Lab Trends for the Next Five Years

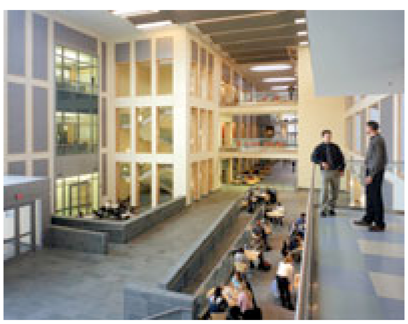
What types of laboratories will be built within the next five years? What will drive these projects? What will their most dominant features be? The outcome to each of these items may very well be dictated by a series of trends driving the current laboratory design climate.

Limited capital = Cost conscious buildings

Overall, there is less funding for research buildings now than in the late 1990s. The recession meant less tax revenue for public capital projects. Companies with lower earnings are less prone to embrace large capital projects. The pharmaceutical industry has slowed or stopped its expansion of its R&D workforce. New federal funds are being redirected toward biodefense and homeland security and chargeback rates for federal research grants have drawn more scrutiny.

The bottom line: Capital approval for a lab, public or private, is now harder to obtain.

Consequently, lab projects have become a lot more selective and increasingly cost-conscious. But cost-effective strategies, particularly in energy consumption, are being worked in. Just-right-sized mechanical systems are now being designed with lower HVAC requirements. User equipment electrical loads are also being challenged and features, such as operable windows in office zones and recirculation of lab air for local cooling, are back in fashion.



The "collision area" just outside the lab at Cornell's recently completed Duffield Hall literally forces lab workers to run into one another. (Photo: © Larry Falke Photography)

Interdisciplinary science = New projects

These labs house university researchers whose work does not easily fall under any traditional department. Many of these individuals work between the boundaries of medicine, physics, chemistry, biology, engineering, mathematics, and computational science. As such, the labs for these researchers often do not fit in a building designed for a pure discipline, prompting universities, such as Duke, Durham, N.C.; Baylor, Waco, Texas; and the Univ. of Michigan, Ann Arbor, to build separate labs to house these "trans-disciplinary" scientists.

Such buildings are incorporating features designed to keep the exchange of ideas between these dynamic researchers flowing. Library rooms merged with a break room merged with a private group library are being offered, along with community spaces such as multi-ethnic food courts, collision areas, huddle rooms, and group discussion areas.

These efforts are being pushed along by the National Institutes of Health's "Roadmap" which aims to fund more interdisciplinary science. The Howard Hughes Medical Institute, Chevy Chase, Md., is also funding more team research that will scientifically "bless" and accelerate this type of work.

Lab furniture = Kit of parts

The high cost and time delays of reconfiguring fixed lab furniture are no longer acceptable. Many labs are turning to a set of pieces or kits that users can chose from to make their lab. As much as possible, the user can assemble the pieces themselves. Consequently, the pieces have gotten simpler (tables, carts, and shelves).

Utilities are less frequently built-in and more often hung from the ceiling on hooks, rails, or cableways. Flexibility and adaptability are still very important. A lab may have all the furniture for wet bench work, just the overhead utilities if equipment carts are underneath, or no furniture if large equipment is installed. A key requirement in many new labs is that the furniture and in-lab utility systems be able to easily and economically convert between all these configurations.

Given that many of the labs might not need a full complement of pieces, some owners are only purchasing two-thirds or three-fourths of the furniture rather than fully furnishing all the labs.

Shared buildings = Open labs, LERs, and core resources

There are now buildings shared by two or more independent organizations. Completed in 2003 at over 35,000 m^2, the largest shared lab building, the Queensland Bioscience Precinct (QBP), Australia, houses one university institute plus five government lab groups. Individually, they would not have been able to afford new buildings, but together they assembled the funding for a very large project.

High-field NMR is a shared core resource at the QBP.

Large open laboratories are often used so that benches can be easily reassigned without moving walls, with a typical lab featuring 20 to 24 bays of benches. The advantage of this approach is that there are no lab sizes to administer; benches are simply reassigned as groups grow or shrink.

Many of these labs now sport glass walls in the labs to promote team awareness and give more visibility for safety.

Shared linear equipment rooms (LERs) are used to optimize the use of space and raise the useable efficiency of the lab footplate. These spaces are actually very wide (3.7 to 4.3 m) rooms often extending the length of the lab block. They serve the dual purposes of circulation as well as a place to house large non-technical equipment (freezers, refrigerators, centrifuges, and supplies). They work best in bio-science labs with high amounts of equipment that must be in close proximity to the lab. Core resources—animal housings, electron microscopes, nuclear magnetic resonance (NMR) tools, greenhouses, central stores, sequencing tools, parallel computing, BSL-3 labs—are shared and often operate on a chargeback basis.

Interestingly, several state governments are now funding large shared lab buildings in the hope they will house not only university institutes but also start-up biotech and bio-medial device companies. The Arizona Biodesign Institute, Tempe, and Scripps Florida, Jupiter, are the largest of these projects. Both states are spending nearly $500 million each to fund these projects in the hope of nurturing a bio-science industry in their states.

New technologies = New lab types

Two new lab types have expanded greatly: nanotechnology and biodefense. New engineering labs often contain nanotechnology fabrication areas, characterization suites of electron microscopes, adaptable labs for substrate preparation, and device assembly and testing. The fabrication areas are like those found in the semiconductor industry while the characterization suites have very low vibration, acoustic, and EMI limits.

The National Institute of Allergy and Infectious Diseases is currently funding BSL-4 labs at Ft. Dietrich, Md., and Rocky Mountain Labs, Denver, Colo., as well as the National Biodefense Labs at Boston Univ., Mass., and the Univ. of Texas at Galveston. Nine BSL-3 Regional Biodefense Labs have also been awarded. In addition, states are building their own BSL-3 response facilities. The funding in this field has risen over 800 fold in 5 years.

All of these buildings have “embedded high performance subspaces.” These are labs or rooms that either (a) house expensive equipment (e.g. ultra high-resolution electron microscopes) requiring extreme vibration, EMI, and temperature protection, or (b) allow workers to manipulate dangerous organisms or substances.

In both cases, the building design is focused on making these special spaces work perfectly and without failures.

Also, as most research in physics and engineering requires custom-built equipment and as more researchers utilize these atomic-scale tools, the need for lab spaces with high performance environments will continue.

A design conundrum

We are asking our new lab buildings to yield higher performance spaces and greater adaptability, but at a lower first cost while operating for less expense. The challenge to owners, planners, and designers has never been more difficult.

—Richard Rietz

About the Author:
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