

Flexibility Drives Planning for Research Facility Construction and Renovation

New Tools and Strategies Available to Analyze Flexibility Options

Flexibility is the critical cornerstone to ensure that research facilities will be able to accommodate future changes involving staffing, equipment, and space. Incorporating flexibility into the design of construction projects makes it easier to adapt to changes that may not occur for many years.

“One of the most obvious reasons we try to accommodate change is because the size of a group or team grows and shrinks according to funding,” says Jon Romig, director of Science + Technology in the Boston office of The S/L/A/M Collaborative, an architectural, engineering, and planning firm. “Our scientific equipment and the techniques we use are also constantly evolving at a rapid pace, so a primitive piece of equipment from five years ago may become a very complex piece of equipment that requires special accommodations.”

The type of research being conducted is also becoming more interdisciplinary with an emphasis on translational research. For example, many facilities, such as the Emory University Pediatrics Research Building, are now accommodating both clinical research and clinical care, a scenario that was not common a few years ago.

Research facilities must be able to adapt to altered national priorities which set the pace for funding a wide variety of research projects and innovations. Federal government trends show the NIH has been decreasing funding to support biomedical facilities, while funding for the physical sciences from other federal agencies has been increasing and is expected to continue to grow. Comparing the level of NIH funding to the amount of new space that has been created for biomedical research in the United States reveals a situation similar to a real estate bubble.

“Based upon these trends, we have overbuilt our biomedical research space,” says Romig. “We predict that, in the near future, we are going to be looking for biomedical facilities to accommodate different types of research.”

New Type of Research Space Needed

The next generation of buildings must be prepared to accommodate not just biomedical functions, but also increasingly interdisciplinary research. In particular, Romig predicts there will be a growing need for more space to facilitate physical sciences, computational, and engineering research (PSCE).

Organizations must be prepared to take advantage of increased funding to support PSCE research by increasing the construction of PSCE facilities; retrofitting biomedical space to suit PSCE; developing flexible facilities that can toggle between biomedical and PSCE; and repositioning biomedical researchers to seek PSCE funding, pursuing new or existing investigations.

There are significant differences between buildings optimized for biomedical research and the new generation of facilities that can accommodate a broader range of sciences and engineering research. Biomedical research facilities typically have lab modules that are 10 feet, six inches, while PSCE buildings typically have 11-foot or larger modules.

In addition, biomedical facilities are bench-intensive with a highly repetitive lab module; have a floor-to-floor height of between 14 and 15 feet; have a population density of about one person per 200 gsf; have a nominal floor plate of 25,000 gsf; have a maximum clear structural bay of 21 feet by 30 feet; and use standard lab finishes, such as VCT, painted drywall partitions, and acoustical ceilings.

By contrast, PSCE buildings are equipment-driven with less repetitive lab modules and more specialized labs; have a floor-to-floor height of 16 to 20 feet and upwards to accommodate interstitial and high bay space; have a population density that varies from one person per 150 to 400 gsf; have a nominal floor plate of between 20,000 and 50,000 gsf; and feature masonry construction and finishes that are more durable.

The PSCE buildings also feature special exhaust systems, specialized MEP systems, greater vibration control, and fume hood/ventilation density that varies up to more than 30 air changes per hour in the labs. The standard biomedical buildings have very few special MEP systems and the fume hood density may result in as low as six air changes per hour in the labs.

Examples of Next-Generation Buildings

Designed by The S/L/A/M Collaborative, the Rollins School of Public Health at Emory University epitomizes a next-generation facility, especially as the building is almost equally divided into dry and wet lab activities with constant interaction. The design includes oversized shafts so the unpredictable nature of the building's functions can still be accommodated in vertical pathways. A swing zone between the open lab and the support lab areas can be used as either dedicated or shared space. The ratio of dry to wet labs can be easily adjusted as needs change.

"The dry and wet lab relationship is really tight and they are both on the same floor, but we have the space to convert either way, depending on the need," says Romig. "We're planning ahead to address changing needs."

The S/L/A/M Collaborative is also working on a project at SUNY Buffalo's School of Pharmacy, where only 30 percent of the research floor is used as generic lab space. This is a common trait of next-generation buildings where more space must be dedicated to specialized functions.

The generic labs are located towards the middle and surrounded by the areas devoted to specialized functions. The boundary between offices and labs is very soft and can be changed over time.

Another example of converting a facility to a next-generation building is a facility for a major biotechnology corporation in Framingham, Mass. The 40,000-sf building was previously used entirely for basic research. However, the renovation, completed in February 2008, now allocates 10 percent of the space for basic research. This represents the maturing of the life sciences industry that is occurring globally.

“Flexibility can be scaled from the smallest detail, such as the way power and gases are delivered, all the way to a campus master plan for an institution that has various functions,” says Lois Rosenblum, a principal at The S/L/A/M Collaborative. “Businesses know where they want to go, but nobody can predict the future, so we create a flexible framework that can be implemented over time.”

Making 20 percent of a facility flexible is a good starting point. For instance, 20 percent of the casework and the space in each lab should be extremely flexible. Twenty percent of the labs on each floor should be capable of handling specialized functions. Likewise, 20 percent of the buildings on a campus should be able to handle a wide variety of programs and accommodate physical science, computational, and engineering research.

Why Flexibility is Needed

Flexibility is necessary because change is inevitable, regulatory requirements continue to evolve, scientific innovation is growing at an increasing pace with emerging models and methods, and more facilities are using mixed-reality environments where they conduct research both in the physical and the virtual world. The Jordan Hall of Science at the University of Notre Dame has an example of a mixed-reality environment where the planetarium is being used not only for its traditional purposes, but also to study biological topics.

“Multiple and often shifting barrier and containment needs must also be taken into account when you start to plan and design new buildings or renovations,” says Rosenblum. “There are also more customers today, due to the collaborative and interdisciplinary nature of research.”

Planning must be geared toward multiple groups of customers, increased collaboration, additional outsourcing or contract work, and a trend toward larger consolidated facilities. Protocols must be established for sharing core facilities. This means flexibility must be integrated into the planning, design, and construction of research facilities. Flexible swing space is necessary to enable renovations to accommodate this wider range of uses, aging facilities, higher utilizations, and faster changes.

The flexibility to upgrade facilities is also important in situations where mechanical, electrical, and other systems no longer meet current regulations or good practices. Design changes were incorporated to enhance the teaching and research labs in the chemistry building at the University of Maryland Baltimore County. The building has extremely low floor-to-floor height, but 12-foot wide corridors.

“We were able to drop a series of shafts down through the wide corridors in the building and they lead up to a new penthouse,” says Rosenblum. “We were able to upgrade this building to accommodate current good standards by planning ahead and thinking about how we could flexibly move supply and exhaust air through the building.”

The drive toward incorporating flexibility into projects is also being fueled by the shrinking construction dollar, smaller budgets, and higher construction costs. If buildings are flexible, subsequent projects will be less expensive to complete and responding to change will be easier.

Flexible buildings will also be able to accommodate the increasing need for specialized lab space. The trend toward generic lab space is being overshadowed by the growing need to support engineering applications, imaging, biocontainment, computational science, nanotechnology, and other specialized functions. The impact of automation and miniaturization is creating a trend where individual pieces of high-cost, high-throughput equipment are replacing large, generic spaces for performing many routine tasks. Flexibility must also be built into the building systems and equipment, which should be easy to access for upgrades and maintenance.

The next-generation biomedical research building may need to accommodate a long list of programs and uses, including synthetic chemistry, drug development, select agents, biocontainment, animal research, organism biology, imaging, computer science, materials science, clinical research, environmental science, and mixed-reality environments.

Emerging Flexibility Strategies

There are many terms and concepts that are used when describing flexibility. Scenario design, for example, requires working with high-level people in the organization to determine how the programs and functions of the building are likely to change in the future. It is important to find a sweet spot that is common to all of the potential scenarios.

In order to locate this sweet spot and determine where investments should be made, all potential scenarios, including research activity, can be mapped on a bell curve.

“Our strategy is to use the 80-20 Rule. You take the middle 80 percent of the bell curve, design it generically to accommodate about 80 percent of your needs and treat the rest of the facility as custom,” explains Romig. “Take these 20 percent elements off, make them highly flexible and more capable of doing a wider range of specialized functions, and this is the right balance between making commitments to flexibility in generic space and making special space that can handle just about anything.”

In order to complete a financial analysis, it is vital to utilize a concept called churn, which is the yearly percentage of a building’s total existing space that requires facilities modifications due to changes in program needs. Once the expected churn has been

determined, it is easy to calculate whether it is worth making an investment in a flexible feature.

An example where flexible casework is going to cost an additional \$3.24 per sf on a project shows a churn rate of five percent. The cost per sf of renovation would be \$205 without the feature, or \$175 with the feature, for a savings of \$30 per sf. The savings pro rated per year for 20 years equals \$1.50 for a simple payback in two years.

“Initially, flexibility will cost some additional upfront capital money, but you have to look at the other part of the equation in terms of missed opportunities of not including flexibility in your facility,” says Rosenblum. “Your operating costs may be higher, you may not be as efficient, and you may be subject to other risks, such as productivity impacts, by not incorporating flexibility.”

Another approach to achieving flexibility is just-in-time programming to avoid disparity between programming needs and the actual construction project. Just-in-time programming simply means performing detailed programming and design of spaces at the last possible date to ensure that additional changes or renovations will not be needed on move-in day of a new building.

In order to achieve just-in-time programming, design a generic, flexible facility; begin construction; and finalize detailed programming just before procurement of the fit-out elements. Additional costs can be justified by savings on move-in day renovations and a better fit using the life cycle cost analysis.

Sustainability is an important part of flexibility, as well, especially since “flexible” equates to a longer life and the use of fewer resources. “Flexible” also means more efficient operations, which result in a savings on energy and materials. Smarter, flexible buildings are more adaptable to changing conditions and evolving functions.

How and When to Incorporate Flexibility

Start thinking about flexibility very early when the project is being defined and identify potential scenarios.

“Think about what the widest futures are. This requires you to get outside the box because your user group is going to tell you what they want and need today,” says Romig. “Your responsibility to your senior administrators is to create a building that is actually going to be functional for many years, even with program changes over time.”

Justify added costs using the churn payback analysis and use the total life cycle costs of the building to justify the investment. Be sure to maintain quality standards while incorporating flexibility into the design and construction.

Quality means performance, durability, compliance, longevity, ease of maintenance, low operating cost, and flexibility. Rising costs often put pressure on facilities to adjust the quality, scope, or cost of a project. The response is often to reduce the quality by removing a flexibility feature.

“Our recommendation is to set your quality standard at the beginning and maintain it. You can adjust your scope as you go forward,” suggests Romig. “You can make your scope bigger or smaller as costs change by using shell space as a strategy to deal elastically with budget problems. This is a fundamental strategy that everybody should accept as the right way to deal with these situations.”

Reprinted with Permission © October 2008 from **TradelineInc.com**, a registered product of Tradeline Inc., a provider of leading-edge resources to facilities planning and management through conferences, publications, and the Internet community. Visit www.TradelineInc.com for more information.

Biographies

Jonathan Romig, AIA, is director of Science + Technology at The S/L/A/M Collaborative. He has more than 25 years of experience in the design and planning of complex research and teaching facilities with particular expertise in meeting human needs in the built environment for sciences. He is a recognized leader in the design of cutting-edge facilities for corporate and academic clients with more than 18 million sf of research environments for life and physical sciences. Romig is a frequent author and speaker on the analysis and understanding of emerging flexibility concepts for multi-use research facilities.

Lois Rosenblum, AIA, is a principal at The S/L/A/M Collaborative. She has 25 years of experience in the design and construction of new and renovated facilities for research laboratories, colleges and universities, and corporations. A recognized leader in the planning and design of facilities, she has been directly involved in more than 500,000 sf of vivaria and 3 million sf of research laboratory projects. Her skills include ensuring that projects respond to academic and corporate research missions; incorporating requirements for funding and fundraising; aligning budget, schedule, and quality; controlling capital and operating costs; and project designs that are flexible enough to accommodate future needs. Rosenblum serves on the Scientific and Technical Review Board of the National Institutes of Health and has been widely published in journals, such as *Animal Lab News* and *Laboratory Design*.

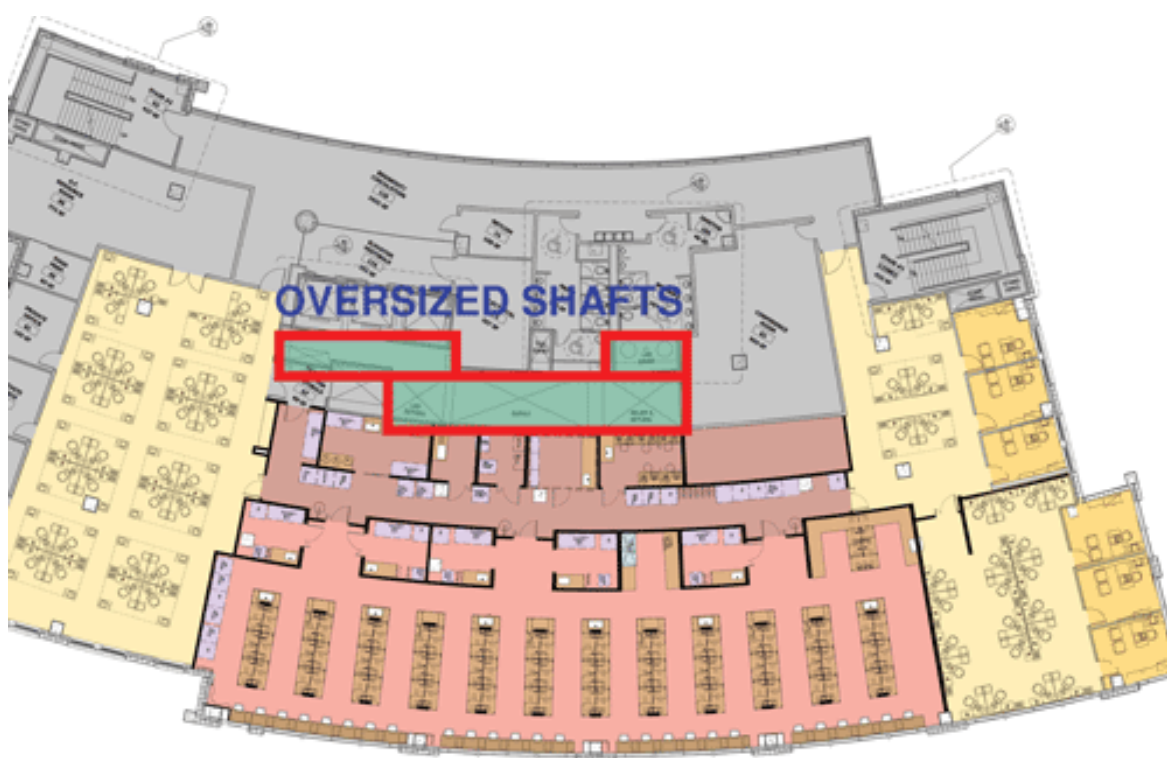
This report is based on a presentation given by Romig and Rosenblum at the Tradeline *Research Facilities 2008* conference in May.

For more information

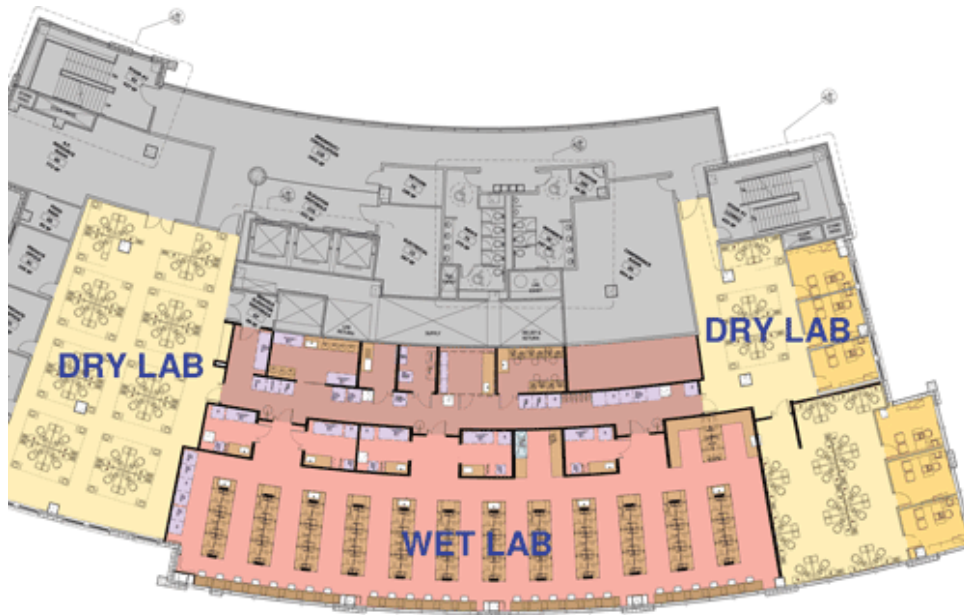
Jonathan Romig, AIA
Director of Science + Technology
romig@slamcoll.com

Lois Rosenblum, AIA
Principal
rosenblum@slamcoll.com

The S/L/A/M Collaborative
250 Summer St., Fourth Floor
Boston, Mass. 02210-1135
(617) 357-1800



Next-generation Buildings: The Rollins School of Public Health at Emory University epitomizes a next-generation facility. The design includes oversized shafts so the unpredictable nature of the building's functions can still be accommodated in vertical pathways. *(Photo courtesy of The S/L/A/M Collaborative.)*



Flexibility Strategies: The Rollins School of Public Health at Emory University is almost equally divided into dry and web lab activities with constant interaction. The wet and dry labs are on the same floor, but there is space to convert either way, depending on the need. *(Photo courtesy of The S/L/A/M Collaborative.)*



The Need for Flexibility: The S/L/A/M Collaborative designed a next-generation building for a major biotechnology company in Framingham, Mass. The building was previously used entirely for basic research, but now 10 percent of the space is allocated for basic research. This represents a maturing of the life sciences industry. *(Image courtesy of The S/L/A/M Collaborative.)*