LABORATORY DESIGN - JANUARY 2007

OUTSIDE THE BOX: RECONSIDERING RESEARCH AND INSTRUCTIONAL LAB SPACE

By: *Fred S. Marino, AIA*

The philosophy driving today's research and teaching laboratory designs has significantly changed from the philosophy of even a decade ago and we will continue to see significant changes in the future. Rather than build a "closed" highly specialized research labs to accommodate an individual principal investigators, architects now design buildings with more open, flexible, generic labs and interaction spaces that encourage teamwork and interdisciplinary collaboration. Teaching labs and support facilities are also being designed to be flexible and allow for more interaction between teacher and students and among students themselves.

This emerging new model creates environments that respond to present needs and will be able to accommodate future demands, according to the National Institute of Building Sciences (NIBS). Its web portal www.wbdg.org/design/labtrends.php is guided by representatives from over 25 participating federal agencies, private sector companies, and non-profit organizations.

According to NIBS: "The most productive and successful scientists are intimately familiar with both the substance and style of each other's work. They display an astonishing capacity to adopt new research approaches and tools as quickly as they become available. Thus, science functions best when it is supported by architecture that facilitates both structured and informal interaction, flexible use of space, and sharing of resources."

According to NIBS' recent report, "Trends in Lab Design," several key needs influenced the development of this model:

- The need to create "social buildings" that foster interaction and team-based research.
- The need to achieve an appropriate balance between "open" and "closed" labs.
- The need for flexibility, to accommodate change.
- The need for technology that provides access to electronic communications systems throughout the building.

In addition, there is a vital need to incorporate advanced technologies, instrumentation, and support infrastructure into both research and instruction spaces. Since these technologies are often costly and change continually, locating them in a centralized shared support or core lab not only provides better accessibility, but also promotes interdisciplinary interaction: a key to modern science.

While open, flexible research labs offer many advantages, they also can pose some disadvantages. In certain instances, depending on the type of work being done in the lab, an open lab may be problematic in terms of control and containment. Therefore traditional labs have their place. The goal of lab planning, then, is to help investigators and instructors think differently than they have in the past, to reconsider how their institutions conduct research and/or teach in their science labs, to figure out how they can balance good design with a cost-effective, flexible solution.

Planners with our leading laboratory design firm, Baltimore, Md.-based Design Collective, Inc., take a process-oriented approach to designing successful research and teaching labs. The process is based on natural leadership; rather than forcing a design, planners always keep in mind that the most successful project is one that meets all of the client's goals. One of the most important aspects of this process is to involve all constituents, listen to their concerns, educate them on trends and ultimately build consensus by reviewing examples of similar approaches taken on other projects.

The following are key strategies found to work well for both teaching and research facilities.

LAB FLEXIBILITY

The most flexible type of research labs generally require higher first costs with mobile casework, but provide a significant degree of flexibility and over time offer less costly renovations to retrofit a lab for a new investigator. In addition, some of the increased costs for mobile casework can be offset by using it in with the "open lab" concept, which conserves money otherwise spent on walls and other types of separations.

Flexibility In teaching labs can also be achieved through various means depending on the curriculum. For instance, for a chemistry teaching lab, our firm designed the lab bench in a "bullpen" or "horseshoe" configuration that offers a high degree of flexibility for various room uses. The lab can be used as a wet lab, dry lab or an instructional space. It can be quickly converted from chemistry instructional space with movable seating in the center of the space to a wet bench teaching lab—or even to space for an entirely different curriculum.

Moreover, the U-shaped design can be "zoned" so the inner ring of the "U" is designated dry and the outer ring wet, or vice versa. Moveable chairs give students the option to slide to different zones, or simply stand. Fixed items such as fume hoods, benches, cabinets, sinks and showers can be located on the room's perimeter, to make them less obtrusive. Informal instruction as well as lectures take place in the center of the horseshoe and is supported by the use of technology located on the instructional wall directly in front of the "bullpen". Items such as pull-down screens, flat screen monitors in the bulkhead and a white board enhance the room's capability to be both an instructional and a wet teaching lab.

Biology, chemistry, and physics instruction labs all can accommodate a variety of lab bench configurations, though they each require the use of different equipment and instrumentation each warranting a somewhat different teaching methodology. Thus, each institution must weigh the pros and cons of various design options and accommodations for each discipline.

For example, a lab that will be used primarily for biology instruction may have moveable tables in any one of several functional configurations fed by overhead service carriers/utilities and quick-connect piping. Overhead carriers and moveable tables are great for reconfigurability, though the array of piping, wires, and cabling descending from the carrier can also by somewhat constrictive. (both physically and visually). Expensive instrumentation on moveable benches is also vulnerable to possible damage from being knocked off. The compromise-fixed casework in a modular arrangement-doesn't allow a spur-of-the-moment reconfiguration of lab benches, but it does solve some other issues related to utilities (particularly water supply and drainage). Depending on the users, it can also provide a higher degree of safety and durability.

GENERIC RESEARCH SPACE

Generic research space--where all labs are the same size and outfitted with the same technology, utilities, services and casework--may be a sensible option when an institution is uncertain who will occupy the space or what specific type of research will be conducted there. Many designers believe this approach has an added benefit: In that it is less costly to construct than a custom lab for each investigator. The most successful generic labs have some degree of flexibility built in and can be easily modified for the installation of new equipment, casework or services. A generic lab incorporates fixed or mobile casework with a standard type and quantity of furniture and utilities.

ORGANIZATION BY CLUSTER VERSUS ZONE

University research buildings tend to be organized in zones by space type, whereas small colleges in the past tended to cluster offices, research and teaching laboratories. The trend for the future is that the smaller colleges are adopting the larger institutions' zoning approach, which provides several benefits. Zoning promotes interdisciplinary interactivity and improves both students' and faculty's access to specialized scientific tools and instruments such as electron microscopes (which can be located in core labs) and support lab activities such as tissue culture rooms. Further, zoning offers significant economies of construction and building operations through appropriate systems design for each zone.

TECHNOLOGY EXPANSION

Whether space is designated for research or instruction, the need for current and future technology--and associated infrastructure--must be incorporated into lab space design from its earliest stages. Multimedia communications, for example, have become commonplace. Space and cabling for video feeds and video monitors/instruction screens should be accommodated. A moveable lectern and or demonstration table, fitted with a laptop to project instruction on an overhead screen, is standard in many labs to enhance the labs instructional capabilities and flexibility.

In the future, research may not utilize much (if any) wet lab work; computers may take more of a front seat through virtual labs and virtual reality. In fact recent trends in research indicate that the need for dry bench or computing space is increasing thereby decreasing the need for wet lab bench space. Benches should thus be sized to include adequate space for computers at each end; modular furniture should be incorporated to prepare for the possibility of equipment changes. Finally, although much modern equipment utilizes wireless hook-ups, the technology remains unreliable. Many labs therefore set up both wireless and hard-wired infrastructure.

ACCELERATION OF SCIENCE

Labs planned as "social buildings" that support team-based research are an increasingly important element in design strategy. As science facilities move forward it is clear that how scientists' ability to interact could lead to significant breakthroughs and possibly change how we live. To promote teamwork, academic buildings should include convenient places for students and faculty to mingle. Breakout spaces or nooks, with spaces to write, talk or connect on-line, should be placed between labs. Likewise, lounges between instruction spaces promote casual interaction. Spaces may include comfortable chairs, scientific artwork, snack vending machines, white boards, and flat screens. To take advantage of every square foot, designers should incorporate social spaces along natural circulation routes. Vertical meeting spaces in staircases, for example, are an optimal way to create informal places to meet and exchange ideas. These may feature built-in seats; they may also open to the exterior or to an atrium in which we can engage the building occupants and visitors in science with collections, displays and poster session space.

The days of the enclosed, four-walled lab, in which researchers work alone and hoarded their intellectual property, are waning. An ever-widening variety of labs—from wet biology and chemistry labs to engineering labs and dry computer science facilities—now incorporate open designs. In fact, most lab facilities built or designed in the U.S. since the mid-1990s possess some type of open lab, according to NIBS. Closed labs, NIBS acknowledges, are still necessary for specific kinds of research or certain equipment. In addition, some researchers find it difficult or unacceptable to work in a lab that is open, and may need dedicated space.

Designers must thus make compromises when they plan open research and teaching labs. However, laboratory design has unmistakably become more open, flexible, and interdisciplinary. The key is to reconsider how space was used in the past, and to think outside the box to maximize its optima current and future use.

Fred Marino, AIA, Principal, Design Collective, Inc., can be reached at 410 685 6655 or fmarino@designcollective.com