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Lab building costs start to rebound

By Ted Hammer, FAIA, LEED AP

Construction costs are on the rise from last year, reversing course after a few years of decreases. As of the writing of this report in June 2011, costs overall have risen about 3.5% from 2010, and construction costs in the R&D sector have risen about 5% since January 2011.

Market indications of recovery—more stability and confidence from investors—are starting to impact construction costs. Though not fully recovered to pre-recession levels, costs have at least climbed back to 2009 prices. With market stabilization, the outlook for the construction industry for the rest of 2011 and 2012 should be more positive.

The most significant facts about the market are:

- This year still reflects a market in flux, and the first half of 2011 indicated a somewhat subdued market. The second half of the year, however, is expected to be stable, with a rising overall market.
- Generally, market prices have increased about 3.5% since 2010; lab costs have also increased, and though in keeping with the upward market trend, have risen about 5% since the start of 2011. They may continue to rise as the market recovers.
- Bids still attract numerous responses, and this competitive environment continues to pressure contractor pricing to remain aggressive in the current market.
- Labor rates have remained relatively stable from last year, particularly with the unions. Some revisions to work rules have been implemented, and all collective bargaining agreements are up for renewal in 2011.
- Materials costs are expected to rise 2% from 2010. Increased demand in foreign markets on limited commodities, such as steel, has also caused significant increases in market prices. Prices for steel goods are up about 20% from January 2010 and will continue to rise, as will aluminum and copper prices.
- Clients are approaching new work with caution on budget and design. Design must be smart, functional and mindful of cost.
- The broader market is still showing good signs of improvement with the recent round of

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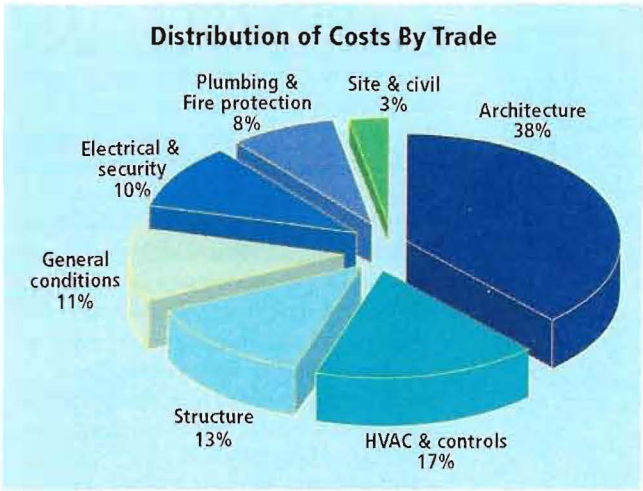

In the typical biochemistry lab building, the cost for architecture is about equal to the cost for HVAC, plumbing, and electrical infrastructure combined. However, in an animal research lab, infrastructure costs outstrip architecture costs by about 10% (data not shown).

FAST & SMART:
Design principles for academic research laboratories

By Michael Chippendale, PhD; Michael Haggans, AIA; Thomas Gieryn, PhD; and Trevor Calarco, AIA

Best practices in the design of academic research laboratories create environments that support learning as well as enable experiments to be conducted efficiently. This is necessary because there are two primary functions of an academic research lab: transmitting knowledge and advancing research. In corporate research laboratories, experimental naïveté is a drag on productivity. By contrast, reducing experimental naiveté is the raison d'être of academic research laboratories.

Mentoring is spontaneous and facilitated by visibility. All photos: M. Haggans

This article is one product a three-year study (2007-09) of a biological sciences research group

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The long haul

By Julie S. Higginbotham, Editor

One special privilege of having been involved in the lab design community for 15 years is the ability to observe cycles over time. *Laboratory Design* has been associated with HLW for more than a decade in its annual cost analysis for new and renovated lab projects, and their data for 2011 appears in this issue (page 1), with a significant extension in our digital edition (http://www.rdmag.com/General/Laboratory-Design-News-Archive/).

It's odd to celebrate inflation, but in this case, there's reason to take it as an encouraging sign that the long weakness of the construction market may be reversing. Customer service, operational efficiency, strategic thinking, special expertise and aggressiveness all remain crucial for enduring such cycles. So does client-side vision that sees beyond temporary conditions to identify the crucial need for top-notch research, teaching, clinical, environmental, forensic and other lab facilities.

Our other features speak to this need. "Fast and Smart: Design Principles for Academic Research Laboratories" (page 1) analyzes the unique aspects of this type of facility design, informed by an extensive user survey.

On page 10, "Sustainable Design Decisions and Costs in Research Laboratories" reviews key factors that will help project teams and clients get maximum bang for the buck when creating greener lab facilities. An article on page 14 discusses the new ductless enclosure standard promulgated by the Scientific Equipment and Furniture Assn.—a needed effort, now that selecting containment equipment tailored to actual needs is critical.

I hope these stories, as well as our regular news, product and project coverage, provide ideas and inspiration. Your feedback is welcome: julie.higginbotham@advantagemedia.com.

Lab building costs start to rebound

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quarterly earnings by publicly listed companies consistently showing profits increasing at a steadier rate.

- China is investing tens of billions in the Latin American commodities and natural resources markets to help spark their economy.
- European debt problems—specifically related to Greece, Portugal and Spain—remain a cause of concern. As recovery is taking place across a global marketplace, the finances of these countries are highly volatile, and while these countries make small contributions to the global GDP, their troubles may affect confidence and growth in the euro-zone as a whole--possibly leading to a "double-dip" recession. There is fear that these countries could financially face what the U.S. faced in 2008, causing a ripple effect throughout the globe.
- Concern continues to grow on the state of public finance—both federal and at the state level. Government is under heavy scrutiny regarding spending given the current state of public finances. Budgets are very tight, and funding is very low.
- Oil prices continue to increase slowly from last year, and may top $90/barrel by the end of 2011.
- Barring further economic problems, construction prices will continue to rise in 2011. As the market continues to stabilize, and the project work begins to pick up, prices are expected to continue to increase. Now continues to be an excellent time to bid on a construction project.

The federal government has proposed a budget of $147.9 billion for research and development in fiscal year 2011. This is up very slightly from 2010's $147.5 billion R&D budget. The proposed budget, however, is under examination for possible cuts to reduce overall government spending.

There has been growth in research partnerships between corporations and universities to maximize resources and funding. Clients are eager to become more efficient and take advantage of low prices for materials, labor and real estate. They are more cautious and conservative with their program needs and budgets, and expect very competitive pricing for architectural services and construction.

The majority of past cost reductions was attributed to the reduction in overhead and lack of

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Cost-forecast methodology

HLW International and Faithful+Gould, along with consultants Turner Construction Co., have collaborated to show the cost trends of the 2011 market. The purpose of this report is to assist those involved in research facility planning, design and construction in benchmarking probable facility construction costs. This document is a benchmarking tool and is not designed to replace a detailed cost estimate prepared during the course of a specific project. It is intended to help set a target and measure progress.

We have employed a multifaceted approach in generating these new forecasts. The methodology for developing the updated costs by facility type includes:

- In-house cost indices for HLW and Faithful+Gould research facility projects.
- Review of nationally published cost data.
- Review and analysis of labor rate and productivity data.

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FROM THE EDITORS OF R&D MAGAZINE

FEATURES

DEPARTMENTS

Design principles for academic research laboratories

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at a major Midwestern university. The authors began the project before the group moved to a new laboratory setting. They continued interviews as the group gained and lost members, continued its research, and published its findings. Previous reporting focused on questions about the move itself and its immediate aftermath, as well as the increasing pressures for speed to meet deadlines and to publish in the academic research community. (See www.TradelineInc.com/content/29054/display/b62xhd.)

PEDAGOGIC FUNCTION OF ACADEMIC LABS

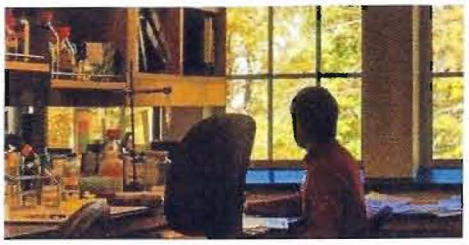
In the university environment, teaching and learning are not restricted to labs designated for teaching or to classrooms for scheduled course activities. The transfer of skills and expertise from a teacher to a learner is a robust social interaction, involving verbal, tactile, visual, material and cognitive aspects. In the research lab setting, teaching is not done solely by faculty principal investigators (PIs). All members of a research group participate in teaching, depending on the skills and expertise they can transmit to colleagues. In fact, the process of transferring experimental skills and expertise in a research laboratory is enculturation: the process by which individuals learn and assimilate a culture.

Much of what occurs during the interactive transfer of skills and expertise in an academic research lab is emergent and spontaneous. It involves the successful transfer of skills and expertise that may be impossible, or just very difficult, to articulate. The goal of the transfer of skills and expertise is not "knowing more" (or "reaching an answer"), but rather "getting it to work." It is far more "efficient" for a novice or naive experimentalist to ask a nearby veteran, or even just to watch what he/she does, than to embark on an autodidactic trial-and-error process.

The focus is on learning from experienced lab colleagues how to do a procedure or manipulate equipment or specimens. A successful transfer is defined by the learner becoming a competent member of a culture/community (e.g., experimental biochemists), rather than merely possessing greater knowledge. The process is about "learning the code"—i.e., learning the techniques that are assumed by community members to be necessary for competent work. No rule book can capture all possible contingencies, which is why the transfer of experimental skills and expertise will likely fail if procedures are "codified" and made available only impersonally via the web or a textbook or a manual.

The transfer of tacit skills and expertise

Informal learning from colleagues is central to an academic research lab.



Proximity of write-up space and the lab bench provides work space that is functional and desirable.

in the academic research lab requires patient and sustained physical real-time interactions between teacher and learner because the need for help can never be predicted in advance. Also, because this transfer may take an unpredictable amount of time, having teacher and learner in proximate physical locations facilitates the transfer process. It follows that the closer the assigned workstations are between teacher and learner, the more successful the process of enculturation will be.

Enhanced visibility of the teacher for the learner will have the same effect. Therefore, a smarter lab allows for the more effective transfer of experimental skills and expertise. Faster labs enable more efficient pursuit of experimental work, i.e. speed. Better academic research laboratories strive to be both: smarter and faster.

THE IMPORTANCE OF WORKING SMART

Academic research labs can be thought of as locations where naïve researchers arrive at the lab and leave as sophisticated researchers because they worked with mentor(s) and were the recipients of the transfer of knowledge. Working smart involves the need to choose a laboratory based on discipline/area of study and a PI to advance one's academic and professional career. These are places where techniques cannot effectively be learned remotely or individually without "reinventing the wheel," and interactions are spontaneous and one-on-one. Involved are the transfer of skills and knowledge requiring teaming with mentors, learning how to troubleshoot errors, and creating networks for present and future needs.

Smart laboratories also require a range of supporting spaces to interpret data (anywhere), test and troubleshoot (lab), gather and discuss (meeting room/lounge), and reflect and write (quiet space). When asked, laboratory team members spoke about the interactions of the group:

- PI: "I'd like to get the crystallography group together, because they have to sit and talk about, and look at their crystals, and also, it's very complex as far as the software and running the Linux computer and doing that, so I think that they need to be together because I think it's more teamwork to get the procedures to work."
- Graduate student: "I cannot imagine two people using the same desk. Using the same bench, also I don't like it, because you don't want to bump into each other on the same bench. So if I have to choose between two people using one bench, and one person using a shorter bench, I still prefer the one designed at (our previous location), the shorter bench, but I can have my own private space. That's the thing."
- Graduate student: "John sits next to me and he's quite senior. He's a post-doc and he's experienced, so I ask him first. Turn my head and ask, 'John, can you answer this question?' So he usually answers all my questions."

THE IMPORTANCE OF SPEED

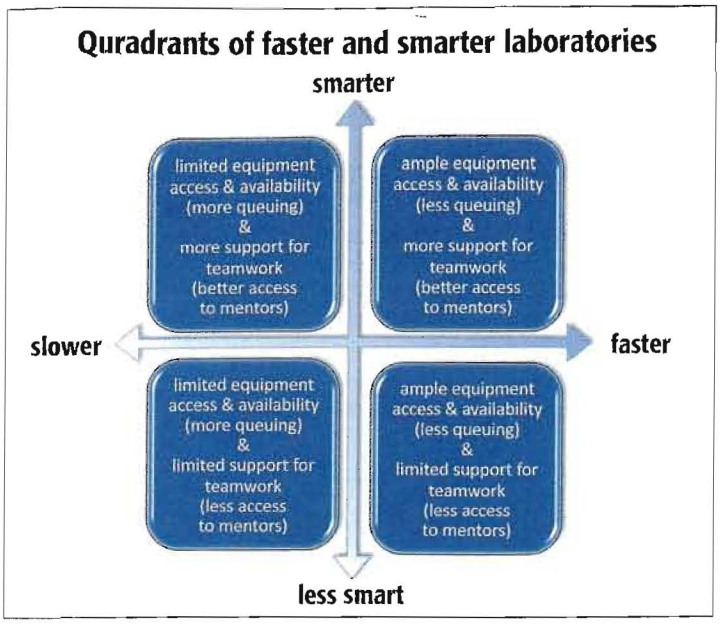
A successful academic research lab must meet self-set and externally set deadlines. The PI is under pressure to be the first to publish new research findings and to meet grant submission deadlines. Graduate students need to complete degree programs as expeditiously as possible. Post-docs need to demonstrate research success to secure salaried positions. Speed is of the essence in completing many essential tasks, including doing literature searches, conducting lab and/or field work, interpreting data gathered, and preparing proposals, reports, and manuscripts.

Our interviews with lab team members identified the following conditions that contribute positively to accelerating operations:

- Having lab members grouped for ease of interaction.
- Having space well-organized for conducting experiments.
- Having the write-up station and bench space close together, minimizing distance, and, therefore, time to access equipment.
- Having sufficient instrument/equipment capacity.
- Maximizing sight of lab members and equipment.
- Having ready access to mentors.
- Having as many functions as possible computerized.
- Having rapid service response to equipment breakdowns.
- Being flexible in scheduling.

Relevant comments from our study include:

- PI: "It'd be nice to get all our centrifuges (co-



This diagram summarizes the concept of linking smart and fast in the design features of academic research labs. Illustration courtesy of the authors

located)... It's like having three or four washing machines, and you've got lots of loads. If I can have four centrifuges loading at once, I can spin down 20 liters of cells in 30 minutes."

- Graduate assistant: "...Our new chemical room, everything's all in one spot. That should speed things up... I used to have to walk over to (the other room), if I wanted to do certain transformations... now it's nice not to have to run back and forth between things like that."
- Graduate assistant: "If I get everything close by, then I can do two, three tasks, and that would really increase my efficiency and save time."

COMBINING FASTER AND SMARTER

Interviews with the lab team members identified aspects in their new lab environment that were both faster and smarter than in their previous location. Extrapolating from this information, we constructed the diagram above, categorizing academic research laboratory environments as a function of the forces that drive their function. The diagram summarizes the concept of linking smart and fast in the design features of academic research labs.

We recognize the differing perspectives of the many stakeholders in academic research labs. Financial and facility administrators usually seek the lowest cost alternatives (less building area per person and a minimum complement of equipment) hoping to maximize return on investment in research revenues. Alternatively, PIs and research groups value space for teamwork and availability of equipment to reduce wait times. This dialogue determines the smartness and fastness of each research lab environment.

The programming and design of academic research laboratories have traditionally underplayed the pedagogical aspects of these environments. Best practices should pay increased attention to the function of the laboratory as a learning environment as well as being a place to conduct research. Academic research laboratories should be designed to allow smart, effective learning and fast efficient discovery to occur simultaneously.

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