MODULAR LABS GOING MAINSTREAM

SYSTEMS WELL SUITED TO THE GROWING MULTIDISCIPLINARY NATURE OF CURRENT RESEARCH EFFORTS by Bernard Tulsi

At some point in his or her career, every lab manager has had to—or will have to—grapple with one or more of the following issues. How can we conduct multidisciplinary laboratory activities under one roof? What is the most efficient and cost-effective way to add new laboratory space? How can we refresh, modify, or replace fixed lab facilities?

Flexible modular laboratory buildings have evolved as innovative answers to these often-daunting questions. Modular buildings can be packed and shipped to different locations on demand, they can be erected or rearranged within hours, or they can remain in one location as highly flexible additional laboratory space.

Over the years, modular laboratory units have been much in demand from government departments that have responsibility for overall environmental surveillance, including air- and water-quality testing and rapid response during natural disasters, disease outbreaks, and terrorist attacks, especially those that may lead to the release of toxins and pathogens. Now that same interest is moving to corporate and university labs.

On top of their inherent traits of mobility and flexibility, modular units offer a number of clever inclusions that have made them more ergonomic and operator-friendly than traditional laboratories. Some of the available innovations are wheel-mounted workbenches; ductless fume hoods that are not attached to large, fixed air handling systems; point-of-use ultrapure water systems; localized (versus centralized) vacuum systems; and labor-saving devices that are conveniently hitched onto walls and ceilings.

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To be sure, these attractive characteristics have not gone unnoticed, and now modular labs are increasingly evident in more traditional settings. "Many companies and universities are building and renovating lab space, and confronting the fact that the rapid advances in science and technology demand that lab space be flexible enough to adapt to changing scientific priorities and technology tools," says Peter Coffey, vice president of marketing with Vacuubrand, which manufactures and sells high-performance laboratory vacuum products.

He notes that a number of cities have developed research parks to serve as incubators for technology start-ups. The hope is to replicate the success of Boston's Route 128, California's Silicon Valley, or North Carolina's Research Triangle, from which more than a few fledglings grew into global players. Coffey says, "New research parks generally have a rotating array of tenants, each with unique needs. These tenants need utilities that are separate from one another, because their needs are different, because they need to avoid cross-contamination, and because the building manager needs to keep billing separate. There is also a strong movement to design labs for flexibility or modularity, to avoid obsolescence and the costs of renovation, and to adapt to changes in mission."

That is certainly the case with laboratory water systems. Wayne Darsa, director of the North American Health Sciences division of Siemens Water Technologies, says that his company builds "modular systems for large medical areas, small areas or clusters of labs, and

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Siemens Water Technologies does not have a separate division for modular labs. Darsa, who works with both modular and traditional labs, defines modular water systems as "smaller central or point-of-use systems going into one or a series of laboratories." He says that, depending on the specific circumstances, there are important installation and operational costs and management differences between modular and traditional labs. In traditional settings, one water system feeds into many areas, whereas in modular labs, multiple systems supply individual departments, according to Darsa.

A common configuration for a small central vacuum pumping system: two pumps and a control panel mounted on a ballast tank in the basement.

"The advantage is that if one modular system goes down, the lab or group of labs that it was feeding can go to another floor or lab to obtain water. When a traditional system goes down, or has to be sanitized, water is inaccessible for a few hours to a few days," he says. Darsa adds that modular systems are designed to meet specific water needs—for example, genetics labs need to keep bacterial levels low and need to sanitize water more frequently.

Darsa believes that modular water systems offer many advantages, but also that there could be drawbacks. "I have seen modular systems that are much more expensive, both in installation and operational costs, than traditional systems. On the other hand, there is no comparison to the flexibility advantage that modular systems have."

He notes that modular systems are not necessarily more environmentally friendly. Traditional water systems have more efficient drainage, because they use variable-speed pumps to control energy and reduce output. Large modular systems save energy and water through the use of reverse osmosis, where recovery rates are high. In smaller modular systems, the recovery rates are low and a higher percentage of the water is sent to drain. "When you multiply that by hundreds of units, the water loss could be substantial," Darsa says.

When deciding on a water-supply system for a modular unit, lab managers should weigh a number of issues, including the volume of water and the number of end points that will be required, according to Darsa. Some labs may need ultrapure water and validation, but they may also have humidifiers that need different quality rates and flow levels, as is often the case in biopharmaceutical labs. "There is always a need to weigh the pros and cons of modular versus traditional systems," says Darsa.

Siemens offers water technologies for all kinds of laboratories. Its largest modular system, the Centra reverse-osmosis and deionization system, can be placed in a closet or central area and can feed five to 10 points of use. Considered inexpensive to operate and maintain, the Centra system can, depending on the code requirements for the distribution tubing or piping, accommodate any type of material—such as stainless steel or polyurethane. This system is often seen in biotech, food-processing, pharmaceutical, quality-control, and research labs, where they are regulated in much the same way as in traditional labs.

With local vacuum pumping systems, the pump fits under a fume hood, with manual or electronic vacuum controls mounted on the fume hood panels.

Today, Siemens has the largest market share in overall water purification. Another major water-systems supplier, Millipore, is the largest in the laboratory market. Darsa says that modular labs have become more prevalent in

the last four to five years. "The market is not necessarily broken down as modular versus traditional, but modular is seen as the growth laboratory market." Darsa believes that, over the next several years, modular systems "will continue to grow and take away from central systems." He bases this prediction on the views of architects and engineers who are active in this area.

Vacuubrand's Coffey says, "It used to be that science would be done in silos. You would put all the biologists in one place and the chemists in another. The common objective now is to build multidisciplinary buildings." This he sees as one of the driving forces behind the growth of modular laboratories.

▲ *A point-of-use modular water system. Tap feed RO/EDI system provides Type II quality water, but will achieve 10 Megohms consistently.*

Turning to his company's specialty, Coffey says that central vacuums have been the traditional approach. "Historically, there was no modular alternative—only one pump per application at a time. Already, the trend in Europe is that local (modular) systems have displaced the central approach, largely because the local approach offers higher-quality vacuum. Modular vacuum systems are new enough in North America that growth rates are high, because penetration is low. In Europe, where there has been greater acceptance, market penetration occurred in the last decade, and there was fabulous growth over the last 15 years. Growth in Europe is slowing now, since local systems have become the standard approach," says Coffey.

He notes that, typically, a central vacuum is installed throughout a building for filtration purposes. If high-performance vacuum were required, however—to manipulate evaporative boiling points, for example—another pump would be installed next to the central vacuum port.

▲ *Custom overhead service carriers, mobile cabinets, and fixed steel casework. Project: Carnegie Mellon University, Pittsburg, PA.*

This would provide two different ranges of vacuum.

"If you don't have to install a central vacuum system throughout a building, and can put the vacuum only where it is needed, and the vacuum system you install has the ability to do what all the dedicated pumps would do, you effectively eliminate much of the need for the dedicated pumps and the central vacuum system—in effect, eliminating a duplicate investment. The idea is to do it in a modular way and put the vacuum where it is needed," says Coffey.

"A lot of people have begun to question the need for the central vacuum system—and many have stopped using them. Because central vacuums draw waste vapors into in-wall piping, institutions are choosing to leave them out of many new buildings," he says.

Coffey predicts increasing acceptance of the modular approach over the next few years. "The critical mass of awareness that happened in Europe will happen in the U.S. as both architects and scientists become more familiar with modular systems," he says.

This view is shared by Chip Diefendorf, Director of Business Development at Mott Manufacturing, which makes and sells furniture for both modular and traditional labs. He says that modular lab furniture has been an area of focus at Mott Manufacturing for the past 15 years. "A

▲ *Mobile cabinets (Sigma Carts™). Project: The MaRS Center, Toronto Medical Discovery Tower, Toronto, Ontario, Canada.*

variety of tables and work stations that are integrated with overhead service carriers have taken quite a jump in the last five years," he says.

"Typically, there is a blend of these two systems. Modular systems allow the lab to be quickly and easily modified to meet changing requirements, such as adjusting a new piece of equipment to a person with a disability. It allows a lab to serve different purposes. Modularity gives you the ability to reconfigure and change."

Diefendorf says that flexible modular furniture solutions generally have a higher initial cost, and the difference depends on the solutions in question. "Typically, you are going to pay a premium for flexibility. However, there will be cost savings through the reduced need for renovations, with the opportunity for quicker lab reconfiguration," he says.

Laboratory furniture is a crowded market segment, with several large manufacturers throughout the U.S., the Middle East, and Asia, says Diefendorf. "Plug-and-play furniture systems and pedestal cabinets are growing the fastest, and the largest markets outside of North America are the Middle East and Asia. Higher education and the government sector are the most active market for this furniture," he says.

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