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Aircuity White Paper

Keeping Smart Labs Smart

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Keeping Smart Labs Smart

The original Smart Labs principles are still critical to achieving maximum benefits

History

The Smart Labs Program was created in 2008 at the University of California, Irvine. Led by Wendell Brase, who at the time of its creation was Vice Chancellor for Administrative and Business Services, the UCI Energy Team that included Matthew Gudorf and Mark Gomez devised the renowned lab retrofit program. The program was designed to create deep reductions in energy use and carbon emissions, improve safety, and reduce capital and maintenance costs. The story of their success is captured in a video from the Department of Energy's Better Buildings Initiative.

Thirteen years later, the UCI Smart labs vision remains the best practice for safe, sustainable labs. It is worth revisiting and reinforcing that original vision, as the term "Smart Labs" has become somewhat diluted over time, often attached to lab energy initiatives that do not follow the core principles of the original vision, and that fail to deliver the full range of potential benefits. It is time to remind ourselves what makes Smart Labs Smart!

Dramatic benefits to date:

Smart Labs is a comprehensive program that optimizes several key benefits over the lifecycle of a building or campus, including:

- The safety of lab personnel;
- Dramatic reductions in energy costs and carbon emissions; [UCI has achieved 50%–60% energy savings in labs!]
- Reduced capital and ongoing maintenance costs by right-sizing HVAC systems;
- Real time collection of accurate safety and performance data to support continuous commissioning, reassure employees, anticipate and avoid mechanical failures, and enable continuous learning.

Smart Labs is even more critical going forward:

In spite of the dramatic benefits, many universities *have yet to fully adopt the complete Smart Labs Program. We expect that to change given the future challenges those universities face:*

- The growing imperative for campuses to achieve net-zero carbon status in the next 10 to 20 years and the increasingly large carrots (utility incentives) and sticks (carbon penalties and ESG requirements) they face as the world gets serious about carbon neutrality. (Note that a true Smart Labs Program will have a greater impact on campus sustainability/ESG goals than any other initiative).
- Increasing cost pressures (A true Smart Labs Program can dramatically reduce facility lifecycle costs, including avoided capital costs and reduced maintenance).
- The heightened (post-Covid) concerns and awareness of Indoor Air Quality as a health and safety issue. (A true Smart Labs Program tracks and communicates IAQ and safety information to reassure building occupants).

What is Smart Labs, and what makes it so effective?

The effectiveness of the Smart Labs Program lies in three core principles:

1. Taking a broad, systems-thinking approach;
2. Using technology to enable dynamic, automated control; and
3. Optimizing benefits for multiple stakeholders over the full life cycle of a facility.

1. Holistic systems approach

Smart Labs is an integrated process that optimizes the entire lab airside system to create savings and benefits that are "more than the sum the parts." The elements that can be coordinated in a Smart Labs system include:

- Demand based ventilation via a Dynamic, Digital Control System
- VAV Lab Control (Fume Hood Airflow Optimization)
- High performance fume hoods
- Exhaust Fan Discharge Velocity Optimization
- Low pressure drop design for fans and air distribution system[1]
- Demand based, LED Lighting with controls
- An energy recovery system
- Data analytics to track performance, anticipate failures (thus enhancing safety), accelerate learning and continuous improvement, and provide real time commissioning to avoid performance degradation.

2. Leveraging technology to dynamically, intelligently manage the system

First and foremost, **Smart Labs are meant to be Smart** and therefore do not need significant manual intervention. That is achieved with an intelligent IAQ measurement and management platform using highly accurate, frequently calibrated sensors. The IAQ platform is integrated with an intelligent Direct Digital Control system that dynamically adjusts mechanical equipment, such as ventilation fans, based on the cleanliness of the air in the space being monitored.

A Smart Labs system should provide the maximum efficiency (deep energy retrofit) when possible, but also provide the maximum safety when needed. That kind of adaptive performance cannot be achieved by setting a pre-determined, static air change rate, or by changing the air change rate based solely on occupancy.

Smart Labs are not about a one time or yearly risk assessment. Labs are extremely dynamic as there are ongoing changes both in the nature of the experiments being performed and in the functioning of the mechanical equipment meant to provide health and safety (and which also consume massive amounts of energy). A true Smart Labs program relies on accurate Air Quality measurements to **dynamically adjust ventilation** to achieve maximum energy savings AND much safer environments (by going to full ventilation in the event of a spill or other IAQ event). Again, labs that rely solely on occupancy sensors to manage ventilation rates, or those that use a static, prescriptive air change rate cannot adapt dynamically to the continuous changes in labs. This means that, compared to a true Smart Labs system, they use more energy while providing lower levels of safety.

As Wendell Brase notes in the Smart Labs Video, "This is what we mean by a smart system: it uses sensors and controls to apply just the right amount of energy at just the right time…as opposed to going to the worst case condition and running at a fixed volume. It's a dynamic system."

This kind of dynamic system relies on feedback and intelligence regarding what is happening in each lab space. Capturing feedback, insight and intelligence at the individual lab level is a must. **You cannot manage or optimize what you don't accurately measure**.

3. Focusing on the total benefits for all key stakeholders, over the full lifecycle of a building

Because of its holistic, systems approach, and the intelligent use of technology, Smart Labs are able to capture a much broader range of benefits over the building lifecycle, as compared with a program focused on a more limited subset of energy savings and safety assurance measures. One key reason for this is that a static system creates much more constraining tradeoffs between safety and carbon and energy reduction. A fixed air change rate can be both wasteful when the air is clean, and not as safe when there is an event.

1 This can include removing sound attenuators that are no longer needed due to reduce air velocity.

A dynamic system can deliver the ideal amount of ventilation when it is needed, but not waste energy when the air is clean.

The full range of benefits of a true Smart Labs Program versus a less holistic, less intelligent system include:

- Optimizing safety/minimizing risk by reducing prolonged exposure when events occur
- Reducing insurance costs and liability by having the best practice in place
- Achieving ESG goals including carbon reduction and a path to net-zero
- Deep energy savings (50%–60% at UCI and other universities)
- Avoided capital costs (size of chillers, chilled water piping and pumps, size of AHUs and exhaust fans, etc.) and related maintenance costs
- Creating a rich, accurate data set for: tracking performance; identifying good and bad practices in the labs before they become crises and providing the foundation for continuous learning and innovation.
- Attracting and retaining top researchers who value lab facilities that are state of the art with respect to safety, healthy air and sustainability.

In addition, intelligent systems are more easily sustained over the life of the building. The best practices and organizational knowledge they embody remain in place as PI's, researchers, EH&S and Facilities personnel turn over.

What are "Non-Smart" Labs?

We consider Non-Smart labs to be those that violate any of the true Smart Labs principles by:

1. Focusing on discrete sustainability or safety measures in isolation, rather than adopting the Smart Labs holistic, system-thinking approach to design and operation, for example, making EH&S risk assessment the primary focus of an energy savings effort.
2. Not leveraging technology—the intelligent systems that make Smart Labs smart! Examples of this include using manual ACH turndown strategies instead of a dynamic, DCV system, and/or not using technology to capture and analyze real time data to track system performance and enable continuous commissioning and continuous learning.
3. Not seeking to capture the full range of potential benefits over the full lifecycle of the building. This often entails trying to achieve a more modest level of energy savings and carbon reduction, and an acceptable level of safety, while minimizing the initial investment, when a true Smart Labs Program would deliver much higher energy and carbon savings, while generating greater lifecycle cost reductions!

Why are there still many "Non-Smart" Labs operating?

Diffusion of innovation typically takes a long time

It is not unusual for innovations to diffuse slowly. It takes time for new knowledge to spread, and for existing cultural attitudes and professional practices to change. This well know phenomenon is captured in the technology adoption lifecycle model. (But there is new urgency and awareness today regarding healthy air as a critical issue (due to Covid), and an increasing imperative to accelerate the shift to net-zero carbon)[2].

Many well-meaning stakeholders are reluctant to embrace any technology that they fear could compromise safety (when, as we have discussed, a properly designed, intelligent system can improve both safety and sustainability.)

2 As the *New York Times noted on May 18, 2021*, "Investment in new oil and natural gas projects must stop from today, and sales of new gasoline- and diesel-powered vehicles must halt from 2035. These are some of the milestones that the International Energy Agency said Tuesday must be achieved for the global energy industry to achieve net-zero carbon emissions by 2050."

Dysfunction and value illusions in the Design-Bid-Construction process

Another factor that has slowed the adoption of the true Smart Labs model is the sometimes dysfunctional nature of the Design-Bid-Construction process. A design engineer might not specify a dynamic DCV system in order to reduce the initial cost of the project, but that kind of myopic focus on the "first cost" can actually deprive the owner of millions of dollars in energy savings and other benefits, as UCI has demonstrated.

Or, the engineer might specify a dynamic DCV system, only to have the Controls subcontractor remove the specified system in the name (ironically) of "value engineering." The best way to avoid these value illusions is for the owner's leadership team to become educated on the full benefits of a true Smart Labs Program, and to commit to a Smart Labs specification.

Solution providers often add to the noise

It can be difficult for customers to determine the best solution for optimizing safety and sustainability in their lab buildings. Decision makers may not be knowledgeable regarding all aspects of lifecycle value, or which technologies have proven track records.

Compounding this information challenge, some consultants and equipment vendors steer customers toward one or two isolated elements of a complete Smart Labs solution—the elements for which their product or service is a good fit. Some vendors can add to the noise, by characterizing the ***non-smart*** solution they are proposing as a best practice that is aligned with the **Smart Labs Program**! In effect, they use the halo effect of the original Smart Labs Program's reputation in order to sell a solution that falls far short of the vision first established by UCI.

What is the path forward?

Smart Labs is still the best solution for optimizing safety and sustainability in labs, unlocking deep energy savings, addressing deferred maintenance, and maximizing sustained EH&S benefits through intelligent insights. If anything, the Smart Labs Program is more relevant than ever, given the heightened focus on IAQ and safety, and the acceleration of net-zero timetables.

There are many Universities and Life Sciences organizations that have not yet adopted the Smart Labs Program. For those institutions, Smart Labs is a great opportunity to take their safety and sustainability games to the next level.

BUT...

In order to capture the full benefits of the Smart Labs Program, customers must embrace all of the core elements of the program, and embrace the core principles of:

- A holistic, integrated approach; based on
- A dynamic, intelligent system;
- That delivers benefits to all key stakeholders over the full building lifecycle.

To help customers achieve this optimal set of outcomes, all solution providers must start by understanding the core elements and principles of a truly smart, Smart Labs Program, and then design and apply their offerings to support such a program. They should avoid over-selling more narrow solutions that leave their customers with a less than optimal, non-smart overall system.

Wendell Brase, who is now UCI's Associate Chancellor for Sustainability, often says, "It (Smart Labs) is not just about Aircuity." And he is 100% correct, but it is equally true that it isn't about any other standalone strategy either. A truly Smart Lab integrates all of the critical elements:

- EH&S safety assessments play an important role as part of a comprehensive Smart Labs Program but don't, by themselves, provide any of the technology-based benefits cited above.
- SkySpark and other SCADA-level continuous commissioning platforms are also very important, but for those systems to provide value, they need

accurate IAQ data inputs. They cannot measure IAQ on their own!

- An intelligent IAQ platform is essential for the core Smart Labs strategy of accurately measuring Air Quality to dynamically control ventilation.

The path forward for Smart Labs is for customers and vendors to work collaboratively, combining the strengths of each best-in-class solution to optimize safety and sustainability benefits for all stakeholders. That will accelerate adoption of the Smart Labs Program and generate maximum long-term benefits for customers, vendors and the planet.

About Aircuity

Aircuity is the 20-year leader in healthy, sustainable and accurate ventilation through its patented solution. As a result, commercial, institutional and lab building owners can protect occupants, improve employee productivity and wellness, lower operating costs, and verifiably reduce energy use by as much as 60 percent. Headquartered in Newton, MA, Aircuity's solutions have benefited organizations such as Google, Amazon, SUNY, Eli Lilly, Durst Organization, the University of Pennsylvania, and the University of California-Irvine. For additional information on the company and its solutions, please visit: www.aircuity.com.

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