SAND2020-9534C

Starting a Smart Labs Program

Robin Jones, P.E.| Sandia National Labs

I2SL 2020 Annual Conference
Back for More: Smart Labs PechaKucha 2.0
October 5, 2020

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Energy Exchange 2019

Energy Exchange℠

Be Efficient and Resilient

August 20 – 22, 2019

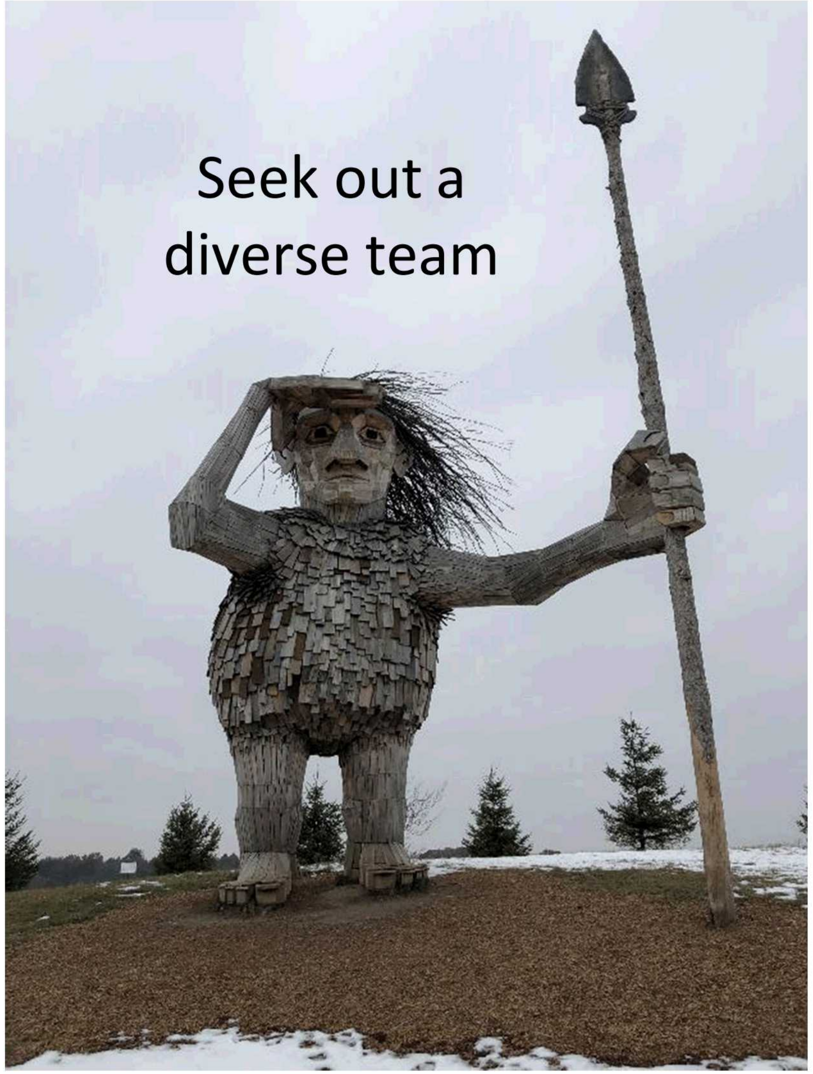
Smart Labs Accelerator Team Meeting

Smart Labs
Better Buildings
U.S. DEPARTMENT OF ENERGY

Smart Labs Workshop

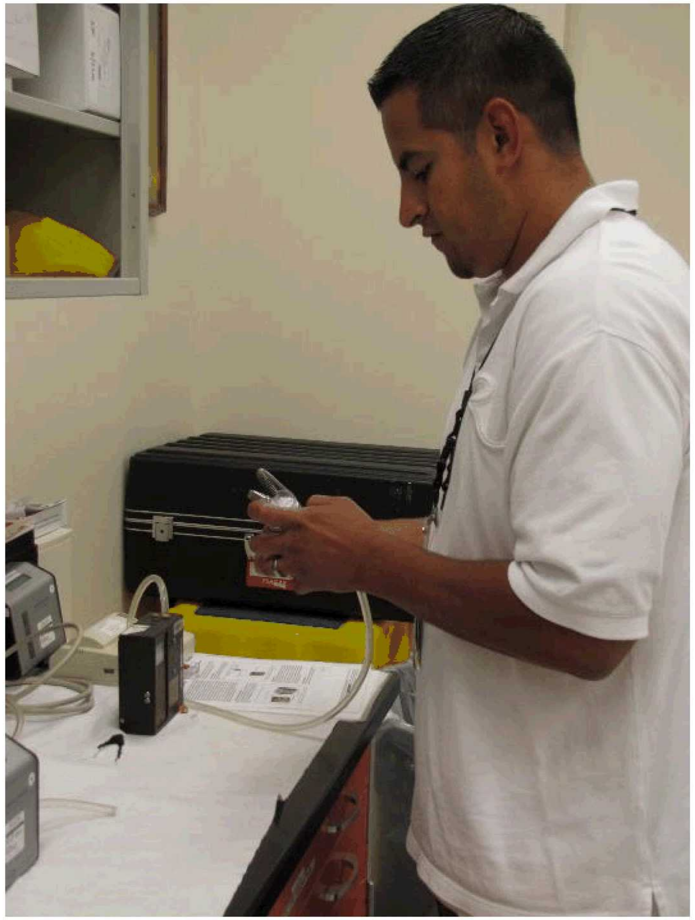
Argonne
NATIONAL LABORATORY

Involve Industrial Hygiene Early



We Recruited Industrial Hygiene

Chris Quinn-Vawter



Lorenzo Villarreal

Smart Labs Workshop

UCI University of California, Irvine

Keys to Starting a Successful Smart Labs Program:

1. Learn Everything You Can
2. Network with Others
3. Bring a Diverse Team

Smart Labs Workshop – UC Irvine

Organizational Readiness

A healthy organization is able to:

- Challenge status quo
- Question accepted limits
- Think comprehensively: re-engineer whole systems.

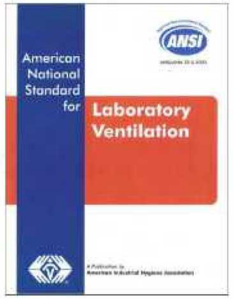
UC Irvine

The standard of care is based on the ANSI / AIHA Z9.5 American National Standard for Laboratory Ventilation

- **Best Practices**
  - Control Airborne Hazards
  - Provide Dependable Operation
  - Operate Energy Efficient Systems
- **Specifications for New and Renovated Labs**
  - Hood Design & Operation
  - Laboratory and Ventilation Design
  - Commissioning, Routine Testing and Maintenance
- **Requires a Lab Ventilation Management Plan (LVMP)**
  - ***Hazard Evaluation and Risk Assessment***
  - ***Tests to verify safety performance***
  - ***Personnel Training***

AIHA Protecting Worker Health

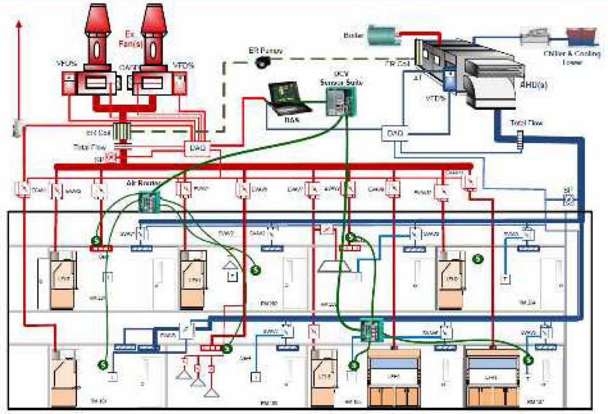
The American Society of Safety Engineers



UC Irvine

Building Level Monitoring and sequences of optimization

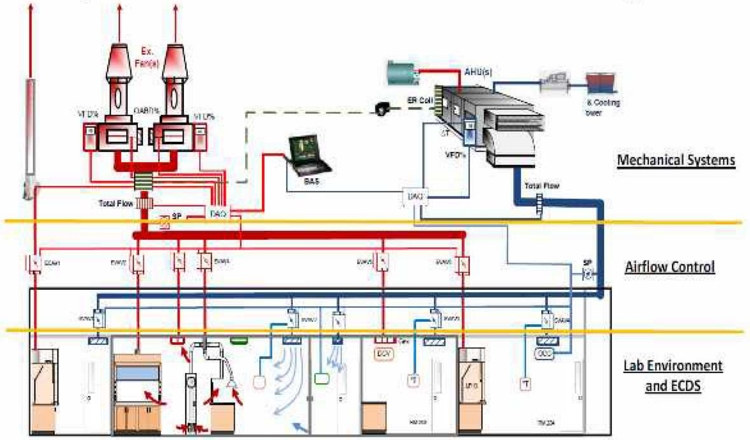
- AHU(s) & EF(s) VFD
  - Energy
  - Power
  - Run Command
  - Run Status
  - Speed
  - Frequency
- CHW control valve
  - Position
  - Supply temp
  - Return temp
- Pre Heat control valve
  - Position
  - Supply temp
  - Return temp
- Outside Air Temp
- Supply Air Temp
- Static Pressure
  - Per floor
  - Set point
- Cooling Load
- Supply Air Flow
- Wind Direction
- Wind Speed
- Alarms
- Exhaust stack velocity reduction with wind sensing
- Static pressure reset based on zone voting (Supply & Exhaust)
- Supply air temperature reset based on zone voting



Optimization drives complexity, which drives the demand for enhanced commissioning, fault detection and analytics.

UC Irvine

Many opportunities can be considered to improve the efficiency and effectiveness of the airflow systems



What We Have Learned since 2008

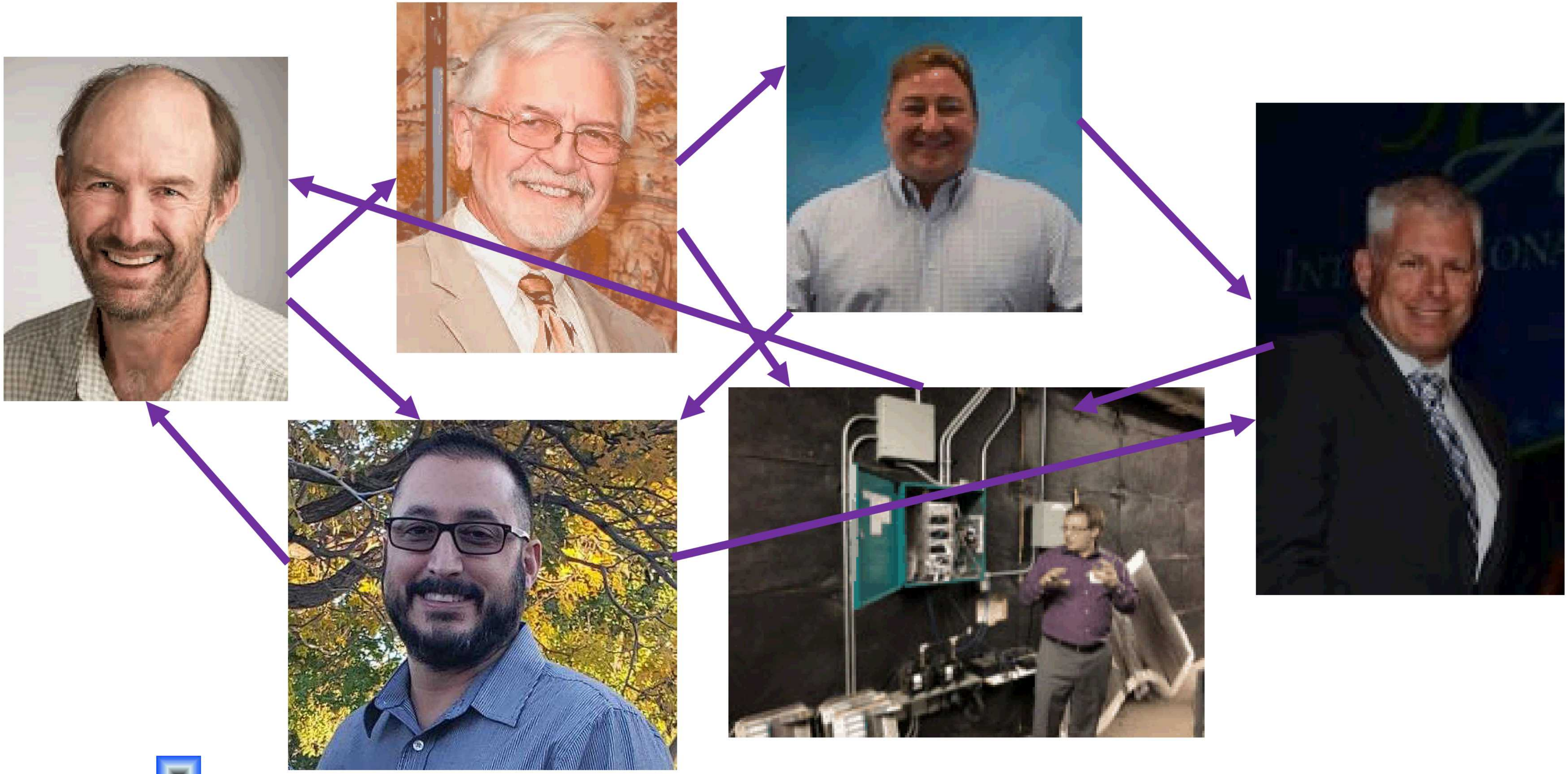
- What we suspected in 2008 was confirmed – and then some!
- Sensors and software changed everything!
- "Information layer" as important as dynamic building control systems, themselves
- Co-benefits >> anticipated.

UCI | Southern California Edison | Better Buildings Challenge U.S. Department of Energy

Laboratory Building		BEFORE Smart Lab Retrofit			AFTER Smart Lab Retrofit		
Name	Type	Estimated Average ACH	VAV or CV	More efficient than code?	kWh Savings	Therm Savings	Total Savings
Croul Hall	P	6.6	VAV	~20%	40%	40%	40%
McGaugh Hall	B	9.4	CV	No	57%	66%	59%
Reines Hall	P	11.3	CV	No	67%	77%	69%
Natural Sciences 2	P,B	9.1	VAV	~20%	48%	62%	50%
Biological Sciences 3	B	9.0	VAV	~30%	45%	81%	53%
Calit2	E	6.0	VAV	~20%	46%	78%	58%
Gillespie Neurosciences	M	6.8	CV	~20%	58%	81%	70%
Sprague Hall	M	7.2	VAV	~20%	71%	83%	75%
Hewitt Hall	M	8.7	VAV	~20%	58%	77%	62%
Engineering Hall	E	8.0	VAV	~30%	59%	78%	69%
Averages		**8.2**	**VAV**	**~20%**	**57%**	**72%**	**61%**

Type: P = Physical Sciences, B = Biological Sciences, E = Engineering, M = Medical Sciences

Network with Others



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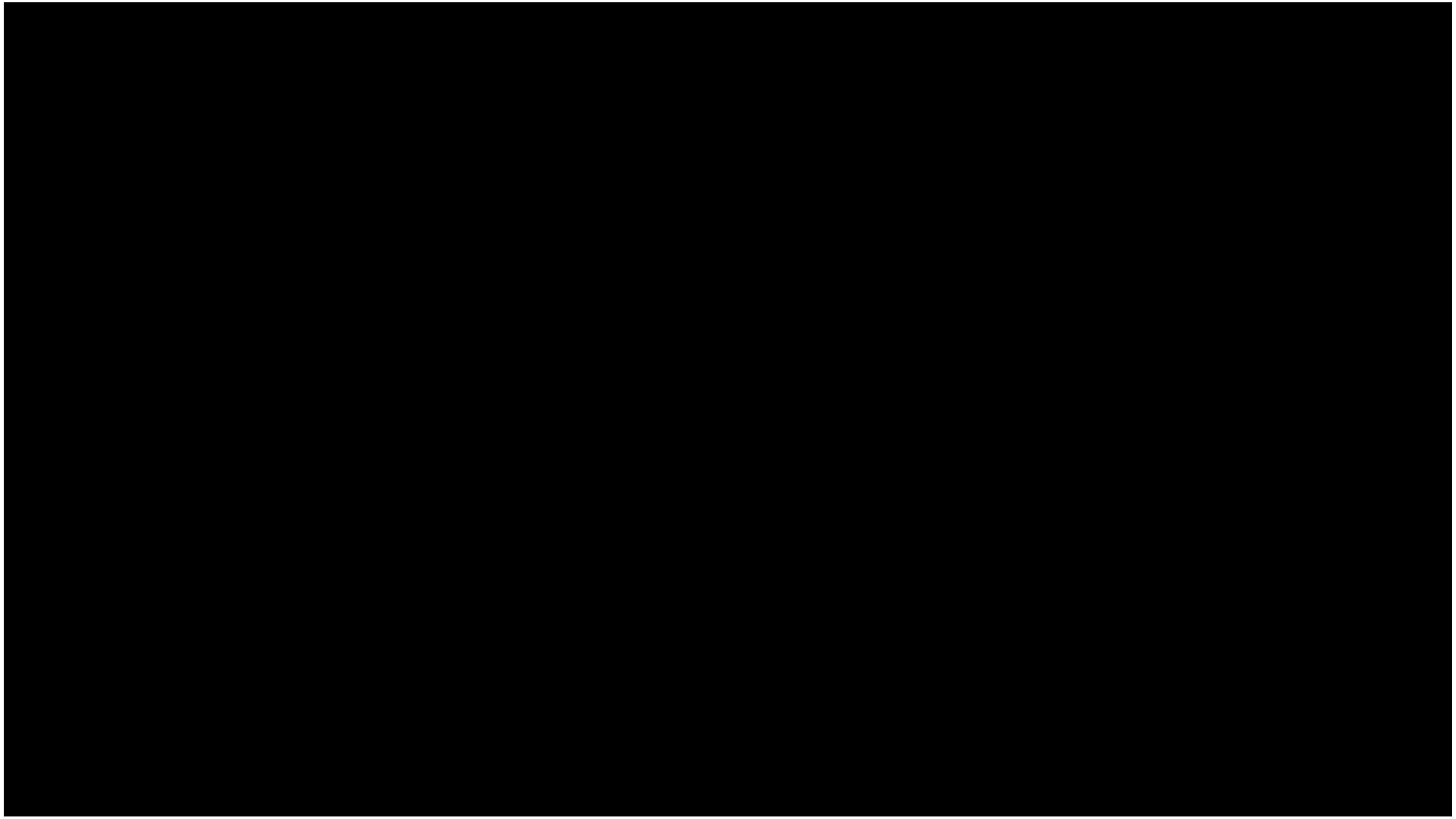
4. Find Champions

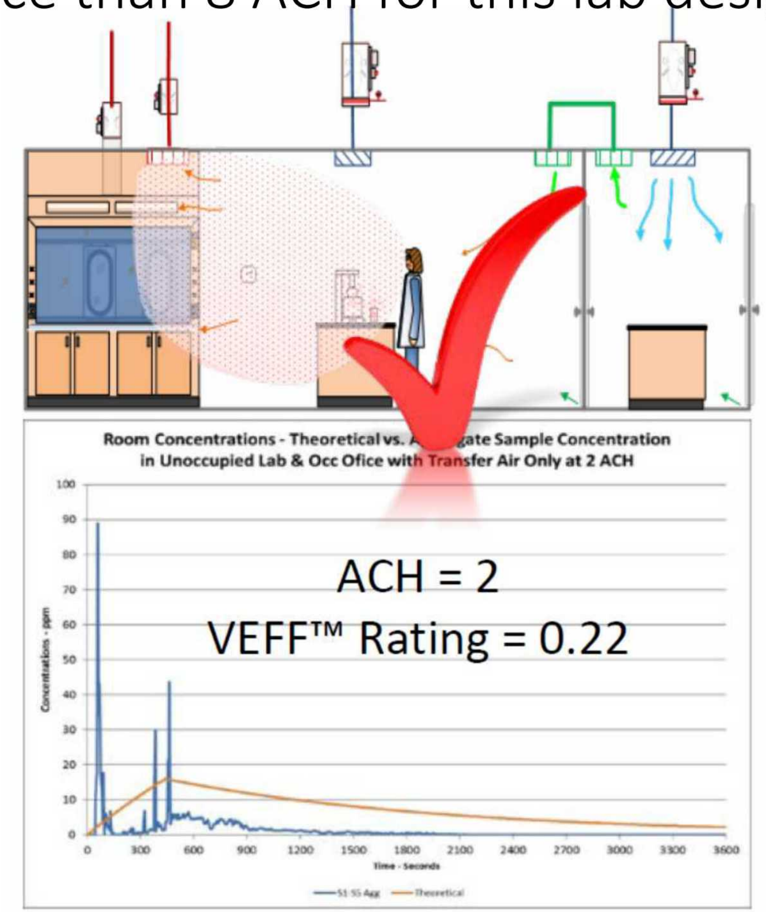
Presentation to the Environmental Management System, Management Advisory Board



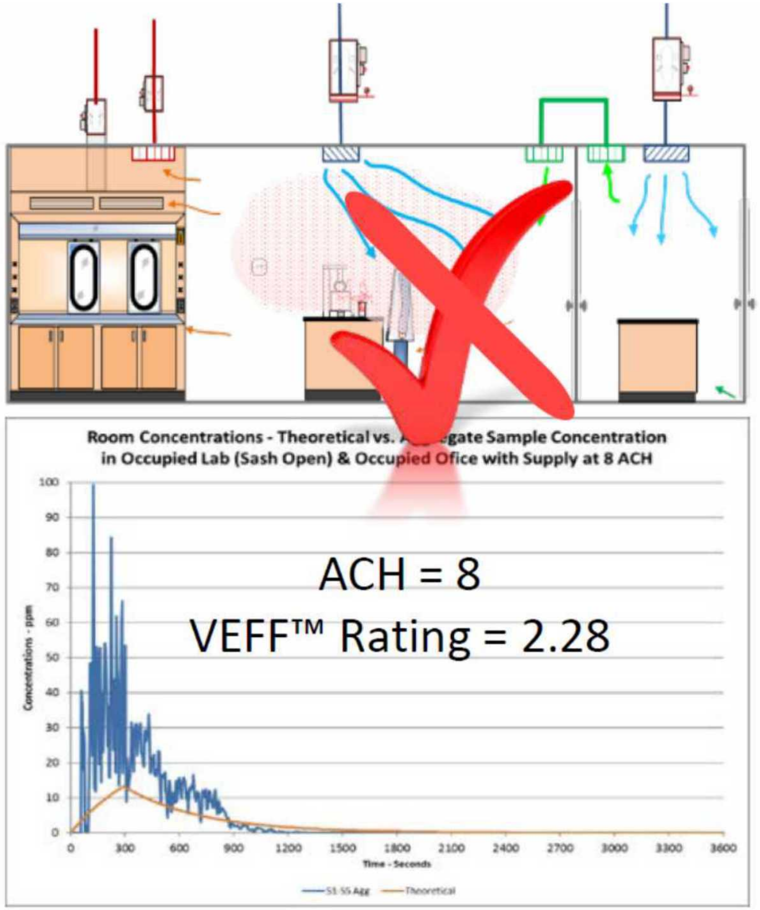
The Money Slide

Lab VEFF tests indicate 2 ACH provided better performance than 8 ACH for this lab design

Adding More Air Changes Not Always Safer



Effective air changes = **9 ACH**



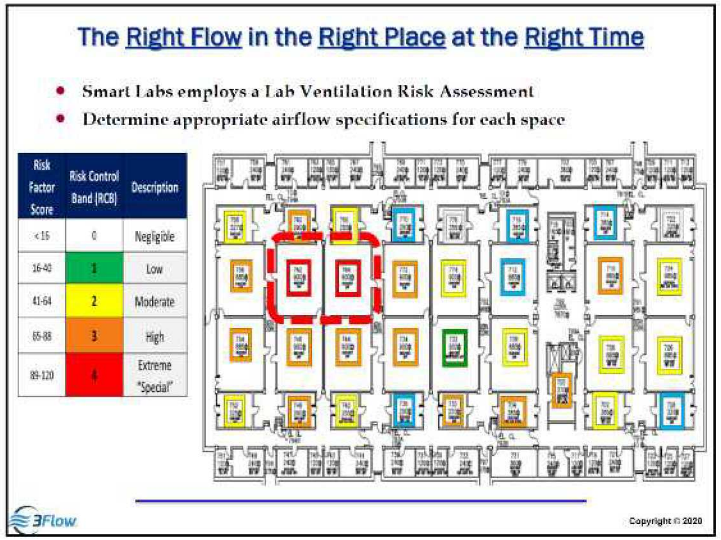
Effective air changes = **3.5 ACH**

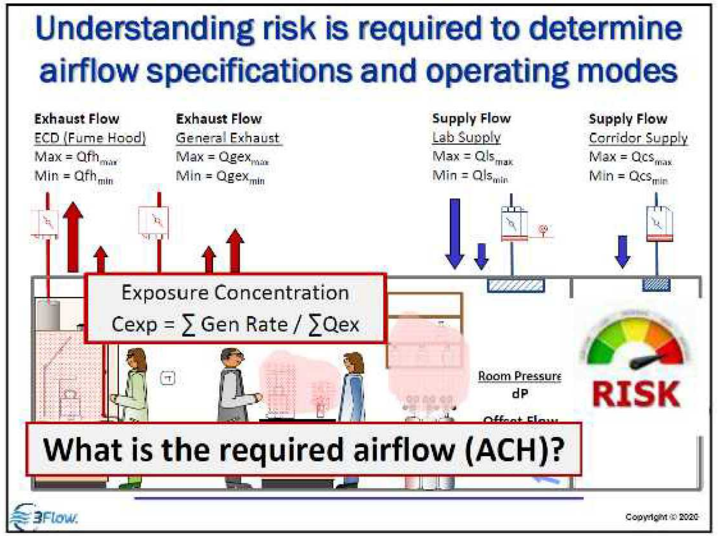
The Program Sells Itself

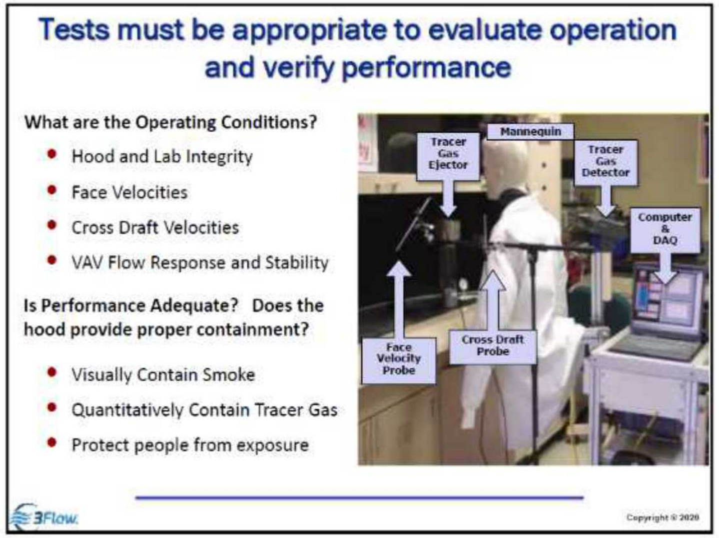
Improved Safety	Improved Reliability	Energy Savings
		

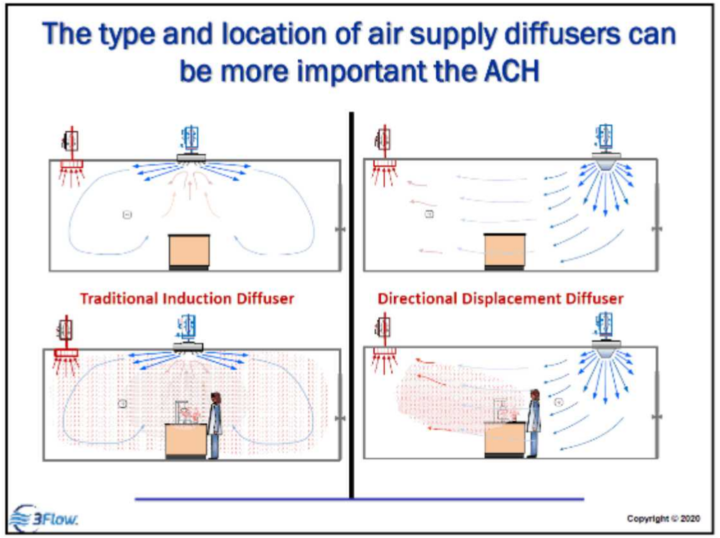
Training 3Flow

"A Primer to Improve Airflow in Labs and Critical Workspaces"

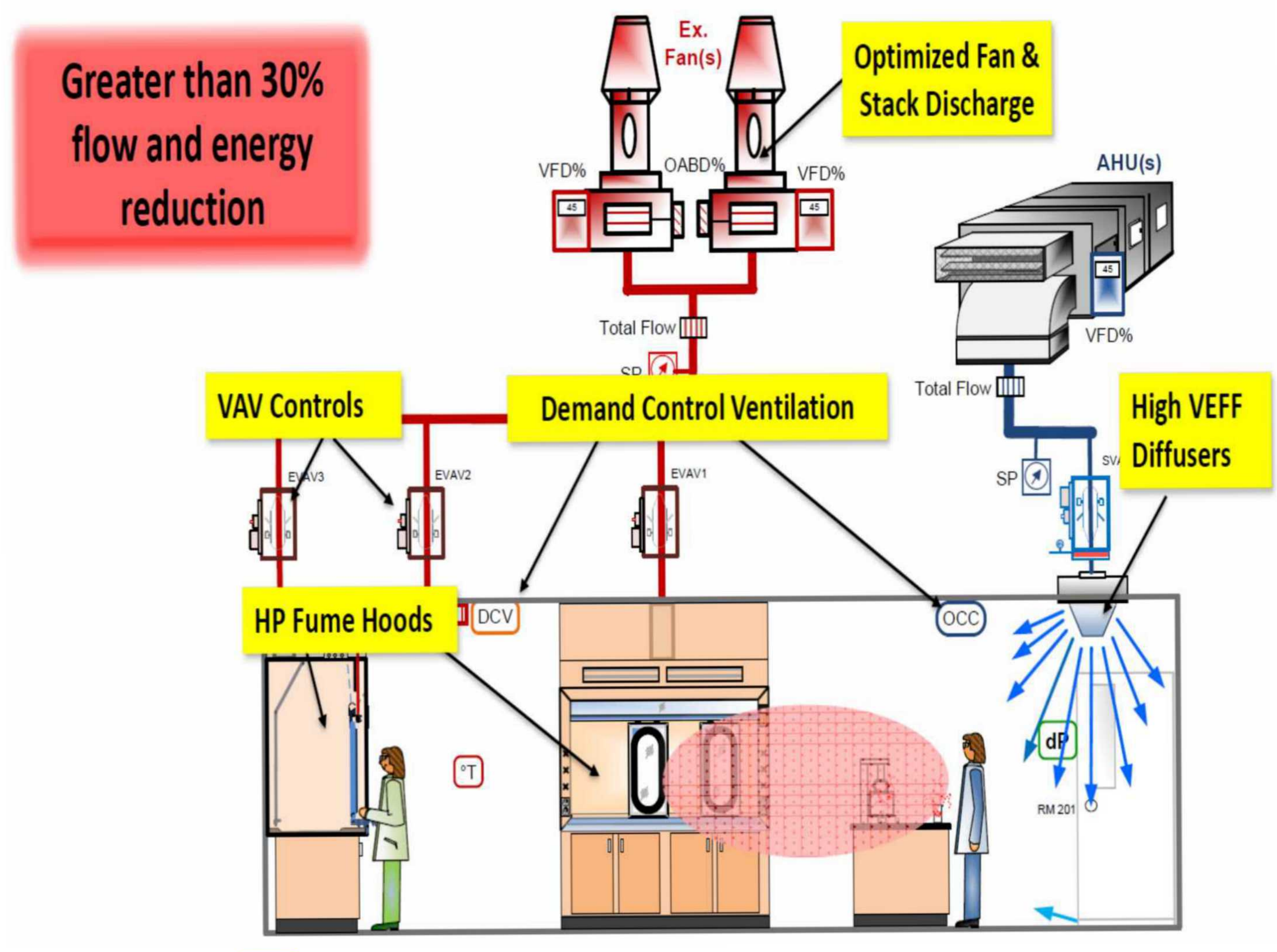


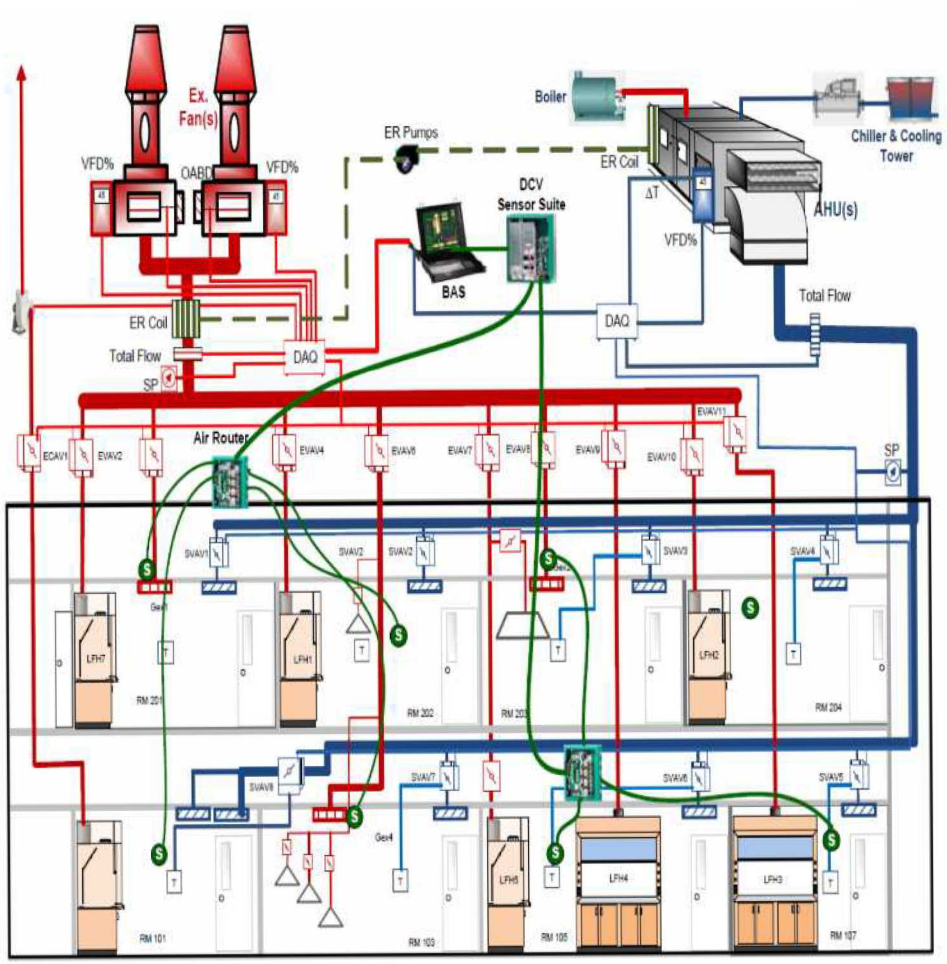






Whole Building Design Approach





Smart Labs Toolkit

INTRODUCTION

PLAN

ASSESS

OPTIMIZE

MANAGE

Introduction to the Smart Labs Toolkit

Why implement a Smart Labs Program?

Organizations spend hundreds of millions of dollars building laboratories with specialized workspaces that will support scientific activities, attract highly skilled people, inspire innovation, and bolster success of the organization. Laboratory scientific discovery is crucial to the advancement of these institutions, and it is often the main driver of their reputation, growth, and profitability. On the other hand, laboratory buildings are complex, costly, and challenging to operate. People working in labs depend on proper design and operation of the building systems to provide safe and controlled workspaces to support their scientific endeavors. It is critical to get the laboratory airflow control systems right. Many laboratory buildings suffer significant and persistent operational issues that hinder success of lab activities, increase waste, and negatively impact the health of the organization [1], [2], [3]. When left unresolved, these issues can degrade performance, hinder recruitment of top talent, and possibly cause irrevocable harm to people, property, or the environment.

When a Smart Labs program is implemented, an organization has a systems-based management approach that yields a high performing laboratory building. Employing Smart Labs methods during design and construction of new facilities or when upgrading existing facilities can provide significant benefits, including:

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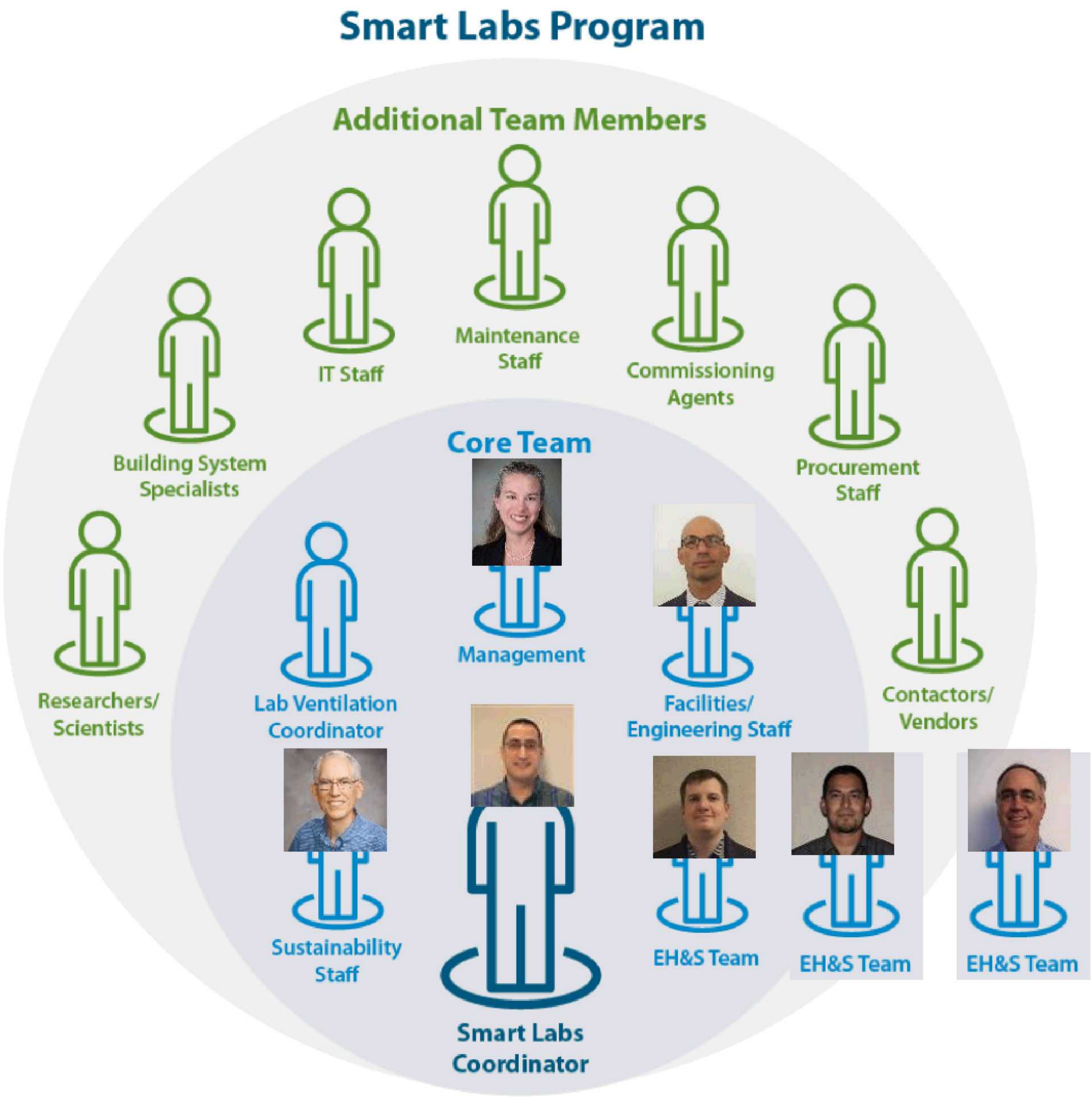
A systems-based management approach studies how each individual system works and how it relates to the total laboratory building both in the present and historically. Advanced monitoring can be used to assess how individual systems effect a laboratory building.

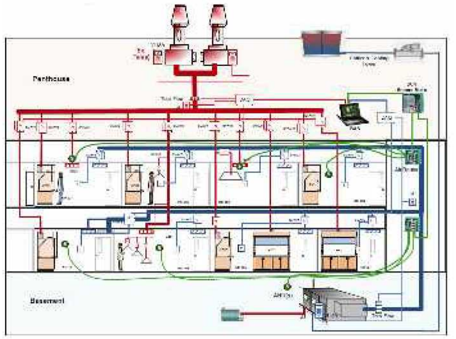
Identified Team Members



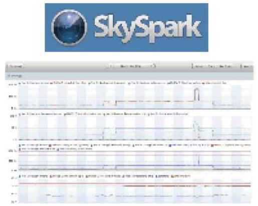
Choose a Facility for Success

Success Factors

- Building Automation System with control to each fume hood



- Fault detection with data analytics



- Scientists who want to participate in Smart Labs

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5. Follow the Toolkit