MAGAZINE

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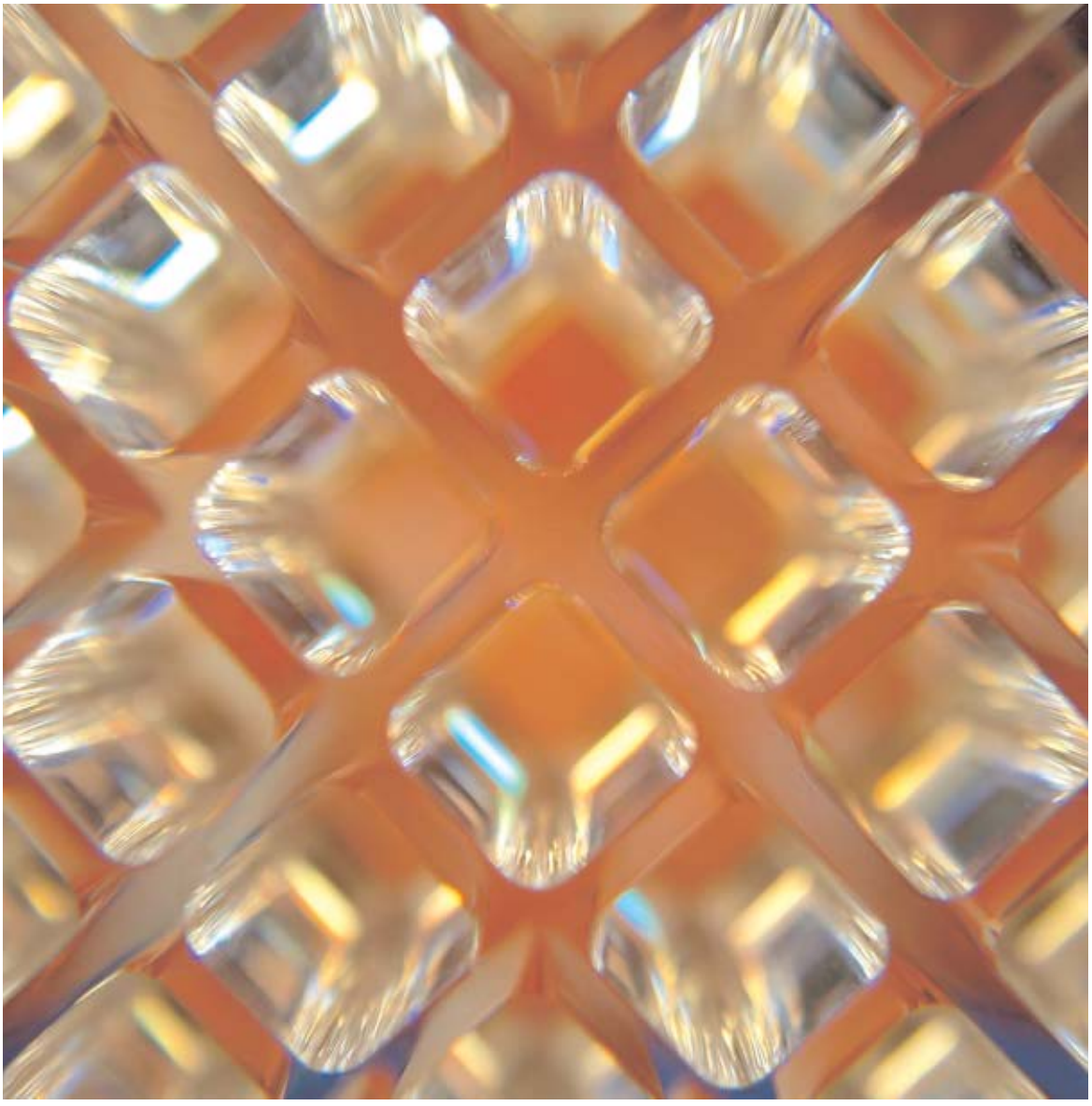

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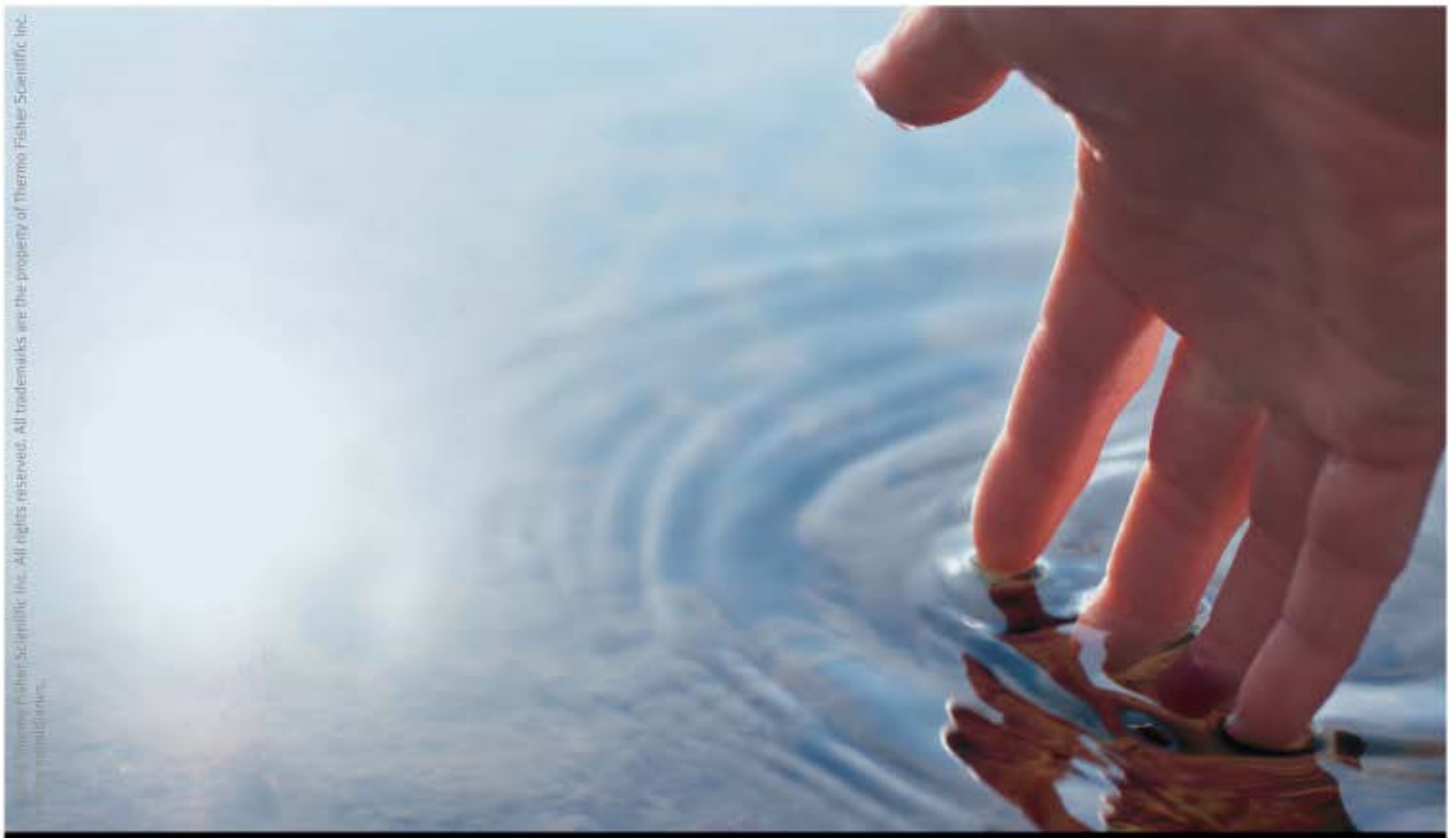

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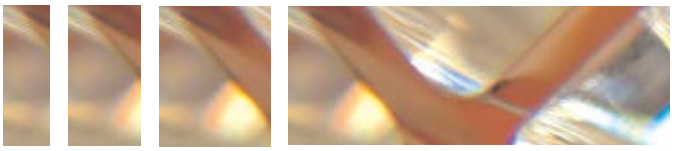

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Our Innovation, Your Research — Shaping the Future of Life Science

Automation and Innovation

This month, staff members from *Lab Manager* will be heading to Palm Springs and the LabAutomation 2008 conference and exhibition. As with every show we attend, we'll be manning our booth to talk to people, walking the hall floor to see what exhibitors have on display, sitting in on a few of the sessions, and looking at the posters. Conferences are a "hit the ground running" part of our jobs but also one that enriches what we do and gives us new ideas, the opportunity to met new people and hear what they have to say, and overall a bigger outlook to bring to the magazine and e-newsletter.

In keeping with the theme of the conference, we are taking a look at automation and innovation in this issue. The first article approaches automation from our main focus — how does management fit into the process? *Management's Role in Laboratory Automation* by Joe Liscouski talks about making effective use of automation. Though that seems like an obvious goal, the process of getting there involves a lot of decision-making and planning. For automation to truly work, the driver to the process is not the technology itself but the clearly stated goals of what is to be achieved and the flag-waving for that goal at every turn while measuring all decisions against it. Will that further our goal? Does this keep us on the path to our goal? It's easy to get sidetracked in a complex process but having this trail of breadcrumbs so to speak can be the small thing that keeps an initiative from being swallowed up by complications. The motto is: Ask not what automation can do —— ask what can automation do for you.

Ask not what automation can do — ask what can automation do for you.

One of the plenary speakers at LabAutomation 2008 is Henry Chesbrough, Ph.D., Executive Director of the Center for Open Innovation at the Haas School of Business, University of California Berkeley. Chesbrough's book, *Open Innovation: The New Imperative for Creating and Profiting from Technology*, not only coined the term "open innovation" but created a model where companies look outside their boundaries for ideas and intellectual property (IP) they can bring in, as well as license their own IP to other organizations. In his article, *Open Innovation Becoming Key to R&D Success*, John Borchardt looks at Chesbrough's model and how it has been adopted as part of the R&D program at several companies.

If you are attending the LabAutomation show, please stop by and see us at booth #663. We always welcome input and look forward to seeing you there.

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MANAGEMENT'S ROLE IN Laboratory Automation

JUST WHAT SHOULD MANAGEMENT BE DOING? FOR STARTERS, SETTING THE GUIDELINES AND EXPECTATIONS FOR PROJECT DEVELOPMENT.

Conference vendor exhibits show the latest wares in laboratory equipment. Those focusing on life sciences, including an October 2007 LRIG[1] meeting in Cambridge, Massachusetts, displayed microplate handling equipment to measure bacteria growth, cell counters, physical sample management systems, and more; most with one element in common — they were all microprocessor controlled and programmable.

Automation is an integral and inescapable part of laboratory work.[2] Much of it is at the task level, built into instrumentation to carry out a fixed, but programmable, set of functions. Many offer some form of electronic output, some as files, others with USB[3] connections. Using the instrument output is left as an exercise for the user.

Integrating systems may cause you to step back from the lab as it exists now, plan for the lab-as-you-need-it-to-be, and then develop a migration plan to get there.

Making effective use of that equipment and other automation options in the lab will require managers to take an active role in developing policies that guide automation projects, including the purchase of intelligent instrumentation, so that the next stage in automation can be addressed: systems integration and the improved utilization of the labs intellectual property.

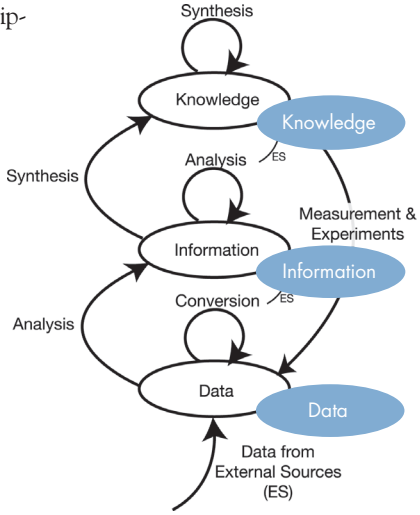

Figure 1: Modeling laboratory processes results in a graphical description of how the lab works, what the major structural elements are, and how they are used.

In addition to the items noted above, the term "automation" in a lab also covers automated pipettes, instrument data systems (e.g., chromatography, GC/LC-MS, etc.), LIMS, and electronic laboratory notebooks. Some are focused on making manual tasks more efficient, others completely offload what had been manual work to fully automated workflows. As workloads increase, more manual tasks are going to be shifted to electronic/mechanical devices, many with data capture capabilities and the ability to connect to computer systems. Management planning for each step in that transition is essential. This article serves as an introduction to management's role in lab automation — setting the guidelines and expectations for project development and technology management.

These policy guidelines will help lab managers with two relevant issues in particular. A recent article[4] covering a small survey (72 individuals in 37 companies) reported that:

- Only 56% of the automation projects "succeeded in delivering the expected results"
- An increasing dependence on outside sources for project development

The planning process described in this article and elsewhere[5] will improve the success of projects by providing a strong architectural platform for their development. It will also provide a method for documenting and communicating project expectations and relationships between automation projects, giving product vendors and outside contractors an understanding of a laboratory's current automation operations, and how new projects fit in.

Joe Liscouski

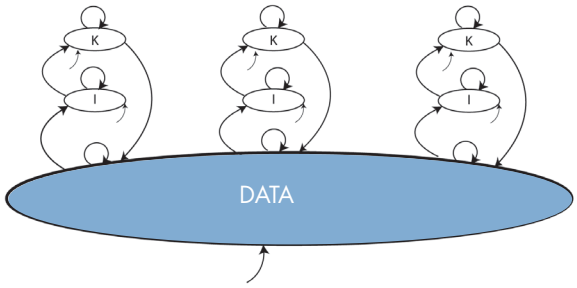

Figure 2: This model represents three researchers working from a common "data" database with each individual working on independent projects.

TECHNOLOGY PUSH SHIFTS TOWARD MANAGEMENT POLICY

In its early days, laboratory automation was a technology push — we learned how to acquire data, process, and report it. We also learned how to use robotics to off-load repetitive tasks. LIMS were developed to manage workflows in testing labs and electronic notebooks provided a means of helping researchers work with laboratory data.

The next stage in the development of laboratory automation is going to take us from the task-automation level to that of integrating systems so that the full benefit of the technologies and products that have been developed can be realized. That stage is going to require management to take a more active role in driving the application of technology to laboratory work.

The policies and practices developed by management are going to provide the infrastructure that will enable integration within the lab, cooperation between labs, and successful partnerships with Information Technology groups.

Those policies are critical to the successful development of systems that:

- Are effective and supportable,
- Meet the labs automation and regulatory needs,
- Reduce the overall operating costs of lab operation and improve the lab's return on investment,
- Provide a basis for working with other groups including Information Technology departments,
- Coordinate the work of outside contractors and equipment vendors,
- Protect the intellectual property developed in the labs,
- Make the most effective use of people's talents.

TRANSITIONING FROM INDEPENDENT PROJECTS TO COOPERATIVE AND INTEGRATED SYSTEMS

Whether you are working in research, testing, or quality control, the introduction of laboratory automation systems requires planning. That planning should include:

1. The definition of policies and practices that govern the use of automation technologies and products within a lab,
2. The relationship between different labs (one laboratory supporting the operations of others) and groups (QC sending results to process control),
3. The development of workflow models that describe how each lab does its work.

Those three points apply to both existing facilities and those in the planning stages. Integrating systems may cause you to step back from the lab as it exists now, plan for the lab-as-you-need-it-to-be, and then develop a migration plan to get there.

A LABORATORY AUTOMATION ENGINEERING[6] (LAE) METHODOLOGY

This approach differs considerably from practices currently used today. Systems that work together are the result of planning and engineering.

Current Practice

- Task-oriented, focused on bottle-necks, local work spaces
- A laboratory being viewed as a collection of individual task stations
- Technology-driven — how can a product's technology be used to improve a given situation
- Automation-as-an-extension-of-the-instrument viewpoint — automation is used as a setup to instrumental analysis or as a post-run activity, supporting the instrument is the center of focus

LAE Approach

- Engineered systems point-of-view
- A top-down structured approach
- Designed to protect the value of a laboratory's products (knowledge, information, and data) and enhance the labs (and larger company's) ability to gain value from those products

The first stage in the planning process is the definition of policies and practices that all automation projects have to address. This is the equivalent of describing the infrastructure of the labs operations. "Lab" may refer to a single room or a large complex; common infrastructure/automa-

tion policies should apply equally to both situations. Their purpose is to describe the parameters and standards that guide project development and implementation, and provide a common basis of standardization to communication, software systems, and automation components so that the outcome of those projects can work together and minimize support costs.

Those policies should include (they are given a brief treatment here due to space limitations):

The management and protection of the lab's intellectual property

The knowledge, information, and data that the lab produces (the primary products of the lab's work) need to be managed so that they are retrievable and accessible by anyone who needs them. This would include data file structures, requirements for cataloging, backup, and archiving. Technical details may be left to engineers; however, the expectations of how things should behave and function are management policies.

Security

Control over access to the labs facilities, protection against unwanted intrusion by malware (e.g., viruses, worms, etc.), and protection against power loss. (Note: protection against power loss is a major issue since instrumentation, computers, etc. may react differently to power interruption; a couple of seconds delay in switching from normal to backup power may result in equipment damage or unsafe operating conditions.) In some cases, uninterruptible power backup may be required. Management's responsibility is to make sure that these points are understood and addressed for each project. When needed, facilities and IT may be required to provide needed services and support.

Software development

Setting standards for documentation, testing, controlled release of software versions, and use of spreadsheets and other easily modifiable software tools. This is a key consideration since it is possible that those working on one project may not be the same people working on a future version or related project — you want to be sure that whoever works on a project at a later date can understand the details. Software development and customization is significant portion of most automation projects, so the ability to understand earlier work is basic to a system's ability to be supported and to exchange data with other automation projects.

Validation

Whether you operate in a regulated environment or not, the concepts and practices underlying systems validation are key to the success of an automation project. A system that has not gone through a validation process will be difficult to maintain, support, and upgrade. As managers, you are responsible for setting the criteria that validation protocols have to meet. In larger companies with formal regulatory oversight, those departments may provide insight on specifications that have to be met.

INTEGRATION: MERGING PROCESSES AND INSTRUMENTS

Integration needs careful consideration. What is it that you are integrating? Unless you are an instrument vendor, you don't integrate instruments (hyphenated techniques such as ICP-MS for example), you integrate processes that involve instruments and laboratory equipment. Process integration requires a thorough understanding and documentation of the processes, what "integration" means, and how that integration is going to occur. Will the integration be the result of communications via file transfers, message transfers, or will the systems be more tightly linked? Will there be a supervisory system in control, providing the coordination of several devices? You also need to consider when the integration is going to occur; is it part of one project or a set of separate projects that have to be connected at a later date? Many of the technical details may be left to engineers, however ensuring that the means (technical and documentation) of carrying out the integration steps is managements and part of the systems acceptance criteria.

This also underscores the importance of the software development documentation. If the process and the software supporting that process is not well documented or understood, the likelihood of a successful integration program is small.

In addition, policies should be developed on process management, change management (the human side of laboratory operations, keeping those in the lab informed and providing training to maintain skill sets), project scheduling, systems retention, etc.

A lab manager for a quality control laboratory in a manufacturing facility should be able to determine the policies for that lab's operations. More complex organizations, such as research laboratories, will require more extensive discussions to provide for data exchanges between groups. A common set of policies and practices is useful since they can help ensure coordination of systems when needed, and reduce development costs.

Successful systems integration is not just confined to operations with a lab, but should take into account exchanges between labs and other departments. This will make the process more complex but may also open addition-

al funding if the efficiency and effectiveness of the overall facility is improved. It will also require the cooperation of Information Technology groups since the implementation of intra- and inter-departmental communications is going to be built upon corporate network infrastructures.

LABORATORY WORKFLOW

Once the policies for the lab(s) have been determined, each laboratory should examine the workflow model that describes how the lab should function. In a given facility, different labs will have different structures depending on their mission and how they decide to carry it out. Testing labs (analytical, quality control, etc.) are going to have a different structure than research labs. The need for collaborative work is going create additional requirements for products and how the knowledge, information, and/or data produced in the lab is managed.

Modeling laboratory processes results in a graphical description of how the lab works, what the major structural elements are (databases, workflow management systems, document management, etc.), and how they are used. The modeling exercise also provides a means of determining if a potential automation project is ready for automation. If it is not, the areas where issues exist can be analyzed to determine how much effort and cost it will take to overcome those issues and whether or not it is worth it (cost/benefit analysis). This type of workflow analysis will also enable you to determine the ability of each process to be part of an integrated workflow system.

You may also uncover common process elements that can be automated and benefit more than one experimental technique. Doing so will help justify the economics of proposed automation programs.

Figure 1 is an example of one such model.[5] The ovals represent databases, the arrows are processes that operate on the database elements (each test/experimental protocol would have a separate process description, as would each analysis technique). In some cases "data" can be converted and still remain "data" (simple temperature conversion) in others an analysis on data can yield information (for example, developing a calibration curve of peak area vs. concentration for chromatographic data and then applying it to samples).

In a quality control lab, the "data" database may represent several instrument databases (e.g., chromatography, mass spec libraries, etc.). The "information" database may be a LIMS. The "knowledge" database would be a document management system that contained current test protocols, hazardous materials documents, etc. In a research system, an electronic lab notebook could combine both "data" and "information" databases into one system.

This is a simplified drawing. In the real world (your world) each process line in the diagram above may in fact be several parallel processes each representing a different experimental protocol or test procedure.

Figure 2 is a model variation that represents three researchers working from a common "data" database, a genome database for example, with each individual working on independent projects.

This model's structure shows that in order for the lab to be successful, the "data" database needs some particular characteristics:

- The data format for data structure elements should be standardized so that common software routines can be used to read and write to the database
- It should be shareable with multi-user simultaneous read/write access (or people will become frustrated with delays in getting access to the data elements they need)
- It will require a cataloging system that is searchable
- In addition to each individual having their own backup/archiving system, the shared database needs its own backup /archive facility that will ensure that each user will retain their access privileges
- Since the data is being shared the database system has to be designed so that as it grows it can span multiple volumes; the database can only grow as new material is added, older material has to be retained since it's relevance to future projects is uncertain

The models can be used to generate product requirements that will be used in evaluating vendor offerings.

These same models, and their variations tailored to specific situations, can be linked to show how the work done in one lab is transferred to another lab or department. As a lab's mission changes, the models and policies can be updated.

SUMMARY

Rather than using automation products to fix bottlenecks, lab managers should look ahead and determine how they want their labs to operate. Setting policies and practices that are used to develop all automation projects and a developing a workflow model that shows how each automation element fits into the larger picture will result in a more stable and streamlined opera-

tion. Costs should be reduced since you avoid recreating existing projects to make them work with newer systems and the benefits of purchases are more easily described.

1. LRIG – Laboratory Robotics Interest Group, http://lab-robotics.org.
2. The high level of automated equipment available to the biotech/pharma industries isn't as evident in others. There are several reasons for that including the funding available. In addition, the experimental protocol are heavily dependant on fluid handling, small sample sizes, and the wide acceptance of microplates as an experiment platform; that standardization is key to the rapid development and easy acceptance of automation systems. Standardization of equipment as well as data interchange standards is an essential element of successful automation programs, something that should be evaluated carefully in other disciplines.
3. USB – universal serial bus.
4. Hamilton, S.D., "2006 ALA Survey on Industrial Laboratory Automation," Journal of the Association for Laboratory Automation, 2007, Vol. 12, Num. 4, pp.239-246.
5. A thorough description of these models and the policies can be found in a "Manager's Survival Guide to Engineering Laboratory Automation" written by this article's author, Delphinus, Inc., 2007.
6. Liscouski, J., "Are You a Laboratory Automation Engineer," Journal of the Association for Laboratory Automation, June 2006, Vol. 11 Num. 3, pp.157-162. (An expanded version of this material can be accessed through at www.Delphinus-LAE.com/emailforms/RULAE.htm — Note: the URL is case sensitive.)

Joe Liscouski *is part owner of Delphinus, Inc. in Groton, MA. He is a specialist in the application of automation technologies in laboratories and is working to develop the field of Laboratory Automation Engineering. He is the author of a "Managers Survival Guide to Engineering Laboratory Automation" and can be reached at JLiscouski@Delphinus-LAE.com; 978-448-2836; www.Delphinus-LAE.com.*

Open Innovation Becoming Key to R&D Success

A NEW TREND IN PRODUCT INTRODUCTION MATCHES TECHNICAL NEEDS WITH TECHNICAL SOLUTIONS FROM EXTERNAL SOURCES.

"In many industries today, the logic supporting an internally oriented, centralized approach to research and development has become obsolete," declares Henry Chesbrough, Director of the Center for Open Innovation at the University of California, Berkeley. "Competitive advantage now often comes from leveraging the discoveries of others." He coined the term "open innovation" to describe this process and defines it as "a paradigm that assumes firms can and should use external ideas as well as internal ideas, and internal and external paths to market." Open innovation has become a hot topic since the 2003 publication of Chesbrough's book *Open Innovation: The New Imperative for Creating and Profiting from Technology*, (Harvard Business School Press). Chesbrough observes, "Useful knowledge is widespread in many industries and ideas must be used with alacrity if they are not to be lost."

Open innovation is becoming more widely practiced in R&D as companies realize that simply hiring more scientists and increasing research budgets may not accelerate innovation. Two days after becoming president of Lucent Technologies' Bell Laboratories, Jeong Kim commented, "We must innovate innovation." Open innovation provides a means of doing this and enables organizations to increase both their innovation imports and exports thereby increasing the pace of innovation and new product introduction.

THE OPEN INNOVATION R&D MODEL

Open innovation requires firms to identify relevant innovative ideas to complement their own innovation advantages.

Chesbrough's model of industrial R&D eliminates traditional boundaries between businesses, universities, start-ups, and other sources of innovation. By eliminating these boundaries and collaborating with other organizations including customers, suppliers, university researchers, and even competitors, companies can import lower cost, higher quality ideas from the best sources in the world, and do so more rapidly than independently inventing their own, which often involves "reinventing the wheel." Doing this enables companies to focus their own innovation efforts on areas where they have clear competitive advantages. This reduces R&D risks and increases funds available for the most promising opportunities. In addition, achieving this focus can assist companies in identifying innovations to sell or license to other firms that could put them to more profitable use. This can raise cash for additional innovation investments in the firm's core areas.

One firm that is using open innovation, what it calls its "Connect and Develop" strategy, is Procter & Gamble. P&G has announced a goal of accessing 50% of its new ideas, technologies, and products from outside organizations. A key element in this open innovation strategy is effective utilizing the Internet to match technical needs with the innovators around the world who have technology solutions and "ready-to-go" products that P&G can utilize.

Open innovation requires firms to identify relevant innovative ideas to complement their own innovation advantages. Meanwhile, effectively exporting innovations means selling patents and other intellectual capital to increase profits. To accomplish this, firms can work with a variety of open innovation enablers. Scientists can be actively involved in both importing and exporting innovation.

OPEN INNOVATION ENABLERS

R&D is increasingly performed in smaller firms and academic laboratories that are often difficult to identify. A National Science Foundation study indicated that U.S. companies with 25,000 or more employees accounted for 39% of total 2001 R&D spending or $75.7 billion. Of this, more than $5.3 billion (7%) was spent on outsourced R&D. Other companies receive 92% of these funds, universities 6%, and

John K. Borchardt

non-profit laboratories 2%. In addition, 180 companies spent $4 billion on collaborative R&D with 98% of these funds going to other firms.

Companies with fewer than 1,000 employees accounted for 23% of total R&D spending. Paul Stiros, President and CEO of NineSigma, notes that in 1972, companies with fewer than 1,000 employees received 5% of new U.S. patents. By 2000, they were receiving 30% of new patents. Technology suppliers also include academic researchers who are increasingly developing and patenting intellectual property.

To identify firms seeking to buy or sell technology, a new type of firm that uses Internet Web sites to aid potential partners in finding each other has developed. These firms offer a variety of services and include yet2.com, NineSigma, and InnoCentive.

YET2.COM

In 1999, an investment consortium of Procter & Gamble, Dupont, Bayer, Honeywell, Caterpillar, Siemens, and NTT Leason founded yet2.com. The Web-based firm offers services that bring buyers and sellers of technology together enabling each to maximize the financial return on their intellectual assets. The firm's clients are said to represent over 40% of the world's R&D capacity and include companies in the chemical, pharmaceutical, and biotechnology industries.

NINESIGMA AND ACCELOVATION

"I founded NineSigma with the belief that the Internet could be used to match technology innovators with the companies best positioned to exploit those innovations," said Mehran Mehregany, Chairman and Founder of NineSigma. "Using its proprietary Internet-based Managed Exchange process, NineSigma delivers connections to sources all over the world to meet its clients' technology needs."

Projects include applied research, design and development, process improvements, finished products, and both new applications and markets for existing technologies. NineSigma matches technology seekers with unobvious or disruptive innovations using knowledgeable qualified program managers (some of whom are chemists), Web-based tools, and a global database of solution providers.

"We're managing strategic open innovation programs for more than 40 industry-leading companies," says Paul Stiros, President and CEO of NineSigma. Clients include UOP, DuPont, PolyOne, AveryDennison, Kraft, Abbot Laboratories, Case, Unilever, Kohler, Battelle, and Case Western Reserve University. Clients fall into two categories, technology buyers called innovation managers and technology suppliers called solution providers. Small businesses are often technology suppliers.

Miles Drake, Vice President and Chief Technology Officer for Air Products, explains the logic of his firm becoming a NineSigma customer, "We believe that working with NineSigma will amplify our internal R&D efforts and will expand our ability to access external resources and capabilities globally."

According to Milan Jevtitch, P&G's e-R&D leader, "By utilizing NineSigma's unique process, we can be more proactive in accessing the tremendous innovation assets and ideas that exist outside of Procter & Gamble." Jevtitch goes on to say, "NineSigma's experience and access to researchers and companies will expand our ability to tap into new, breakthrough technologies and product opportunities around the globe."

Another firm, Accelovation, was founded at the MIT Media Lab and provides software that uses text mining and natural-language processing to enable innovators to mine the Web for insights into unmet needs, trends, innovations and market activity.

WORKING WITH INDEPENDENT INVENTORS

Web-based InnoCentive was founded in 2001 by Eli Lilly's Ventures unit. "InnoCentive's mission is addressing the R&D challenges of leading, global companies by connecting them to the world's brightest scientific minds," explains Darren Carroll, Director of New Ventures at Eli Lilly and former CEO of InnoCentive. Eli Lilly founded the company and maintains a majority ownership position. Among the users are chemical firms, such as DuPont.

According to Carroll, when starting InnoCentive, "We picked synthetic organic chemistry instead of biology because we were better able to frame questions and thus test the viability of open innovation." Now the problems posted on InnoCentive include more than 40 different fields of chemistry, biology, life sciences, and other disciplines. The customer case has expanded from its initial focus, pharmaceutical companies, to a variety of industries including consumer products, petrochemicals, basic chemicals, specialty chemicals, polymers, and other industries. More than 30 companies have posted problems on InnoCentive.

Through the InnoCentive website, www.innocentive.com, "Seeker" companies can post their toughest R&D challenges to more than 120,000 scientists and researchers in 150 countries worldwide. These "Solvers" can submit solutions to challenges and earn a financial reward of up to $100,000 if their solution is chosen. Overall, the solution rate for problems posted on InnoCentive is about 40%. More than a third of the over two-dozen requests P&G has submitted to InnoCentive's network have yielded viable solutions.

One doesn't need to be a research chemist with a vast amount of experience to solve problems posted on InnoCentive. A 19-year-old senior undergraduate chemistry student, Drew Buschhorn of the University of Texas at Dallas, solved one problem, a replacement for cyclododecane for use in art restoration projects. (Buschhorn is now a chemistry graduate student at the University of Indiana at Bloomington.) Cyclododecane worked well but is expensive and accumulates in the environment. Buschhorn proposed using glycerin, biodegradable and much less expensive, as an alternative.

YOUR ENCORE

*Your*Encore was founded in 2003 when "P&G and Eli Lilly recognized the need to utilize the expertise of their retirees," says Mike Burns, Chief Technology Officer of P&G. Fourteen other companies have joined *Your*Encore. An account executive works with a client company to identify their technology needs and identify experts in the *Your*Encore database that meets these needs. Currently *Your*Encore databases have more than 1,500 experts, not all retirees, listed. The experts describe their experience and qualifications in a keyword-searchable database. Also, they check off categories of jobs called service offerings for which they are qualified and in which they would like to work.

Eli Lilly's Carroll notes, "Over the past 2½ years more than 80 projects have been completed using *Your*Encore personnel. The 80 projects utilized about 110 people. The overwhelming majority of *Your*Encore people working for Lilly are from other companies. This helps enhance the diversity of solutions. One of the big advantages of open innovation is the increased diversity of the thought processes used and the solutions arrived at. By using retirees from other companies, we are taking full advantage of what *Your*Encore has to offer."

OPEN INNOVATION AT PROCTER & GAMBLE

Larry Huston, Procter & Gamble's vice-president for innovation and knowledge, explains, "Connect & Develop is really all about turbocharging our innovation output, turbocharging our innovating. . . .It's about recognizing that there are a lot of bright people outside P&G and developing methods of working with them. . .To do so we have to build discipline into our organization, build networking capability and build processes to discuss deals and negotiate intellectual property agreements." He observes, "Every aspect of R&D, strategy and vision to rewarding people to what skills we give them, had to be revamped for Connect & Development to work."

Chemist Ed Getty was P&G's first technology entrepreneur (TE) and currently runs the network of TEs within P&G. The TEs identify technologies of interest to P&G from other companies, government labs, and universities. Dr. Getty explains, "It's really important to not try to replace researchers' skills but to make them more capable of building new, productive connections outside P&G. . .This requires new skill sets particularly understanding in depth the problems we're trying to solve and being able to discuss the problem in language that researchers in other industries will relate to. The objective is to link their research to P&G needs." Getty's responsibilities include developing the capabilities to increase the scope and speed of making outsider connections. Organizations providing these capabilities to P&G include yet2.com, NineSigma, InnoCentive, *Your*Encore, and other firms.

CASE HISTORIES

In August 2004, Procter & Gamble entered into a technology transfer agreement with AMCOL International Corporation under which it will license polymer technology to AMCOL's Health & Beauty Solutions Group. This technology enables the use of polymer particles to deliver active ingredients in wet wipe applications. AMCOL HBS already produces polymeric microparticle delivery systems for cosmetic, personal care, and pharmaceutical applications.

The licensing created a win-win situation for the two participants. Larry Washow, AMCOL president and chief executive officer, says, "This license complements the intellectual property portfolio that we have developed in-house. The significance of this license is that it opens the door for the use of our polymeric delivery systems

in wet wipes applications — a growing business area." Kevin Cureton, AMCOL HBS managing director, notes, "In addition, AMCOL HBS is looking forward to applying these technologies to new markets such as household products and surface cleaning applications." Meanwhile, Lisa Nalpolione, director, baby care research and development, P&G observes. "This licensing agreement is a perfect example of extracting additional value from our R&D investment."

Huston cites a recently commercialized product, Olay Regenerist, as another open innovation success story. First, research at the U.S. National Institutes of Health (NIH) indicated that certain proteins could promote faster healing of cuts with less scarring and were useful for wound treatment. Then a French company, Sederma, discovered five proteins that include penetrate elastin and collagen in wounds to promote wound healing. P&G thought these properties also would be helpful in anti-wrinkling creams, made a connection with Sederma, licensed the technology and applied their formulation expertise to develop Olay Regenerist. The overall development program combined P&G formulation capability with basic science developed by Sederma and NIH. Huston estimated that P&G saved at least 50% in time compared with doing the research entirely in-house.

In 2004, NineSigma identified two solutions providers for adhesives manufacturer Fasson Roll North America, a division of Avery Dennison. Fasson Roll North America signed joint development agreements and arranged a joint development agreement for new adhesive systems for use in automotive, building and construction, electronics, and medical device applications. "The NineSigma process was very successful in uncovering companies and technologies that we would not have identified otherwise," said James Macuga, New Business Development Leader for Fasson Roll North America.

IMPACTS OF OPEN INNOVATION ON CHEMISTS' CAREERS

Even when importing ideas and technology, Chesbrough notes that companies need to maintain adequate internal R&D activities to turn these external ideas into profitable products and processes. Thus traditional career opportunities for chemists will continue. Moreover, open innovation also creates the opportunity for chemists to engage in a broader range of activities and assume new responsibilities.

Researchers need to link internal activities to the surrounding value network that creates and delivers that value to customers. Building this network means establishing processes for buying and selling intellectual property as well as mechanisms such as corporate venture capital, licensing, spin-off firms, external research projects, and intellectual property management. Each of these processes and mechanisms requires chemists and business managers to help design agreements between the internal organization and external suppliers and to administer contracts once they are signed.

For open innovation to succeed, the corporate culture must change to emphasize teamwork and network building outside the organization. In particular, researchers need to overcome the "not invented here" mindset and both welcome and use ideas from outside their own organization. Carroll explains, "Open innovation involves a willingness to restate the role of scientists from problem solvers to innovators identifying innovative solutions. One of the real values of scientists is defining questions that need to be answered and find solutions no matter where they are. In other words, one must be agnostic about the source of innovation."

Carroll says, "We have changed the job content of people around the company, including R&D, so that people are more externally facing (interacting with others outside the company) than a few years ago. "We are trying to understand how to properly incentivize research staff behaviors to encourage open innovation."

"Open innovation will continue to be valuable because the pace of innovation is so great that it will be exceedingly hard for companies that don't work in an open environment to keep up," states Carroll.

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Effective Presentations for Chemists and Other Scientists

BOOST YOUR CAREER WITH THE SKILLS TO DEVELOP AND DELIVER A POLISHED PRESENTATION.

I still remember the first time I presented a paper for publication in the Analytical Chemistry journal of the Florida Section of the American Chemical Society. This was many years ago, when I was a graduate student at the University of South Florida. I initially prepared a technically enriching speech which would have taken me at least a half day to present, but after what seemed like weeks, I was able to reduce pages and pages of research text down to a five minute presentation. At the time, I had such a terrible fear of public speaking that I read my presentation from index cards in a monotone voice. I was very thankful that I didn't have to be concerned with my shaky knees or gesturing because no one could see me. The room was totally dark to view the slides — not PowerPoint slides but the Kodak slides of years past.

Though visual aids have changed tremendously since the late '60s when I gave my first presentation, the presentation style, in my opinion, has not significantly changed — especially for chemists and other scientists. As a chemist and as a business/computer consultant for many years, I have given and have seen many technical presentations at conferences, at work, and elsewhere. The presentations were generally quite informative, technically enriching, and the presenters were very knowledgeable on the subject matter. However, many of them (and I include my own), were rather unexciting and ineffective. I have also seen many exciting, motivational, and inspirational presentations for the general public and also for the technical audience. You don't need to be a professional speaker to spice up your presentation but by both knowing and understanding some of the same principles professional speakers use, you can enhance your presentations.

Speech writing is much different than writing reports or articles for a journal.

WRITING YOUR SPEECH

If you are doing a presentation, most likely you've written a report or submitted an article for publication. Perhaps you have used the text for your speech and created PowerPoint slides to help outline the structure. However, I would suggest you write your speech from scratch with emphasis on simplicity and conciseness.

In my commonsense assessment, speech writing is much different than writing reports or articles for a journal. The brain processes spoken words differently from written words. When we read, we can see whole phrases at a time. As a result, we can instantly understand phrases and sometimes whole sentences (except for those long, drawn-out sentences we sometimes write). We also can go back and reread the text if we must.

However, we process the spoken message instantaneously, one phonetic sound at a time. We mentally accumulate these phonetic sounds in our memory until these sounds make sense. Once we mentally interpret these phonetic sounds into whole sentences, we can move on to the next spoken sentence. For example, if I said, "We mentally accumulate" and stop, you have no idea what I'm attempting to say until I complete the sentence; whereas, in reading this article, you can easily understand the meaning because the whole content is right here on this page. Although the spoken process is immediate, it is a slower process than reading so keep this in mind when writing and delivering your speech.

SIMPLIFYING YOUR MESSAGE

Use short, simple sentences. Your written report will likely contain comprehensive and long, drawn-out sentences describing the details and results of your project which is fine for a report, but rather long and tedious for a speech. It's important to break down the technical detail into a few short and concise sentences.

For example, in my report, I wrote, "It is useful for our purposes to distinguish between two types of substitution procedures: 1) a true substitution procedure, in which the amount of the metal-DTPA complex added is equal to or greater than the amount of the sought-for metal ion; and 2) a pseudo-substitution procedure, in which only a small amount of the metal-DTPA complex is added to activate the indi-

Frank S. Adamo

cator mechanism." Whew! What a handful of words to say all at once.

For a presentation, I would re-word the sentence to read: "For our purposes it is useful to distinguish between two types of substitution procedures. [pause] One type is a true substitution procedure. In this procedure, the amount of metal-DTPA added is equal to or greater than the amount of the sought-for metal ion. [pause] The second type is called a pseudo-substitution procedure. Only a small amount of the metal-DTPA complex is added to activate the indicator mechanism in this procedure." Thus, I broke down one long sentence into five shorter sentences.

REDUCING UNNECESSARY VERBIAGE

In the example above, I simplified the sentence structure, but I didn't rework it to make it more concise. In my workshops I give examples of speeches that I helped rewrite such as, "Let me tell you about Mary Smith. Mary Smith lives…" I changed it to "Ask Mary Smith. She lives…" Not only did I reduce it from ten to five words, it became more active in tone. In essence, be short, concise, and to the point when writing a speech for a presentation.

REFRAINING FROM USING JARGON

As chemists, we use chemical terms, acronyms, and other jargon everyday. These terms are second nature to us, but may not be to others. As the program chair for our Rotary club, I invited the public relations person from the regional water replenishment district to give a talk. During his presentation, he used words and phrases such as micro filtration, groundwater basins, saturated zones, heterogeneous aquifers, and injected recycled water after recharge. I understood the terms and perhaps one or two others, but I'm certain many other members had difficulty understanding the terms and, thus, his talk.

To be effective in your presentation, refrain from using your industry's jargon, even if you are presenting in front of colleagues. However, if you do, explain the terms in a simple and understandable way.

FOCUSING ON BENEFITS, NOT DATA

In my experience, most scientists focus on technical data. This is natural because this is what you do for a living. You research, you synthesize, you investigate, and you analyze. You then formulate a conclusion based on the data of an investigation. As a result, the presentations are based on the collected evidence. But what are the benefits of your research? Let's say you have been researching a cure for cancer for years and recently discovered a specific structure in DNA that would prevent all cancers. Of course, all the data and results leading up to the cure are necessary to submit to the science community, but what is more important to the listeners when presenting, the data or the benefits of the research?

For example, what is more valuable for the audience to hear? Data such as "…by doing this and that, we were able to reduce the growth rate of the cancer cells from 90,000 cells per hour down to only 10 cells per day; thereby virtually eliminating the growth of cancer," or benefits such as "Based on our research; we can save 250,000 lives within the next three months if this DNA alteration is approved." In essence, benefits emotionalize features (data); thus benefits grab the audience's attention more than facts and figures.

Overall, if you speak in short, concise sentences, refrain from industry related terminology, and discuss the benefits of your findings, you will give a more effective presentation.

WRITING YOUR CONCLUSION FIRST

Many presenters write their speeches in a logical order; first, they construct the opening, followed by the body (where they add the details and supporting data), and then finish with the conclusion. However, by the time they start writing the conclusion they tend to adapt the conclusion to the supporting data rather than ensuring that the data fits the conclusion. What is your call to action? What concepts do you want to leave the audience with? What is the specific purpose of your talk?

With these questions in mind, develop your conclusion first. For example, if you're seeking a grant for your colon cancer research, you might end your presentation with "Are you prepared to invest in saving the lives of 250,000 colon cancer patients over the next five years?" By focusing on your closing message, you can then add and arrange the specific details of your talk to support your conclusion, and then create a powerful opening statement based on your conclusion.

STARTING WITH AN ATTENTION-GETTER

How long do we have to grab the audience's attention? Some have said as little as seven seconds. Others say ten to 15 seconds. Surely, we have no more than 30 seconds to capture our audience's attention.

Yet, how many times have we seen someone begin with a statement such as "Thank you, Mr. Chairperson, for allowing me to speak this evening. Ladies and gentlemen, I'm honored to be here tonight to discuss this most pressing issue of…." This would take about ten seconds to say. Ten seconds to get to the point. Ten seconds before the audience begins to know, "Why am I here? By then, you may have lost your audience.

Instead, grab the audience's attention immediately, then, if there's a need, compliment or thank the organizers and the audience. For example, you may say, "More than one million people die each year of colon cancer. Our research team has developed a procedure to reduce the number of colon cancer deaths by more than 70% over the next five years. Thank you Mr. Chairperson, fellow colleagues, and welcomed guests. We are on the verge of reducing colon cases by introducing…"

MAKING A POINT AND TELLING A STORY

What's remembered weeks, months, or even years after your presentation? It isn't the data or the details you presented. It's the stories. You may wonder how you can incorporate stories in your technical presentation. It can be done and it is powerful when you do it.

Several years ago, I was in network marketing. The company hired two biochemists. Both developed great products, both were very knowledgeable and both gave good presentations. One of them was, in my opinion, the typical presenter. He was very informative giving us a series of data, but quite dry in his delivery. To this day, I don't recall any information he discussed. On the other hand, the other biochemist told stories and illustrated his points. Fifteen years later, I still remember the picture he verbally drew as he described how the lungs are affected by smoking.

REDUCING AHS, UMS, AND OTHER FILLER WORDS

Though filler words such as "ah," "um," and "you know" can be a distraction to the audience, rarely are we consciously aware of making these utterances. But you can become aware and learn to speak and pause without having them infiltrate.

Let me tell you a story to illustrate this point. I saw the 1986 air crash of the AeroMexico DC-9 flight 498 in Cerritos, CA. A single engine Piper Archer crashed into the tail of the DC-9. The airplane lost total control, turned over, and plunged into the Cerritos neighborhood like a bomb. It crashed within two miles of our home and within yards from friends and relatives. My wife was out of state and didn't experience the disaster. About a month after the crash, my wife and I took a 30-minute walk around a nearby park. After we returned from the walk, I asked her how many planes she heard. She said none. I

was so sensitized to the air crash that I had heard 31 aircraft fly over.

Similarly, you can become sensitized to your filler words. First, make a conscious effort to listen to others on TV or talk radio, at work, at seminars, at home — everywhere. Mentally count the number of filler words. As you become aware of others saying them, you will become conscious of your own filler words. Eventually, you will reduce, minimize, and even eliminate your filler words. In fact, you may become so sensitized to filler words that they will become a major distraction when others speak.

ANSWERING QUESTIONS

Have you been to a presentation where the speaker ended with a powerful conclusion, you were excited and ready to take action, and then the presenter asked something like "Do you have any questions?" After a few questions and answers, your excitement from the powerful conclusion waned and you left without taking any action.

Typically, presenters will conclude their presentations and then ask for questions. However, asking questions at the end will generally reduce the impact of a strong conclusion. Then, when should we accept questions?

Some presenters may encourage questions anytime during their presentation; however, they really need to be on top of their presentation to assure that they don't lose track and complete their presentation on time. This can be a challenge for many — even for the most experienced presenters.

I generally ask for questions after each main topic. Typically, I will have an opening, a body, and a transitional conclusion for each main topic. At the end of each transitional topic, I will call for questions. For example, I may say, "Before continuing, do you have any questions?" After accepting no more than three to four questions, I'll proceed to the next topic. To let the audience know that you need to conclude the question and answer section, you can say something like, "I will take one more question" or "I'll be available after this presentation to answer any individual questions." If appropriate, I may transition to the next topic by incorporating the last question. At the end of my last topic, but before my final conclusion, I will ask for a final set of questions.

DEVELOPING YOUR SKILLS

There's so much more to know on how to give effective presentations, including how to use gestures, vocal variety, PowerPoint, and the lectern along with how to layout the room, prepare a checklist, etc. To learn more, attend workshops, read books, and learn by doing. And I believe, the very best place to learn by doing is the laboratory of communications, Toastmasters (www.toastmasters.org). Even if you are an accomplished presenter, everyone can practice and improve their skills.

***Frank S. Adamo** has a Master's degree in analytical chemistry. He is now a communications and a certified career coach, trainer, and an author. His "31 Tips to becoming an Effective Presenter" is available on his Web site and will be in bookstores in Spring 2008. He can be reached at frank@fsadamo.com; 714-408-9287; www.fsadamo.com.*

Considerations in Choosing an FT-IR IMAGING SYSTEM

FT-IR IMAGING IS A POWERFUL TOOL FOR MATERIALS CHARACTERIZATION

FT-IR microscopy has been a powerful technique for the analysis of small sample areas for almost two decades. Application areas include the identification of impurities, defects, and inhomogenieties down to 10 x 10 µm in size in a wide range of materials from polymers to pharmaceuticals. However, in many cases a complete view of the distribution of a molecule or functional group across the sample is required to check for changes in composition. This requires many individual spectra to be acquired to build up an image which is time-consuming using a traditional FT-IR microscope.

To generate these chemical "pictures" of a sample, FT-IR imaging systems with multi-element detectors have been developed to allow rapid collection of spectra from many points across a sample area (Figure 1). This has accelerated the adoption of FT-IR imaging and it is now seen as an essential tool for research and development (R&D) and troubleshooting laboratories — assuring product performance and reducing development time for many products. New application areas are constantly emerging as the technology develops, including biomedical applications and studies of pharmaceutical formulations.

FT-IR imaging is now seen as an essential tool for R&D and troubleshooting laboratories — assuring product performance, and reducing development time for many products.

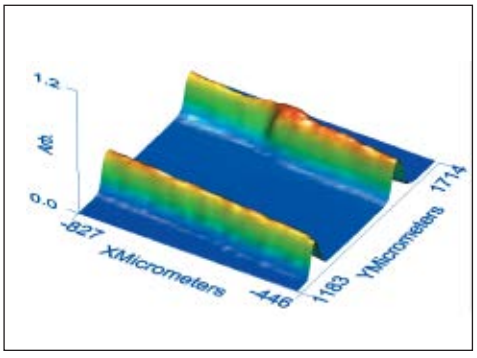

Figure 1: An IR image of the distribution of a carbonyl band at 1740 cm-1 in a multilayered polymer cross-section. This highlights two adhesive layers, one of which is slightly distorted. The area shown is approximately 0.5 x 0.4 mm and consists of 5300 data points. Data collection time for the whole image was less than two minutes.

CHOICE OF DETECTOR

The first FT-IR imaging systems employed large focal plane array detectors which were originally designed for military surveillance applications. These systems suffered from poor reliability, low sensitivity, and a reduced spectral range which limited their usefulness for routine operation in the laboratory. New approaches have included a patented linear mercury cadmium telluride (MCT) array detector with 16 individual liquid nitrogen-cooled elements in which the sample image is swept across the detector in a precise linear pattern, and by synchronizing the movement of the stage with the interferometer of the FT-IR spectrometer, up to 170 high-quality, full-range (7800–700 cm^{-1}) spectra per second can be collected, which equates to over 10,000 per minute.

One significant advantage of this approach is that by moving the sample across the detector, images of variable sizes and aspect ratios can be measured rather than a fixed size which is dictated by the layout of the detector array. This clearly saves time in many analyses as only the area of immediate interest needs to be sampled.

Another important consideration is the spectral range of the array detector. Many commercially available arrays show very poor sensitivity below 1000 cm^{-1} and cannot effectively collect data in this region. This restricts the ability to characterize materials with inorganic content such as filled polymers or paint chips. Analysis of the latter is particularly important in identifying trace evidence in forensic science.

VARIABLE IMAGING RESOLUTIONS

Many imaging systems can measure down to a pixel size of around 10 µm. However, a range of pixel sizes should be available to match the resolution of the measurement to the expected

Dr. David Clark

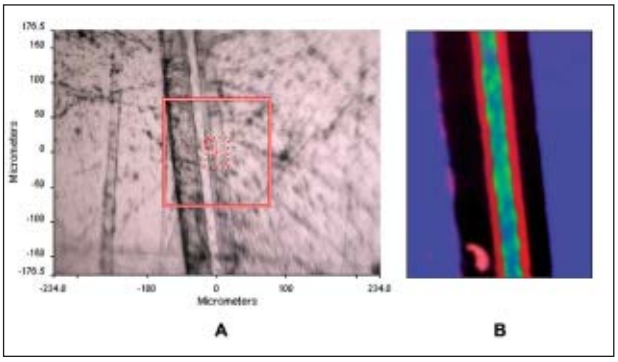

Figure 2: Visible and IR Reconstructed Images from Embedded Laminate

size of the areas of chemical difference in the sample. This may be determined by particle size or physical composition. For example, many polymer laminates have layers of only a few microns in thickness so a very high resolution is required to reveal the individual layers in an IR image. Conversely, samples such as pharmaceutical tablets may have relatively large particle sizes in some formulations. In many studies of excipient distribution, collecting data at very high-resolution is unnecessarily time-consuming and a lower resolution would be more appropriate. In addition, some systems now have the ability to survey the sample rapidly at a resolution of the order of 50 microns. This is extremely useful as a first-pass screen to quickly identify any areas of inhomogeniety across the sample. If necessary, the user can quickly re-measure areas of interest at higher resolution to characterize fine structure.

ATTENUATED TOTAL REFLECTANCE IMAGING

As mentioned above, polymer laminates often have layers which are a few microns thick, presenting particular challenges for analysts. Even with very careful preparation of very thin microtomed cross-sections, it is difficult to maintain sample integrity throughout the sampling process. Also, using traditional transmission spectroscopy, it is impossible to obtain clean spectra of these layers as the spatial resolution becomes diffraction-limited.

ATR (attenuated total reflectance) imaging can overcome some of these limitations and resolve detail which is difficult, if not impossible, to observe using conventional IR microscopes and imaging systems. As a reflectance technique, the sample need not be cut into thin cross-sections — samples are typically mounted in an embedding resin and polished to a flat surface. Also, the amount of sample interrogated by the IR beam is relatively low — around 1-2 µm using germanium ATR crystals. Images tend to be sharper and spectra show fewer artefacts due to beam divergence,[1] and interference fringes. Additionally, ATR imaging provides data with higher spatial resolution than transmission imaging.[2] A resolution of less than 4 µm is achievable with ATR, whereas the physical diffraction limit for transmission work is typically three to four times this in the mid-infrared fingerprint region.

To obtain good ATR images, the sample must be brought into close, uniform contact with the crystal across the entire measurement area. To achieve this, the laminate needs to have a flat surface at the point of contact and be adequately supported to avoid distortion under pressure. The polished resin sample block is placed directly on an anvil on the ATR accessory and the anvil is raised to bring the sample into firm contact with the crystal.

APPLICATION EXAMPLE: ATR IMAGING OF A POLYMER LAMINATE PACKAGING MATERIAL

Figure 2a shows the visible image of a packaging material section embedded in epoxy resin. Despite the surface scratches, it was possible to generate good ATR images because the sample was slightly compliant, allowing the crystal tip to be pushed into the sample. Also, appropriate data treatment can minimize the effects of the slightly varying contact across the image. Figure 2b shows the reconstructed IR image where the scratches are no longer apparent.

To obtain the reconstructed image, the image spectra were derivatized, offset-corrected, and subject to principal components analysis (PCA). This technique sorts the image spectra into an independent set of sub-spectra (principal components) from which the image spectra can be reconstructed. For example, if there are five layers present in an image of say 1,000 spectra, then five sub-spectra would be sufficient to describe all the 1,000 image spectra. In practice, more than five spectra are usually required, due to the presence of impurities and other spectral contributions like variations in baseline and atmospheric absorptions. The amounts of the principal components in the original image spectra, or scores, are calculated at each pixel and the resulting score images are extreme-

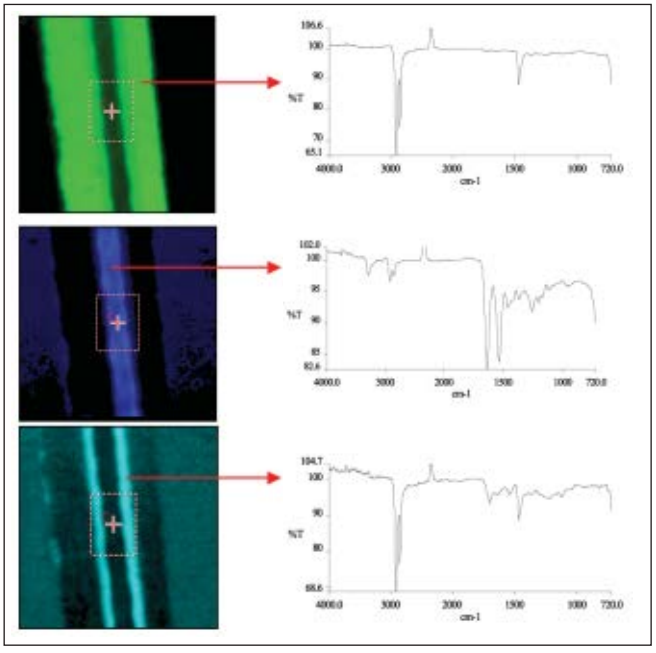

Figure 3: Score Images and Spectra from Principal Components 2, 3, and 4

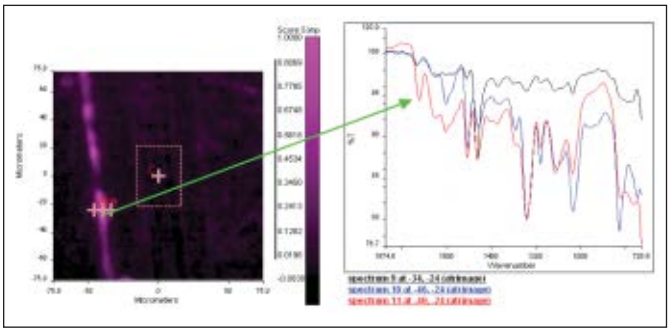

Figure 4: Score Image and Spectra for Principal Component 5

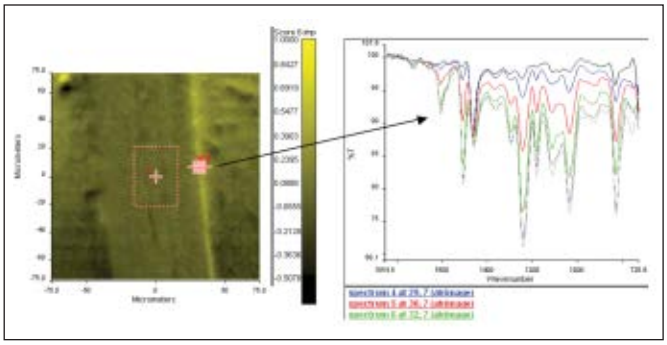

Figure 5: Score Image and Spectra for Principal Component 6

ly useful in enhancing IR image contrast. For this sample, the first three PC score images and corresponding spectra are shown in Figure 3. The second and third images show the major laminate layers, a polyethylene and polyamide, with intermediate layers around 6 µm in thickness, sandwiched by the PE and PA, as revealed in the PC4 image. Here the layers are readily identified by examination of the underlying raw image pixel spectra. The first score image, PC1, is due to the embedding medium and is not shown here

In addition, the features due to the minor variance are shown in the PC5 and PC6 score images. The PC5 image shows a feature 3-4 µm thick close to the outer edge of the sample. Using software, it is possible to view the raw spectra underlying these features, tracking through the feature at steps of 1.56 µm. This shows that there are unique carbonyl features in the spectra of the layer which are not present on either side, thus confirming the distinct chemical composition of the layer (Figure 4). This can be compared with the situation in Figure 5 where the PC score image also reveals a layer. However, no distinct chemical feature appears on examination of the spectra, rather a relatively smooth gradation in spectral intensity from one material to the next. This indicates a physical boundary, such as a ridge, rather than a distinct chemical constituent.

FULL AUTOMATION AND OTHER CONSIDERATIONS

The above application example shows how a powerful, fully-featured software package is important in order to extract the maximum information from each analysis. The ability to manipulate large image files is important and it is essential to have access to powerful processing tools such as PCA in order to enhance image contrast and separate chemical and physical differences across a sample. It is equally important to choose a system in which the software allows very rapid and simple set-up of analyses. For example, simple features such as the ability to define the imaging area directly on the visible image of the sample (see Figure 2a) are very convenient and save valuable time.

It is now possible to automate virtually all of the main functions of the imaging system to provide simpler, more reproducible operation by eliminating manual adjustments. These include provision of fully automated stage movement including auto-focusing, automatic aperture adjustments in single-point mode, and automatic optimization of sample illumination in visible viewing mode. Additionally, many images can be collected and stored in an unattended operation from one sample or from many samples. The imaging areas are defined in advance by inspection of the visible image, the imaging parameters set-up, and the system can collect data unattended for upwards of 24 hours, facilitated by a large volume auto-feed liquid Nitrogen Dewar to keep the detector cooled.

SUMMARY

FT-IR Imaging is now able to meet many of the diverse challenges of materials characterization applications. Automation and powerful software features are increasing productivity and accelerating adoption in virtually every field of study. Traditional limitations such as sensitivity, reliability, and spectral range have been overcome by new detector designs. Modern systems can now operate at a variety of spatial resolutions, allowing the operator to optimize the analysis according to the sample properties and the desired measurement time. ATR Imaging has provided a solution to the established problem of sample preparation and has allowed very small features, of the order of a few microns, to be characterized at a very high spatial resolution.

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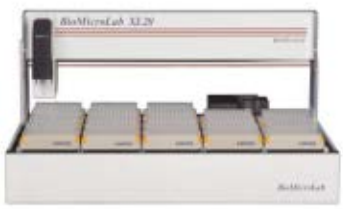

The XL20 tube handler automates the transfer of tubes between multiple 96 well tube racks. The tube weighing mode allows automatic capture of tube tare, gross, and net weights. It includes software that guides the loading and unloading of tube racks which allows for quick setup of complex sorting projects.
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DNA/RNA ISOLATION SYSTEMS

The QuickGene 810 and 610L are automated DNA/RNA isolation systems validated with Affymetrix Genomewide 5.0 array. They are based upon thin membrane extraction technology. These benchtop systems are affordable and fast. They can process up to 8 samples in 6 minutes and produced nucleic acids ready for MDX assays.
Autogen
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This software alleviates the bottlenecks of high-throughput qualitative Spectral and Chromatographic analysis using automated processing, interpretation with an awareness of chemical structure, and management of data from multiple analytical techniques and instrument vendors. Standardized, uniform HT results are then delivered to desktops.
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The QIAsymphony SP, a medium- to high-throughput automated system, combines magnetic-particle chemistry with broad application range for RNA, DNA, and protein purification. The system features optimized protocols for up to 96 samples per run, plus processing of large sample volumes.
Qiagen
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MICROPLATE READER

The Infinite™ M1000 is a high-end multimode microplate reader equipped with premium quad4 monochromators. The reader provides a wide range of detection modes and plate formats and is optimized for luminescence and TR-FRET-based assays. Modular and upgradeable, it offers injector, stacker, and barcode options.
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The FDSS6000 drug delivery system provides fluorescence and luminescence detection with high-throughput assays, multiplexing capabilities for versatile data analysis, plus durability and reliability. The system was designed for cellular assays, assay development and high throughput screening for both fluorescence and luminescence modalities.
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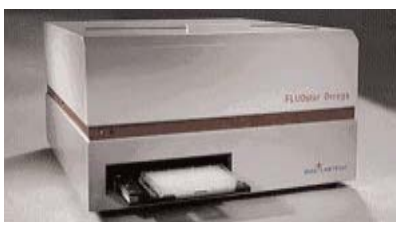
MULTIFUNCTION READER



The FLUOstar Omega is a multifunction reader with a UV/vis spectrometer. The spectrometer allows the capture of the entire UV/vis spectra of a well, 200nm-850nm, in under a second per well. It works for F, FP, L, TRF, A, FRET, BRET, and TR-FRET.
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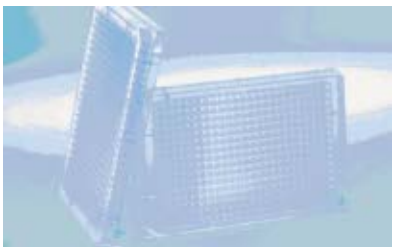

The 384 DeepWell polypropylene microplate, with novel well geometry for direct-transfer positioning, features square-top wells that transition to conically tapered flat bottoms, enabling wide volume range with minimal waste. A standardized microplate footprint ensures automation capabilities.

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Eppendorf North America
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The Cryo-Compact and sealed-system PRESTO circulators are for applications requiring wide temperature ranges, rapid heating and cooling, and small footprints. EasyTemp Professional software can control, monitor, and program eight laboratory instruments with a graphical interface and data export for record keeping or analysis.

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How it Works

Environmentally Friendly Circulators and Water Baths

Problem: In order to save money, many laboratories use improper equipment or environmentally unfriendly processes. This leads to questionable lab work, varying results, and lowered safety. Additionally, laboratories often fail to validate their equipment, allowing it to degrade until it fails due to age or because it cannot meet necessary parameters, such as temperature control. This equipment often gives results that are not reproducible and are more costly in the long run.

Solution: Circulators and water baths, such as the FL-300 recirculating cooler from Julabo, precisely control process temperature. Distillations, chromatography, and chemical reactions all require specific temperatures. In addition to maintaining a set temperature, there are concerns of uniformity in the container, safety, and cost saving concerns with dry ice or liquid N_2.

Often these applications use glass reactors and vessels, because of their chemical corrosion resistance and the need to observe the process. When glass is used, and often without any insulation, the quality and performance of the temperature control device is even more important due to the higher demand of heating and cooling.

The Julabo FL-300 Recirculating Cooler

Another area of concern is water conservation. From a simple rotary evaporator to a large laser system, many pieces of laboratory equipment are connected to tap water for cooling and temperature control. By using the proper equipment instead of just tap water, the water is in a self contained unit and circulated at the precise required temperature. In addition, overhead costs of water consumption and its drainage impact can be eliminated.

The FL-300 recirculating cooler from Julabo provides environmental-friendly cooling and saves tap water. The units are rapid, powerful, highly efficient, and offer short cool-down times. The units feature a bright LED temperature display that is clearly visible across the room. Designated models are water-cooled and thus operate almost noiselessly and offer reduced heat generation to the environment. The units feature warning and safety functions; all wetted parts are made of high quality stainless steel or plastic. Filling is rapidly and conveniently made on the front.

Circulators and water baths are used for many applications and should be used in any application where water conservation can be achieved. The cost of one of these products can often be recouped in one year! At the same time, they precisely control the temperature of a process.

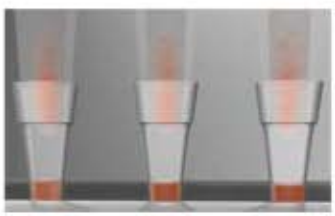
Julabo offers a variety of circulators, baths, and chillers that can perform multiple operations at a defined temperature, pump fluid externally to a larger system or self-contained system, or accurately control temperature sensor calibration.

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

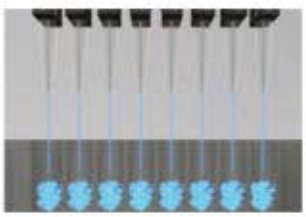
Is your pipetting channel as clean as you think?

Aerosols have the potential to contaminate!

Manufacturers of automated air-filled systems cannot offer decontamination protocols because of the complexity of their design. Tecan's Freedom EVO® robotic workstation with Flow-Thru Technology can help ensure internal cleanliness by washing the pipetting channel as needed. Using a two-step process, it cleans the exterior and interior of fixed washable tips or disposable tip cones.



Bad contamination?
The potential for contamination exists from aerosols and splashing during sample transfers in an air-filled system.



...Washing is the answer
Flow-Thru Technology helps ensure a clean internal system with a two-step wash cycle to clean the interior and exterior of your tips.

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Applied Biosystems

Glenn Ketcham, CIH and Vince McLeod, CIH

Health and Safety When Building Green

In the Safety Guy's column last month we provided a brief introduction to green building and the LEED (Leadership in Energy and Environmental Design) certification process. We discussed what it means to build green and examined the U.S. Green Building Council's LEED rating system for new construction. In this column we will touch on some of the potential health and safety issues and possible impacts on construction workers and building occupants.

QUICK REVIEW ON "BUILDING GREEN"

Briefly, the U.S. Green Building Council (USGBC), founded in 1993 and comprised of leaders from every sector of the building industry, aims to move construction towards environmental responsibility and sustainability. In 1999, the USGBC introduced LEED, a nationally recognized rating system for design, construction, and operation of high performance green buildings. First designed for new commercial construction, there are now LEED rating systems for existing buildings, schools, and others, as well as systems under development for healthcare and laboratories.[1]

The LEED rating systems measure performance in six key areas and award four different levels of certification based on the cumulative scores achieved. The areas scored are: sustainable site development, water savings, energy efficiency, materials selection, indoor environmental quality, and innovative design. The four levels of LEED accreditation, ranked in order, are Certified, Silver, Gold, and Platinum.

The reasons to "build green" and obtain LEED certification are convincing. These projects, according to USGBC research, can realize up to 30% energy savings, 35% reduction of carbon emissions, use 30 to 50% less water and generate 50 to 90% waste cost savings. All of these benefits and more for only a 1 to 7% increase in construction costs.[2]

HOW IS HEALTH AND SAFETY IMPACTED?

Designing and building green mainly focuses on minimizing environmental and resource impacts. It is exciting to see that building occupant health and productivity are also receiving attention. But, is enough done and are the approaches the most effective or desirable? And, what about the construction worker's health and safety?

In working through the LEED rating system requirements, there are particular areas to which the health and safety manager should pay attention. Granted there are many positives to building green and LEED certification. But, potential negatives exist as well. By increasing our awareness and putting thought into these issues at the beginning, we can minimize or possibly eliminate them from our green building project.

CONSIDERATIONS FOR THE CONSTRUCTION WORKERS

Three of the key performance areas contain potential pitfalls for construction workers. We'll discuss them in the order encountered under LEED for new construction. First, in the section of sustainable site development credit 3 is for Brownfield redevel-

opment. A "Brownfield," for those unfamiliar with the term, means "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant."[3] The intent is to rehabilitate damaged sites — a good idea. But, if you are building a project on a Brownfield, then you better make sure you have all the information available and have incorporated it into a comprehensive health a safety plan for use by all the various contractors and their construction crews.

Materials and Resources is another section with potential health and safety issues for construction crews. This segment includes a requirement for a construction waste management plan and deals with recycling and material reuse. Collecting and storing recyclables leads to additional material handling (as much as two or three times more than usual)[4] and the potential for increased sprains, strains, and puncture injuries. The need for more dumpsters and containers on site can create congestion resulting in traffic accidents, trips, or falls. On the other hand, if set up logically and maintained, the result is better general housekeeping and a cleaner, more organized, construction site.

A third sector affecting workers during construction is under the indoor environmental quality segment. Credit 3.1 requires the development of an Indoor Air Quality (IAQ) management plan for the construction and pre-occupancy phase. The purpose of this plan is to prevent IAQ problems resulting from construction activities. By controlling pollutant sources, using low-emitting adhesives, sealants, paints and finishes, and protecting materials from moisture, potential exposures to both the construction workers and the building occupants are minimized or eliminated.

LEED, BUILDING GREEN, AND THE BUILDING OCCUPANT

LEED for new construction impacts building occupants directly in two key areas. The first one is building commissioning contained in the energy and atmosphere section. Commissioning is the process by which the building systems are verified as installed, calibrated, and operating according to design. Since this includes the heating, ventilating, and air conditioning system (HVAC), it is important that a knowledgeable person review the test and balance and commissioning reports.

The entire indoor environmental quality section is aimed at providing for building occupant well-being. Two pre-requisites must be met: minimum IAQ performance and control of ETS (environmental tobacco smoke). Additional credits are awarded for using low emitting materials, controlling indoor chemical and pollutant sources, and imple-

Human Relations

The six most important words:
"I admit I made a mistake."

The five most important words:
"You did a good job."

The four most important words:
"What is your opinion."

The three most important words:
"If you please."

The two most important words:
"Thank you"

The one most important word:
"We"

The least most important word:
"I"

–Author unknown

menting an IAQ management plan prior to occupancy.

As industrial hygienists and consultants, we have worked to solve indoor environmental quality problems since the late 1980s. We still face architectural features and design issues that lead to IEQ problems on a regular basis. Flat roofs, internally insulated ductwork, porous wall finishes in high moisture areas, improperly installed (or missing) vapor barriers, and poor access to ventilation equipment for maintenance are a few of the most common. Unfortunately, IEQ experts and industrial hygienists in particular have had little, if any, input into developing the LEED rating systems. Therefore, although the premise of LEED certification is a very good first step, we should continue striving to improve on this process. Industrial hygienists and IEQ experts need to get involved.

CONCLUSIONS

Here we have presented a brief overview of building green and LEED certification. We touched on the health and safety issues facing both construction workers and building occupants. We mentioned the need for the health and safety manager to raise his/her level of awareness and pointed out the major concerns to watch for during a green build (or any construction) project. In future articles we hope to discuss these issues in more detail and present positive actions to incorporate into your management plan checklist.

Until then remember, Safety First!

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Vince McLeod *is a Certified Industrial Hygienist and the senior IH with the University of Florida's Environmental Health and Safety Division. He has 17 years of occupational health and safety experience in academic research with focus in the research laboratory. His specialties are in hazard evaluation and exposure assessments.*

The Safety Guys welcome your comments and questions. You can email them at thesafetyguys@labmanager.com.

How it Works

A Better Way to Break up Samples

Problem: Many tissue homogenizers cause bottlenecks in the workflow of a biology laboratory. This is largely due to the common one-tip design, which breaks up samples either by mechanical shearing or sonication. Since users have to use the tip with one sample at a time, it is slow and cumbersome, often requiring disassembly of the instrument for cleaning in between samples. Not only is this one-by-one technique prone to contamination and excessive heating of the sample, it is inconsistent between samples, very loud, tedious, and causes some of the sample to be lost when the probe is removed.

Additionally, the methods used for different types of cells require different instrumentation which can be expensive and redundant — homogenizers for tissues, sonicators for cells, shredders for plant material, etc.

Figure 1. The Bullet Blender™

Figure 2. The Bullet Blender™ can process up to 24 samples in closed tubes at once.

Solution: It is more consistent, reproducible, and cost-effective to use equipment which can process multiple samples simultaneously. Available from BIOCON Scientific and manufactured in the U.S., the Bullet Blender™ can process up to 24 samples in closed tubes at once. It vigorously strikes sample tubes, transferring the energy to the tissue within. The only thing that touches your sample is what you put in the tube — so cross-contamination is not an issue.

The Bullet Blender™ can be used for disrupting cells, homogenizing tissue, and shredding plant material by simply adjusting the agitation power and the selection of beads in the tubes. This solution from BIOCON Scientific can help save you at least six times what a sonicator would cost you compared to the Bullet Blender™.

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

Writing Action Steps - Part II

So are you applying the first five Writing Action Step principles?

1. Using Simple Command Statements
2. Keep Action Steps Simple
3. Avoid the Passive Voice
4. Identify the Responsible Person
5. Use Quantitative Information

Could your Standard Operating Procedures (SOPs) be improved by moving toward more action oriented statements? Well here are five more principles to consider.

WRITING ACTION STEPS

As a reminder, our approach is to write SOPs from the perspective of the user. They are responsible for performing the work so the SOPs should be written with them in mind. We will use action steps that provide the user with direct commands to perform specific actions.

PRINCIPLE 6: State the Condition First

Conditional steps are used when a decision is based upon the occurrence of a condition or a combination of conditions. Conditional steps use the conditional terms *if, or, then, when, and,* or *not* to present required action(s) and condition(s). The most common practice is to write the conditional statement first, followed by the action.

Example: *If device does not have pressure, then check valve for leak:* (If two conditions are involved and one or both of these conditions must be met before the action is taken, place the conditional term or in between the conditions.)

Example: *If pH is below 6 or above 10, then notify a supervisor*: For a negative condition, use the conditional term "not." Avoid using "not" if a single word can be used and the condition can be stated in a positive manner. For example, "If the valve is open, ..." is preferable to "If the valve is not closed, ...")

PRINCIPLE 7: List Multiple Objects

Often an action step is followed by several objects.

Example: *Verify the temperature, pressure, and pH level* (If the there are more than three objects consider listing them in a vertical format using bullets, dashes, or asterisks. Use numbers only to indicate order of performance. Use charts and matrixes to present a series of objects.)

PRINCIPLE 8: Use Parallel Structure

Write headings and words using the same tense, ending, or other value. In other words, use a parallel structure. When you use parallel structure, you increase the readability of your writing by creating word patterns readers can follow easily.

Not Parallel: *Test documentation requires recording data, completing logs, and to sign on the coversheet.*

Parallel: *Test documentation requires recording data, completing logs, and signing the coversheet.*

PRINCIPLE 9: Emphasize Important Information

Use emphasis techniques, for example, bold, italics, or underlining, to highlight important information. Emphasize information which if overlooked or misinterpreted could result in user error or injury. For consistency purposes it might be helpful to define what will be emphasized and how it will be emphasized.

Warnings: alert users to potential hazards to personnel

Cautions: alert users to potential hazards to products or equipment

Alerts: advise users of important information when neither danger to individual or equipment is involved

Notes: call attention to important supplemental information

For example:

Table 1 shows how important information is to be emphasized. To assure consistency amongst all SOPs, a table could be placed in an SOP on

Table 1: Emphasis Techniques

WARNING	WEAR RUBBER GLOVES AND FACE SHIELD WHEN MIXING TEST CHEMICALS
CAUTION	Charge Batteries in a Well Ventilated Area
ALERT	Do Not Change Switch Unless Power Is Off — Equipment Settings May Be Lost
NOTE	No smoking allowed within 50 feet of building

Norm Moreau, PE

SOPs to show SOP writers how information will be emphasized in a facility. For example WARNINGS are to be boxed, bolded, and all letters in caps.

PRINCIPLE 10: Use Referencing Branching Appropriately

When you direct the user to go to another step or section within an SOP or to go to another SOP, the writing technique you are using is called referencing and branching. So what is referencing and branching?

Referencing directs users to other steps or sections within the procedure, or to other procedures, and then back to the initial point.

Branching routes users to other steps or sections within the procedure, or to other procedures, but the user does not return to the initial departure point.

Be careful when using referencing and branching. Warnings, cautions, and notes are easily overlooked and it is easy to lose track of exit and entry points

So there you have it, ten principles for making your SOPs action oriented. Apply these principles consistently and your users will be thankful.

Norm Moreau *is a consultant and trainer known for developing SOPs and implementing SOP programs that demonstrate GLP/GMP and nuclear QA compliance. His products and services are used to achieve ISO 9001 registration and ISO 17025 accreditation or by organizations that simply want to improve their operational efficiency and effectiveness. Since 2000, Norm has been offering the Writing SOPs that Work workshop at the National Meetings of the American Association for Laboratory Animal Science (AALAS). He welcomes comments, questions, even criticisms and can be reached at nmoreau@theseuspro.com.*

For a free pdf of all Ten Principles for Writing SOP Action Steps, go to www.labmanager.com.

10

Are You Ready to Give That Presentation?

Shore up your confidence and polish your content and delivery by using the simple oral presentation checklist at www.mftrou.com/oral-presentation-checklist.html. Lyndsay Swinton's website "Management for the Rest of Us" offers the checklist on preparing to give a talk as well as a companion rubric to grade a presentation.

Mentoring Strategies for TIME-PRESSED MANAGERS

"The greatest gift one can give, other than love, is to help another learn," according to Chip R. Bell, author of *Mentors as Managers: Building Relationships for Learning* (Berrett-Koehler Publishers, 2002). "Learning is the fundamental process and the primary purpose of mentoring," wrote Lois Zachary in her book *The Mentor's Guide: Facilitating Effective Learning Relationships* (Jossey-Bass, 2000). However, traditional mentoring is in trouble in today's world of flatter corporate structures. Many lab managers have a broader span of control because they supervise more employees. They are also more concerned with managing their working relationships with their own supervisors and peers in other corporate functions. There are just not enough hours for the extended discussions associated with traditional mentoring.

At the same time, for companies to succeed in today's competitive environment and retain their employees, they must create a workplace environment that facilitates employee growth and learning. "When mentoring relationships are rooted in the fertile soil of a mentoring culture, they also enrich the quality of organizational life," notes Zachary in *Creating a Mentoring Culture: The Organization's Guide* (Jossey-Bass, 2005). This can improve employee retention.

As a result of these factors, a new model of mentoring — teaching staff members by example and offering intermittent feedback rather than meticulously reviewing everything they do — is being adopted formally and informally at many companies. These feedback discussions encourage employees to continue to learn and develop productive behaviors effective in your organizational culture. Because of this, managers must strategize before meeting with employees rather than simply criticizing aspects of their performance that need improvement. For example, combining praise for some aspects of performance with discussion about what the employee needs to improve can lead the employee to accept criticism and improve more quickly. Some managers encourage the "sandwich" approach opening the conversation with praise for some aspect of the employee's performance. Follow this with criticism of the aspect of the employee's performance that needs improvement. Couch this in terms of a critique of the employee's behavior, not the person. After stressing the need for improvement; discuss, don't dictate, strategies for improvement. The employee should leave your office with a sincere commitment to improve that aspect of their performance and have a plan for doing so.

To help assure that the employee leaves your office in this frame of mind, complete the discussion with the last piece of the sandwich. This is appropriate praise for another aspect of the employee's performance. Thus the discussion sandwiches criticism between praise. Keep this final praising brief but sincere so the employee feels better but is still focused on the need for improvement when leaving your office. If you can't find much to praise, send the employee on his/her way by saying in essence, "Fix this and it will improve your chances for "X." X may be chances for promotion, a desired job transfer, or some other award that is a good fit for the employee's aspirations. Do this in a non-threatening way.

MENTORING ALTERNATIVES

Some mentoring relationships just don't work. Reasons include personality mismatches, the staff member's discomfort with the authority of the manager, or some other factor. No two people respond to feedback and constructive criticism in the same way.

If you as a manager are not able to establish an effective mentoring relationship with a staff member, look for alternatives. Mentors need not be power figures such as an employee's manager. However, they have to be respect figures — individuals the staff member respects. In interviewing experienced lab professionals nearing retirement, I've learned that many want to mentor younger co-workers. Indeed, many feel a real commitment to do so in order to leave a constructive legacy behind them when they retire. Managers should encourage this.

Highly accomplished lab professionals that engage in many of the activities that younger employees also perform seem excellent candidates to be mentors. However, these experienced employees do have to want to mentor. Many engage in activities that gradually develop into mentoring relationships. These include talking shop, going to lunch, and sharing a lab with younger colleagues. However, for one person to approach the other and asking to be mentored or volunteering to mentor often creates an uncomfortable situation. This does not promote effective mentoring. This is a drawback of corporate programs in which employees are assigned mentors.

The team workplace environment provides opportunities for mentoring alternatives. When a manager places a staff member on a team, the staff members can use successful fellow team members as role models. By analyzing the role model's behavior in the work environment, the staff member can get ideas for how to improve his own work performance. Performance reviews with a manager who doesn't mentor can still define areas in which the employee needs to improve his/her performance.

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

John K. Borchardt

The Keys To Unlock Your Top Performers' "Discretionary Energy"

The investments your laboratory makes in creating a high performance culture and retaining top talent are key to optimizing workforce engagement and unleashing the "discretionary energy" of key performers.

That's because individual output ebbs and flows based on individual employees' sense of belongingness, their fit within your lab environment, and the sense of self-satisfaction they get from giving the very best of themselves to the role they're in and to your organization as a whole.

That's according to Alan Guarino, the author of *Smart is Not Enough!*, in which he contends that so-called 'book smarts' aren't the only ingredients for success in a management role. And he argues that the common denominator for high performance teams is a culture in which the most talented managers are "engaged, empowered, excited and proud" to be part of its steady growth.

It's important to understand, Guarino contends, that they, like other employees, have their own "discretionary energy," and their willingness to put it to work for your organization depends on their feeling of engagement with your mission, culture, and reward system.

The retention of key lab managers is critical because they model the right behaviors and mirror the organization's culture in all of their dealings with other lab employees. But, he adds, "You can't do retention."

The best teams — both in the laboratory and outside it — continually reinforce high performers' sense of belonging to maximize the contribution of individual employees by re-recruiting them and giving them reasons to stay and feel an important part of your team.

Their discretionary energy reaches its apex when these critical team members believe they fit with the group culture and are surrounded by other team members with the same commitment to individual and organizational performance.

What It Means For Your Career: If you're not giving your best effort to your current employer, you're likely wasting your time and theirs. It's up to you to find an environment that will excite you, challenge you, reward you, and keep you engaged at the top of your game. You owe it to yourself to find the right place and the right role to develop and push your abilities — and your "discretionary energy" — to advance your career.

Joseph Daniel McCool *is a writer, speaker and consultant on talent management, recruiting best practices, and corporate management succession. He is the author of Deciding Who Leads: How Executive Recruiters Drive, Direct & Disrupt the Global Search for Leadership Talent, to be published in April by Davies-Black Publishing. He is a contributor and online columnist for BusinessWeek and also a senior contributing editor with ExecuNet, a leading executive business, recruiting and referral network. His perspectives on recruiting best practices have been cited in The Economist, The Financial Times, The Wall Street Journal and other media around the world. Contact him at JoeMcCool@comcast.net*

Joseph Daniel McCool

Ray E. Clement, Ph.D.
Senior Scientist Research and Development
Ministry of the Environment
Ontario, Canada

Never mind that it's the title of a 1999 movie, starring Robert De Niro. "Analyze This" is the right title for the story of a life, starring Ray Clement.

"It depends on the way you think," said Clement. "I always like taking a clump of stuff and trying to figure out what's in there. It's kind of fun. There are other people who think like that too, and they should go into this business."

But they're just not making analytical chemists fast enough; demand outstrips supply, the workforce is aging, and Clement worries that his profession isn't sufficiently "sexy" to attract fresh talent. "How do you get young people enamored of something beside Hollywood?"

So Clement, a natural storyteller, makes it his job to educate students and other opportune publics about the value of his profession. "If chemistry is the central science," he tells them, "then analytical chemistry is the backbone."

He is four parts environmental research chemist and two parts industry promoter, with a nose for issues that bear on the successful uptake of the next generation of career chemists — mentoring, networking, and management's care and feeding of staff

His personal story is the stuff of good timing and network power. Through a "process of elimination" he wound up majoring in chemistry in college, where he parlayed his aptitude for programming into graduate school, where he met Dr. Francis Karasek, who was then pioneering instrumentation methodologies for trace analysis of hazardous substances.

Clement bore down. He tamed his wandering mind and developed expertise using gas chromatography/mass spectrometry equipment at about the time that dioxin hit the fan in the 1980s, which served to light the fuse for the explosive growth of environmental research and public awareness of industrial toxins.

"We were," he said, "the first people in North America to research dioxins" in incinerator ash.

Karasek taught him that results matter. "One day when I was miffed over him praising someone else, he looked at me and said: 'It's not what you can do, it's what you do do.' And I never forgot that." Karasek subsequently introduced him to the manager of a lab studying dioxin levels in Great Lakes' fish, who gave Clement his first government job. "She gave me the room to take off, then got out of my way and let me fly."

Clement is now senior research scientist in Ontario's Ministry of the Environment. On his office wall is a quote by William James summarizing his management credo: "The greatest discovery of any generation is a human being can alter his life by altering his attitude."

Which brings Clement to a favorite pet peeve of modern life — short term thinking. "Nature thinks in terms of hundreds and thousands of years. Yet I know people who don't think past their next meal."

Short term thinking "is almost always related to some kind of budget issue." Clement poses a scenario where a lab manager with a knack for surviving audits opts to invest in technology instead of conference training for key staff. "That comes back to haunt when your leaders walk out the door because they feel professionally stifled or isolated. In any organization, only a few people rise up to become leaders. You have to protect those people. Now who's going to run the show when your lab gets that big new multi-million dollar contract?

"So your first job as manager is try to let employees do what they're good at, and see they get the support they need. People will walk through walls if they have loyalty to you.

"Number two is good communication; if it's bad news, focus on the issue, not the personality.

"Number three, it helps if you really care about people. Some people do, they're warm and cozy, and some really don't care that much. Both can be effective managers, as long as they understand there's a social contract between management and staff. I think more people now understand that reward and recognition, stopping to celebrate success, is important."

F. Key Kidder

Clement concedes managers have a "really difficult job," balancing demands "from all kinds of employees at different levels who want to get ahead and be noticed" against departmental directives sent down from above. "How many people have all those skills, and are good at all of them?

"It all comes back to attitude — managers understanding they don't know everything, and that the work will get done through the staff."

Clement has always been a keen student of personal interactions like mentoring.

"True mentoring comes from people taking a true interest. You just can't demand that of somebody who's not a people person. But employers want to run programs to make sure everybody gets mentored; lots of companies think you can get mentoring in a box. They buy a book and have all their managers read it, or put some junior person through a six-week training program. It doesn't work that way. Never has and never will."

Clement says it takes about ten years to acquire expertise — in mentoring or any other discipline. "You have to experience all the different combinations of things that can happen." He says mentoring is most beneficial either early in one's career or at a point of career transition.

He became intrigued by a recent white paper analyzing mentoring studies which demarcates the ability to "articulate clearly to others how an expert thinks (and) operates" into seven levels of competency.

Only those who attain the most advanced level of a "consciously competent expert" are efficacious mentors. One step below is the "expert," who typically has 10,000 hours of experience and/or "50,000 chunks of field-relevant information." But because experts operate on "autopilot," they lack the necessary communication skills to mentor effectively.

According to the white paper, programs promoting knowledge transfers and mentoring initiatives can result from "feel good" organizational attempts to deal with "the transfer of training problem" and are doomed because they are conceived by "amateurs."

Other barriers can include tasking already overworked staff to participate in mentoring programs, and a lack of sustained management support.

"My recommendation," says Clement, "is to get a professional in to show them how to do it right."

Francis Key Kidder *started out as a journalist before moving on to politics and government relations, where he still keeps his hand in writing. He may be reached at 410-828-6529; info@labmanager.com.*

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