Laboratory Facilities for the Future

Archana Sohoni- Laboratory Architect

Laboratories are becoming more flexible and digitally connected. The future of science facilities is also being shaped by the growing pressures of commercial and environmental sustainability. The building economic pressures and the desire to achieve immediate ROI, the process of planning and designing of laboratory facilities isaccelerated. The accelerated project schedules require additional effort to maintain quality. Amongst all this, it is observed that the **Design Concepts of a Laboratory are revisited.**

Today, the laboratory design process is characterized by a "more, faster, smarter" approach. Companies are keen on maximizing funds in a short timeframe. The focus is more on developing leaner processes for delivering projects and leveraging technology—like building information modeling (BIM).

Functionality, space, safety, and flexibility have been identified as the four most desired characteristics of a laboratory. These four characteristics are interconnected and changing one of these features affects the others. While functionality and safety are never compromised, there is often a tendency to sacrifice space and flexibility due to budget constraints.Typically, reducing space is the simplest and quickest way to reduce cost. Informal meeting areas, open lounges, and other spaces that enhance collaboration and interaction have been continually thought of ‘waste of space’ as space within a research facility.

To build or renovate

Many times institutions and corporations take more conservative approach to facility development, by way of renovation work thus leading to fewer new construction projects. Clients are seen to be risk averse and want to know whether new facilities or renovation projects will meet their vision and strategic business goals. The problem is that these buildings can be eight, ten even 50 years old—basically out of date and many times

unsuitable to set up laboratory infrastructure. Yet, the outcome need not be negative. Limitations of available space, forces the designer to look at various options and layouts. It also gives an understanding of how spaces can be adapted to new requirements and make systems work more efficiently. Nevertheless, each facility is different. Hence the company stake holders must identify the useful life expectancy target for the facility up front, so that a proper feasibility study can be conducted and correct solutions can be derived. A fresh new facility construction versus renovation decision is dependent on many factors such as location, cost, schedule, and flexibility. If location of site is the priority, then renovation may be the only choice. If expansion or operating costs are paramount, then relocation or building a new facility is the key.The most expensive part of renovating a research facility is downtime.

Flexibility

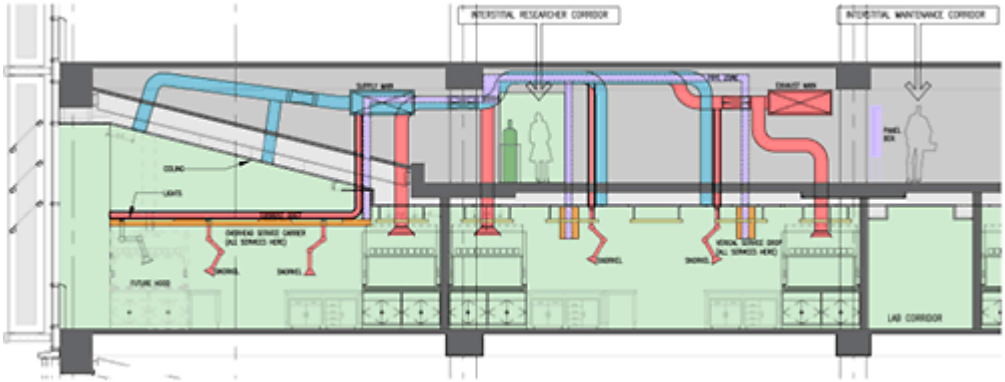
Flexibility is hard to define, but reducing a facility's flexibility may mean the loss of spare engineering capacity and space for anticipated growth. Many owners say they want future flexibility; however, they lack the understanding to define what 'flexibility' means. The concept of flexibility has different meaning to different people. Functionality and flexibility together are design qualities that allow a facility to do more in less space. Sharing a single space between two or more departments is a space-saving method that is relatively easy to recognize during planning process but it is also possible that a single space be planned that will serve multiple functions.

The need for flexibility

Collaborative, interdisciplinary facilities that support and promote the sharing of equipment, technology, and resources are growing in popularity. Researchers want to modify their laboratories quickly, inexpensively, and without facilities personnel. However it has to be thought of and planned as an approach early in the design process or else adopting it at a later stage can be fairly expensive.

Strategies to build flexible, collaborative research environments include the use of casework systems that are easily moveable, limiting fixed elements in the laboratories, and containing hazards in the smallest workable area. Movable and height-adjustable laboratory benches with only minimal services are the norms in the interior of laboratories. Flexible engineering services—supply and exhaust air, water, electricity, voice/data, and vacuum systems—are extremely important to labs.

Labs must have easy connects/disconnects at the walls and ceiling to allow for fast, affordable fixation of equipment. The engineering systems may need to be designed to enable fume hoods to be removed or added, to allow the space to be changed from a lab environment to an office and then back again, or to allow maintenance of the controls outside the lab.‘Service columns’, is a concept where all utilities and electrical cabling can be dropped down from the ceiling. The user can easily connect the equipments and can use the bench space effectively.



In addition to the initial demands, at least an additional 25% should be considered for future expansion. Space should be allowed in utility corridors, ceilings, and vertical chassis for future HVAC services, plumbing, and electrical needs. Service shutoff valves should be easily accessible, located in a box in the wall at the entry to the lab or in the ceiling at the entry. All pipes, valves, and clean-outs should be clearly labeled to identify the contents, pressure, and temperature.

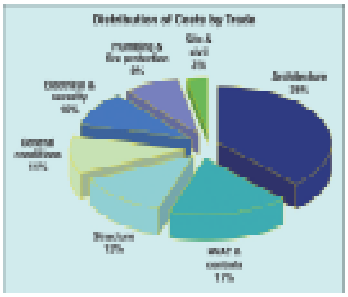
Sustainability

Sustainability has become a laboratory standard, as there has been considerable awareness among the stakeholders on lifecycle operational costs and the move towards green building. Laboratory owners now expect more efficient and sustainable buildings. Planning objectives are set, to achieve U.S. Green Building Council goals of Leadership in Energy and Environmental Design (LEED) Silver, LEED Gold, or even LEED Platinum for their facilities.

In India, CII spearheaded the Green Building movement in India -2001.We also have LEED-India Green Building Rating system-2007, the National Building Code, MoEF guidelines, Energy Conservation Building Code of the BEE, National GLP Compliance Monitoring Authority- 2002 and TERI guidelines.

Research facilities—particularly those involving chemicals, biologics, and nanotechnology—are expensive to build and operate, given the requirement for large

volumes of outside air for ventilation. A typical laboratory uses five times as much energy and water per square foot as a typical office building, due to large numbers of containment and exhaust devices, number of heat-generating equipment, intensive ventilation requirements—including "once through" air, research laboratories form the most energy demanding facilities.



Most laboratory owners are aware that the utility loads and once-through air requirements, can make designing an energy-efficient laboratory a challenge. However, demand-based systems and more efficient engineering can not only yield operational savings, but also reduce design difficulty. High-performance and low-flow fume hoods, and air and lighting monitoring systems are examples. Occupancy sensors on fume hoods can reduce airflow when the laboratory is unoccupied. Isolating chemical fume hoods in hot zones reduces the overall volume of air required for safe operation.

HVAC is the most complicated and expensive aspect of laboratory engineering. While chilled beams are being increasingly used abroad, as a means of addressing ventilation and heat loads, India is yet to adopt this concept and technology due to various limitations and factors. Chilled beams have proven effective in maintaining lower air change rates per hour and reducing sizing of ductwork and central air handling equipment in comparison to the traditional chillers and heat recovery wheels.

Technologies that reduce artificial lighting levels have become more common. Ceiling-mounted occupancy sensors use both passive infrared and ultrasonic sensors to turn off the lights when the laboratory is unoccupied. In contrast incorporating exterior window shading and glazing on the exterior façade of laboratory building has now become more prevalent for both comfort and sustainability. Daylight sensors capture the intensity of ambient light from windows and modulate the lux levels in response to the natural sunlight entering the building.

Virtual Labs

A significant amount of change has occurred in the past ten years primarily in the U.S. and Europe to utilize the computer more for 3D simulation, data crunching, and to allow meetings to occur in real time around the world on flat screens. Many of the researchers have teams in multiple locations around the world to capitalize on funding, expertize, and focus within a country, company, or campus. Virtual spaces are now evolving where a person can be sitting in a lab in Europe and talk to their research team across the globe as easy as getting a cup of coffee from the break room. Speed to market is getting more rapid each year with most institutions working faster than ever. While this is the scenario worldwide, the picture on domestic front is quite different.

Collaborative Spaces

Collaboration is the latest key word in present-day type of working. It is highly influenced by younger generation coming from contemporary academic institutions where students are exposed to brain storming and team work. Many times research labs are designed to considering multi-function types of work within the same lab. Academic labs too are interdisciplinary and rarely designed solely for one discipline. Thus the trend is toward more collaborative and less private space.

Typically these spaces are designed outside the labs, yet having proximity to lab areas, to encourage spontaneous and higher interaction. They are clubbed with break out areas and are equipped with writing boards/ pin-up boards etc. These spaces are designed as informal

spaces unlike conference or meeting rooms thus opening an avenue for open discussions and sharing. These spaces are designed with lot of thoughts and environment such that the users feel comfortable and relaxed.

Way forward

The interior of a laboratory has an amazing influence on the creativity and productivity of the scientists. The art of designing laboratories for the future is to establish and nurture meaningful connections among people—whether in offices or laboratories—by creating strategically located, dynamic, technology-enhanced environments where people would want to be a part of such environments.

Architects have always been expected to balance the needs of stakeholders to create spaces that are aesthetically and functionally effective, in addition to be economical. Global warming has added a new facet of making sustainable environment and an added responsibility to the designers. Quite often during the design phase of a laboratory, priority is given to functionality and aesthetics are overlooked. The aesthetical challenges in laboratory design can be taken up as an opportunity to create an environment which is motivating,

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Archana is a practicing architect and has an industry experience of more than 22 years. She has done Masters in Construction Project Management from London South Bank University, UK and has been the award winner for the best performance in her course. Archana has expertise in Lab planning, designing and project management and is currently involved in providing Lab Design solutions to various pharma & chemical companies in India. She is the founder and principal architect of the company 'Arena Consultants', Mumbai.

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