and spraying.



▲ RheoSense's new micro-liter viscometer using lab-on-a-chip technology

**Solution:** *m*-VROC® (Viscometer/ rheometer-on-a-chip) is state of the art viscometer that measures "true viscosity". Its measurement principle is based on pressure drop measurement of a flow in a well defined rectangular microfluidic channel: the principle is well described in numerous rheology textbooks (for example, Rheology Principles, Christopher W. Macosko). Liquid flow through the microfluidic channel generates resistance, which in turns generates pressure drop. By measuring the pressure drop at a known flow rate, viscosity is measured. By varying the flow rate, true viscosity is measured as a function of shear rate. With *m*-VROC (see photo above), viscosity measurement is easy and fast. Sample loaded into a syringe is pumped to flow to the VROC® chip in silver enclosure. As the flow rate is controlled by the syringe pump and the VROC® chip senses the pressure drop, thereby,

measuring viscosity.

In addition to the ability of measuring true viscosity, small measuring cell of VROC® enables viscosity measurement for small sample volume (as small as 50 microliters) and viscosity measurement at high shear rates. The VROC® chip has been used to measure wide range of liquids and viscosities.

The fast and easy-to-use *m*-VROC increases the test throughput. Accuracy and repeatability of the viscometer helps determine consistency to the next level.

For more information, go to www.kdscientific.com.

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### There's a lot of nanoscience at Pittcon.

"This is my seventh Pittcon. It's a unique opportunity to hear quality papers and interact with researchers presenting ideas relevant to my work. There are always excellent exhibits and training classes—and I'm delighted with the increased emphasis on nanoscience. This year the most exciting presentation was the Nanotechnology and Electron Microscopy Symposium from Japan. It was wonderful to experience the fruits of Pittcon's international sponsorship of high quality presentations."

WARREN LAYNE | Chemist, U.S. Environmental Protection Agency



# I appreciated the ability to investigate new methods and compare similar products.

"The exhibition was very beneficial. I was looking for new and improved methods for 5-day BOD analysis—and I found some! It was also good to meet the representatives of the companies we work with. I think that building and maintaining these relationships is important for both the companies and their clients."

NATALIE NICHOLS | Laboratory Associate, Illinois EPA



## Pittcon is a great place to learn new things.

"It's where we can learn about research that is underway and not yet complete, and learn about new areas, too. Pittcon is becoming increasingly interdisciplinary. You'll see physical chemists, biochemists, organic chemists, inorganic chemists and engineers walking the exhibit floor or giving lectures. And the lectures are absolutely first-rate, given by true experts—in many cases, pioneers in their fields."

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# HOW IT WORKS O

# CAPTURING MORE VOLATILE EPA METHOD 8270 COMPOUNDS

Problem: EPA Method 8270D is used to determine neutral, acidic, and basic semi-volatile organic compounds that are soluble in methylene chloride, such as polynuclear aromatic hydrocarbons, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols. In most cases, EPA Method 8270 is not appropriate for the quantitation of multicomponent analytes, such as N-Nitrosodimethylamine, Pyridine, and N-Nitrosodiethylamine, because of limited sensitivity for those analytes.

N-nitrosodimethylamine can be difficult to separate from the solvent, and N-nitrosodiphenylamine can decompose in the gas chromatographic inlet and cannot be separated from diphenylamine. Pyridine may perform poorly at the GC injection port temperatures listed in the method. Lowering the injection port temperature may reduce the amount of degradation. However, the analyst must use caution in modifying the injection port temperature, as the performance of other analytes may be adversely affected. Therefore, if pyridine is to be determined in addition to other target analytes, it may be necessary to perform separate analyses. In addition, pyridine may be lost during the evaporative concentration of the sample extract.

Solution: Using the Horizon Technology 8270 Carbon Cartridge Kit enables the capture of the more volatile 8270 compounds. The 8270 Carbon Cartridge Kit is designed for use with the Horizon Technology SPE-DEX® 4790 Automated Extractor System, and the Oasis® HLB (Hydrophilic-Lipophilic Balanced) solid phase extraction disk, developed by Horizon Technology and Waters Corporation. The SPE-DEX® 4790 system provides automatic extraction of liquid samples by solid phase extraction (SPE). Automating the sample preparation step through the use of SPE not only improves the quality and consistency of the results by minimizing

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operator to operator variation, but also offers the additional benefit of reduced solvent consumption by as



▲ EPA Method 8270 – Carbon Cartridge Kit

much as 70 percent as compared to the EPA Method 8270D's manually performed liquid-liquid extractions.

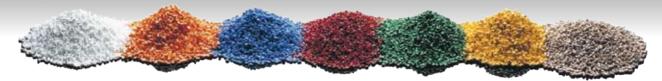
Since EPA Method 8270D has such an extensive analyte list of 243 semi-volatile organic compounds that range in volatility and polarity, the Oasis® HLB SPE disk is ideal as the sorbent used has both hydrophilic and lipophilic groups to maximize retention of these analytes. The 8270 Carbon Cartridge Kit is included down-stream of the SPE disk to scavenge the disk effluent of any analytes that were not retained by the disk. These analytes are typically volatile compounds such as nnitrosodimethylamine, N-nitrosomethylethylamine and methymethane sulfonate. The 8270 Carbon Cartridge is designed to accommodate the higher sample flow rates from the SPE disk without restrictions. In addition the disk effluent passes through the carbon cartridge in the back flush mode for fast extractions with reduced solvent usage. To date very good recoveries of 44 percent to 88 percent and 34 percent to 113 percent have been achieved for the more volatile compounds and the 8270D full list respectively.

For more information, go to www.horizontechinc.com

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# HOW IT WORKS O

# AUTOMATING SAMPLE PREPARATION

Problem: The labor-saving benefits of automation have long been recognized and applied in all types of laboratories. For example, autosamplers are a common sight in separations labs since unattended operation of chromatographs has obvious benefits that are intuitively cost effective. The one area that has been most challenging to automate is sample preparation due to the complexity and variety of samples that typically pass through labs.

Solution: Agilent Technologies has taken an important step forward in automating sample preparation with its 7693A Automatic Liquid Sampler (Figure 1). In designing the new autosampler, Agilent realized that many of the common preparation procedures for chromatography samples could be done by incorporating a precision liquid dispenser along with mixing and heating capabilities into the new design. Addition of a second tower option with a large capacity syringe provides the capability to precisely dispense liquids to a sample vial for common operations such as internal standard addition, solvent dilution, and addition of derivitizing agents. An optional bar code reader/stirrer station that heats up to 80oC is sufficient for most dissolution or derivitization procedures while an optional heater/chiller module maintains samples at up to 50oC to keep solutes in solution while in the tray awaiting injection. To accommodate the in-vial chemistry strategy, it was also necessary to provide the capability to sample at any point in the vial to allow the analyst to select the correct phase for injection. As with any complex technology, software automation is necessary in order to reap full benefit. A simple script command language was developed to allow the analyst to set-up and save methods within a matter of minutes (Figure 2).

Lab managers know that any innovative solution must also be vetted against sound business requirements in order to be successful. In developing the business case for this product, the following benefits show that the solution meets financial, safety, quality, and environmental requirements:



▲ Agilent 7693A Automatic Liquid Sampler

- Productivity: Automated sample preparation can save ½ hour or more of analyst time per shift which translates to ≈ 550 hours labor savings per year (0.5 hrs per shift x 3 shifts per day x 365 days per year).
- Safety: Automated sample preparation typically reduces personnel exposure time to potentially toxic solvents and reagents by more than 75 percent. Reduced quantities used in small scale preparation also limit exposure and reduce risks associated with other solvent properties such as flammability. Ergonomic issues are also eliminated for labs with high pipetting requirements.

• Quality: Precision of automated sample preparation exceeds the precision achieved by multiple analysts across shifts which improves the quality and reliability of results. The repetitive nature of automation is more consistent than manual preparation which reduces the risk of analyst errors. This in turn lowers laboratory costs by reducing rework and lowers the risk of price concessions for off-spec product due to lab error for the client.



▲ Sample Preparation Screen for the Agilent 7693A ALS

• Environmental: Small scale sample preparation reduces waste volume which lowers disposal costs. Waste reduction of >50 percent is typical. This approach also supports green waste reduction initiatives such as CMA's Responsible Care® program and ISO 14001.

For more information, go to www.chem. agilent.com/en-US/Products/Instruments/gc/7693als/Pages/default.aspx

## THE LIMS MARKET

A QUICK SNAPSHOT OF THE LATEST OFFERINGS FROM THE MAJOR LIMS VENDORS by Gloria Metrick

Here's what's new with the major LIMS (laboratory information management system) vendors. ("Major" refers to the fact that these are the software vendors with the greatest share of the LIMS market, and they often compete directly with each other.) Although these products can be used in smaller installations, we often associate them with enterprise-wide LIMS projects.

#### **Applied Biosystems**

Applied Biosystems claims that most LIMS vendors are no longer competing with each other to add features because many of them have already built the features customers need into their systems. But one area where Applied sees it can make a difference is by greatly reducing the effort that customers must put into the validation of LIMS implementations.

Its new offering is P4 (SQL\*LIMS P4 Plug & Play Pharma Package), a business solution designed to lower validation costs for the pharmaceutical market. Applied Biosystems has studied the pharmaceutical market to determine what features are most used, built those into this solution, and created validation scripts to support it. The company has also run these scripts so that custom-

ers can audit this activity. In addition, it is focusing on user adoption of P4 and getting data back out of it.

Another recent addition to the company's strategy is the ICE (Innovation Exchange Center), which is "a searchable repository allowing users to search for code already submitted within their area of interest."

#### LabVantage Solutions

LabVantage Solutions now offers a "guaranteed quality management solution" with its SAPPHIRE LIMS product, which comes with a full money-back guarantee on its \$90,000, 90-day implementation. The company previously deployed this strategy for its biobanking solution, but it has now expanded this type of offering into laboratory information management.

SAPPHIRE is built around the testing of raw materials and finished goods, which includes the most common features of such implementations, such as result, entry, and skip-lot testing. Other features, such as stability management, standards and reagents capabilities, and CAPA (corrective and preventative action) activities, which are not included in this basic installation, can be added. This strategy is meant to allow customers to demonstrate quick success by deploying rapidly and getting an early ROI (return on investment).

Additionally, LabVantage has integrated SAPPHIRE with Waters NuGenesis and Waters Empower, which improves automation and workflow. It also has enhanced its SAP interface.

### **MEET THE AUTHOR**

To see an interview with Lab Manager Magazine contributing writer, Angelo DePalma, visit www.qorpak.com/labmanager.

Angelo DePalma, a regular contributor to *Lab Manager Magazine*, has covered the science market for nearly 20 years. In the September issue, DePalma stepped in as our resident technology guru — providing in-depth product overviews of pipettes, particle size analyzers and centrifuges. In this issue, he turns his technology-savvy eye to biosafety cabinets, mills, and grinders. In November, he will contribute an article on the pros and cons of purchasing pre-owned laboratory equipment. Angelo holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. He has written nearly 2,000 trade magazine and online articles on pharmaceuticals, biotechnology, materials, and supporting industries.

To learn more about Angelo and the ideas behind these and other articles, visit the link above. Look for more 'Meet the Author' video links in upcoming issues of Lab Manager Magazine.

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#### LabWare

Building on its "Configure Once – Deploy Anywhere" program, LabWare recently updated its LIMS so that users can now use it from anywhere. Under this "enterprise-wide mobile strategy," users can access the LabWare LIMS with any browser on any piece of equipment, including all handheld and wireless devices, regardless of operating system. This makes the LabWare LIMS browser- and platform-independent, as well as database-independent. Thus, all browser and hardware combinations are available, adding to the system's previous capability of running on client-server and/or Citrix configurations.

This latest version of LabWare's LIMS also has the ability to use character sets from any language, including those from the Far East, such as Chinese. Also, to conform to the FDA's reinterpretation of 21 CFR Part 11 (electronic signatures and electronic records), LabWare has added features to its electronic-signature capabilities to allow more flexibility in how and when e-sigs are applied.

#### **STARLIMS**

The latest additions to the STARLIMS product include more ELN (electronic laboratory notebook) features, and the addition of method-execution features to its current SDMS (scientific data management system) features.

The new features ensure that SOPs (standard operating procedures) are followed.

STARLIMS allows the SOP to be defined by its steps and allows hyperlinks to parts of the SOP to be embedded in those steps. This is done by creating a script to define the SOP.

As the user executes the method, the system can be set up to gather the data from an instrument such as a balance, or from instrument software such as Waters Empower. It can also be set up to verify the data as it is gathered, and to check other associated data, such as verifying that reagents being used by the method have not expired.

STARLIMS can now be interfaced with SAP without using QM-IDI.

#### Thermo Scientific

Thermo Scientific is focusing on "end-to-end laboratory solutions," with its latest offering being Thermo Scientific Connects.

"Connects" is the name the company has given to its new service, which integrates all those pieces of software that are part of an overall strategy. For example, it is not uncommon for companies to have some or all of these systems: LIMS, CDS (chromatography data system), ELN, instrumentation and hardware, document management, and enterprise systems. Coordinating and linking these systems together is a big job, and Thermo, with its extensive experience in this area, has decided to put the name "Connects" on its service to show that it recognizes this as a separate and significant task to address.

Generally, Thermo has decided to take a larger role in enterprisewide decision making, from R&D to sending products out the door. That means it is focusing not just on LIMS,

but on integrating it into the entire enterprise strategy. As another part of this approach, the company recently partnered with Symyx Technologies to include Symyx ELN software products in Thermo's offerings.

N.B.: SQL\*LIMS was bought by LabVantage on Aug. 11. Soon, there will be only four major LIMS vendors.

Gloria Metrick is owner of GeoMetrick Enterprises (www.geometrick.com), which provides consulting services for laboratory informatics projects. She can be reached at 781-365-0180 or Gloria@GeoMetrick.com.

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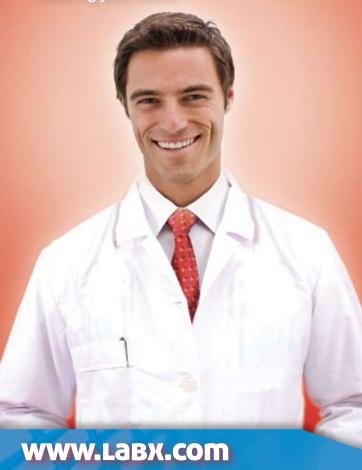
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#### **PARTING POINTS**

#### Takeaways from this month's issue:



#### Show me the Money, p. 10

Nearly 5,000 grants totalling over \$1 billion have been awarded by NIH. Most have been awarded to research labs at large universities and small colleges, while some have been awarded to small research and development companies. The grants have been both a benefit and a problem. For example:

- · Some grants are not enough to have any significant impact
- If money was received, labs were expected to staff up
- Two years later, funds would no longer be available
- With no additional funding, staff must be cut again



#### Honing Your Interviewing Skills, p. 18

For most laboratories, turnover is low and tenures are high, so the opportunity and necessity to conduct interviews is limited. But when it comes time to find the perfect candidate, the following tips will help make the interview outcome most successful:

- Begin with a few simple questions
- Select questions with the intention of eliciting specific types of information
- Listen carefully to what applicants say
- Find out what applicants do off the job
- Trust your gut

#### Training on a Budget, p. 22

In tough economic times many companies slash their training budgets. But training is an investment that pays dividends by helping workers do their jobs more effectively. Key training delivery methods and advantages include:

- Online training Only requires a telephone line and a high-speed Internet connection
- Live training Has been around for a long time and people are comfortable with it
- On-site training Instructor travels to company location where training can be customized
- Public training Open to whoever pays tuition and held in off-site location



#### BSC Ergonomics and ADA Compliance, p. 30

Because of the increased incidence of work-related musculoskeletal disorders among laboratory workers, the principles of ergonomic design and compliance with the Americans with Disabilities Act (ADA) are becoming increasingly important topics in the design of the biological safety cabinet (BSC). Ergonomic hazards associated with traditional BSCs that can cause upper-extremity musculoskeletal disorders include:

- Working in a static, extended posture for long periods of time
- · Limited visibility at the sight line
- · Leaning forward to see work
- Lack of knee/leg space under the cabinet



74

#### Outsourcing, p. 46

Outsourcing laboratory work is usually done on the assumption that another laboratory is able to perform the work more cheaply and/or more rapidly while maintaining adequate quality of the results. The decision whether or not to outsource depends on the following key considerations:

- What is the ability of the receiving laboratory staff to do the needed work?
- When outsourcing is unsuccessful, the work may need to be repeated, with a consequent loss of time
- The lab manager needs to establish an effective working relationship with the receiving manager and staff

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