Moving the Bar: Advancing a Culture for the Conduct of Safe Science in Academic Research

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- How does one evaluate the safety culture within a laboratory research organization?

- What is the starting baseline?

- What are critical variables and attributes in moving the lab safety culture forward?

- What tools can be developed to help advance the safety culture in academic research?

- Most organizations have cultural norms that have been established over time and at some point change is desired to advance on a scale of expected improvement.

- Presentation will focus on identifying critical variables related to laboratory safety cultures and values

- Background

- Reviews and various recommendations to date

- Focus on change within the core research group stakeholders

- Prospects for the future of advancing lab safety culture

- High consequence incidents (low probability?)
  - UCLA
  - Texas Tech
  - Others

- Reviews by agencies with focus on research laboratory organizations (Cal/OSHA, CSB) - most focus on causal analysis of incidents

- Recommendations for organizational and programmatic approaches for prevention/enhancing lab safety culture (CSB, ACS, NRC/NAS

Cal/OSHA Compliance Mitigation Requirements

- <u>Focus on compliance</u> with interpretation and application of Cal/OSHA standards on occupational exposure to hazards chemicals in laboratories and other regulations as mitigations in settlement with UC Regents

    – Mandatory Lab Safety Manual

    – Mandatory Lab Safety Training

    – Mandatory Written SOPs

    – Required Procedures/training/PPE for Pyrophorics/ air reactives

    – Enhanced Reporting Requirements
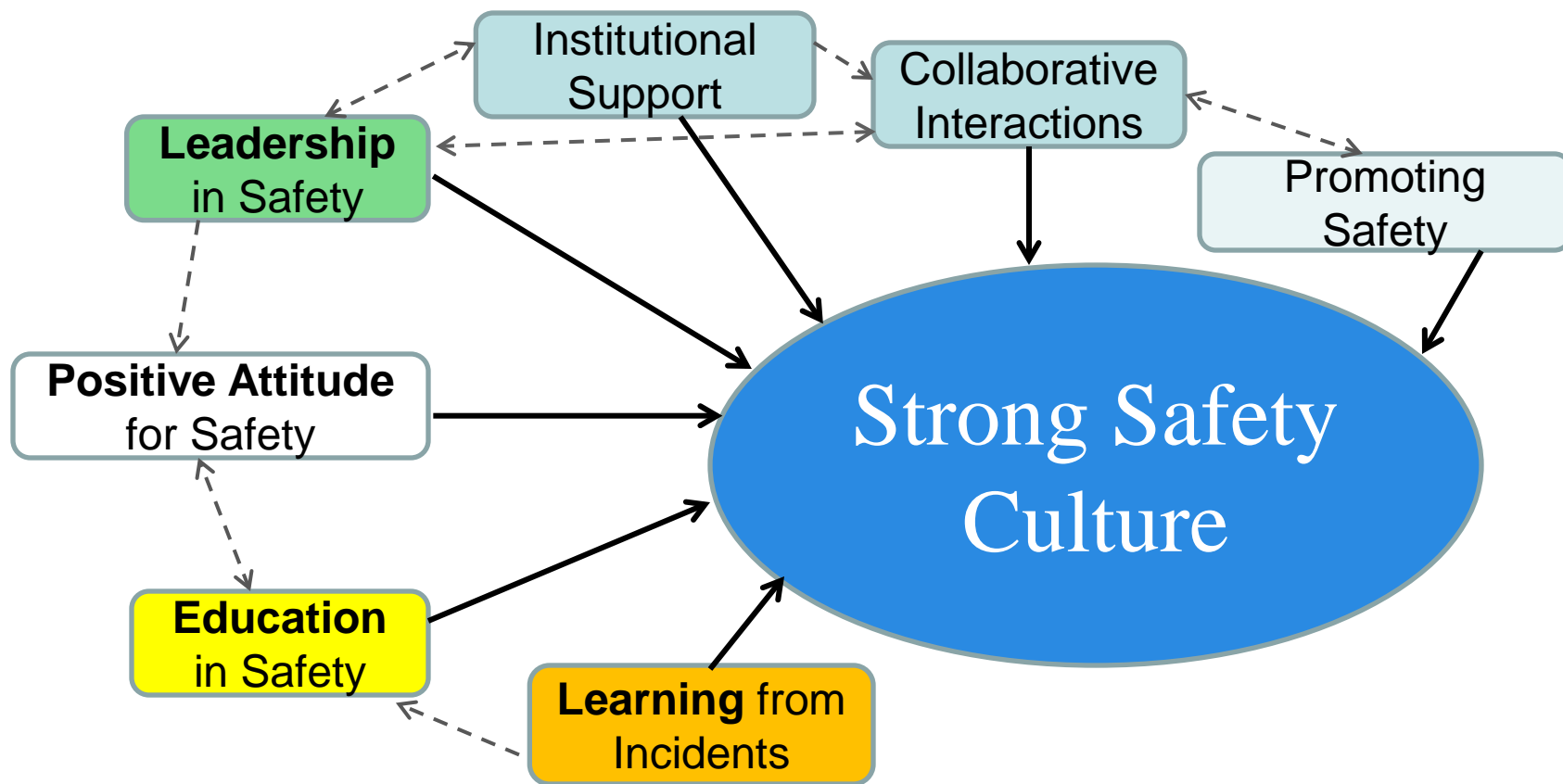
    – Increased CalOSHA Scrutiny

Chemical Safety Board Recommendations

1. Include physical/reactive hazards in lab safety and CHP programming

2. Academic institutions should ensure that practices and procedures are in place to verify that research-specific hazards are evaluated and mitigated.

3. Comprehensive guidance on managing the hazards unique to laboratory chemical research in the academic environment is lacking. Industrial process safety management not fully transferable to academic research.

4. Research-specific written protocols and training are necessary to manage laboratory research risk.

5. An academic institution's organizational structure should ensure that the safety inspector/auditor of research laboratories directly report to an identified individual/office with organizational authority to implement safety improvements.

6. Near-misses and previous incidents provide opportunities for education and improvement only if they are documented, tracked, and communicated to drive safety change.

http://www.csb.gov/assets/1/19/CSB_Study_TTU_.pdf

American Chemical Society, *Creating Safety Cultures in Academic Institutions*. American Chemical Society 2012

ACS Task Force Recommendations

1. Strong Leadership and Management for Safety

2. Continuous Learning about Safety

3. Strong Safety Attitudes, Awareness and Ethics
"the Safety ethic: value safety, work safely, prevent at-risk behavior, promote safety, and accept responsibility for safety"–robert hill

4. Learning from Incidents

5. Collaborative Efforts to Build Safety Culture

6. Promoting and Communicating Safety

7. Institutional Support for Funding Safety

National Research Council's *Prudent Practices in the Laboratory*[1]

- "The ultimate responsibility ..for encouraging a culture of safety rests with the head of the organization and its operating units. Leadership by those in charge ensures an effective safety program is embraced by all."

- **"Teaching safety and safe work practices in the laboratory should be a top priority for faculty as they prepare students for careers. By promoting safety during undergraduate and graduate years, the faculty will have a significant impact not just on their students but also on everyone who will share their future work environments."**

- "The ability to accurately identify and assess hazards in the laboratory is not a skill that comes naturally, and **it must be taught and encouraged."**

- "**Forming the foundation for a lifelong attitude of safety consciousness, risk assessment, and prudent practice is an integral part of every stage of scientific education**. Teaching and academic institutions must accept this unique responsibility for attitude development."

[1]National Research Council, *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards – An Update. Washington, DC, National Academies Press, 2011*

Why Not Emulate Industry Leaders?

- Dow, Dupont, Others
  - Strong central management and support
  - Strong vertical hierarchy of command and control
  - Centrally resourced – personnel and funding built into research programming support

Letter from Dow and Dupont to C&EN

- **"The facts are unequivocal," the letter asserts. "Occupational Safety & Health Administration statistics demonstrate that researchers are 11 times more likely to get hurt in an academic lab than in an industrial lab."**

- **Rebuttal: Facts are not unequivocal, but are incorrect and based on non-lab related data – points out the need for good sound data**

Unique Characteristics of Universities

Facility:

- Site is more like a city than a business
- Have virtually every regulatory issue that is present across all businesses lines
- Additional concerns and issues to manage relating to large on-site residential populations and lands management
- Often visible local/regional/national political targets

Organizational:

- **Numerous and individual cultures** - somewhat like different business units in one large corporation
- **Management structures**
  - Schools and depts/units may have differing structures
  - often reflective of the type of work/research that they do
  - results in very wide span of control (i.e. flat structure with local authority/accountability)

POPULATIONS

- **Role of Principal Investigator (Faculty)**
  - key to fostering safe and compliant attitude in laboratories; but this role is not standardized

- **Entrepreneurial spirit (resistance to central leadership)** - like "herding cats," (very smart cats!)

- **"Worker/researcher" population in labs**
  - relatively youthful, often their first 'job'
  - increasingly diverse cultures: foreign languages; safety/compliance attitudes and practices developed in other countries
  - high turnover in lab population - ~30% per year
  - concern by individual over future if views vary from faculty member

University facility, organizational and personnel characteristics create unique challenges

- **High turnover in laboratory personnel**
  - Research populations with 25-30% annual turnover (1500-2000) – majority of bench researchers are post-docs and graduate students
  - Challenge to keep up centrally with all personnel changes

- **Role in student education**
  - Students learning to work safely so that they take this knowledge and attitude with them when they leave and move on to next level

- **Line responsibility**
  - Role of PI/faculty is mostly self-defined
  - Strict line management, top down enforcement approach **alone** is not well received and does not typically work long-term in these organizations

- **Significant intolerance** for doing something just because it is a mandate – want to see a valid connection to cause-effect (scientific or deductive reasoning process)

- **Managing a central program in a decentralized organization** - (likened to working with 500 independent small businesses at one time!)
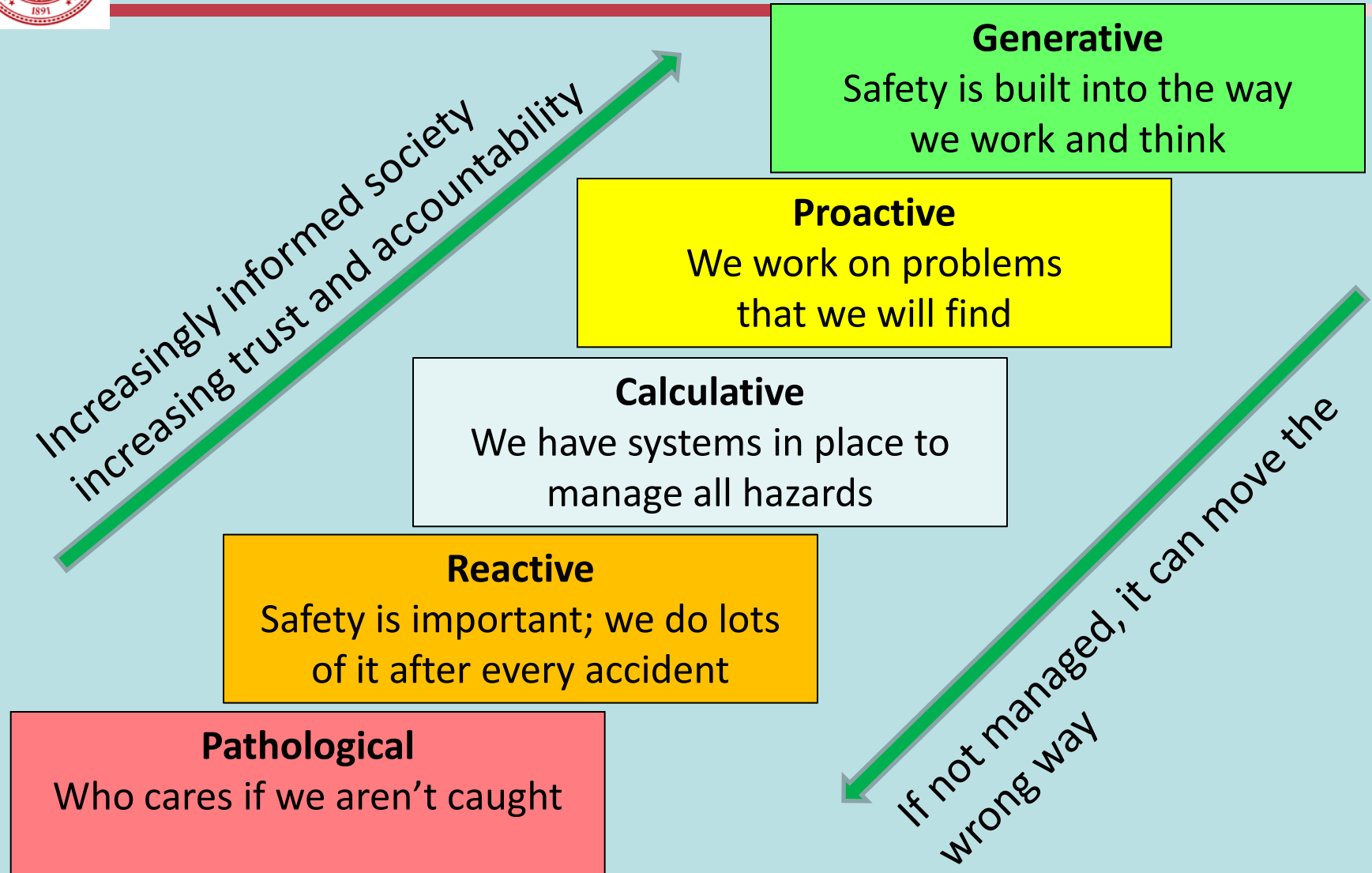
Factors of a weak lab safety culture

- no clear commitment of institutional administration to actively promote safety at all levels (weak or deficient leadership in safety);

- failure to establish accountability for safety among leaders, managers, supervisors, employees, and students;

- Lack of interest in spending significant time or resources on safety;

- Weak or missing safety management system;

- failure to adequately educate students in safety and to build strong safety skills;

- failure to evaluate students' safety knowledge and skills through tests and observations;

- failure to build and maintain strong safety awareness and interest in safety;

- failure to learn lessons from past incidents and implement changes (improved safety practices) to prevent future incidents; and

- Weak collaborative interactions within the safety program and on safety issues.

American Chemical Society, *Creating Safety Cultures in Academic Institutions*. American Chemical Society 2012

The Safety Culture Ladder

Increasingly informed society
increasing trust and accountability

If not managed, it can move the wrong way

Generative
Safety is built into the way we work and think

Proactive
We work on problems that we will find

Calculative
We have systems in place to manage all hazards

Reactive
Safety is important; we do lots of it after every accident

Pathological
Who cares if we aren't caught

Hudson, P. Safety Management and Safety Culture: The Long, Hard and Winding Road (2001)

- Describe the hierarchy of actors responsible for laboratory safety in US education and in national laboratories. Identify the strengths and shortcomings of these hierarchies and how it impacts the development of a culture of safety in academic research laboratories.

- Examine knowledge from the behavioral sciences, and experience with safety systems from other sectors (such as industrial research facilities, nuclear energy, aviation and medical) **for key attributes of successful safety systems and cultures.** Use this to draw lessons that could be applied non-industrial laboratory research.

- Provide guidance on systems (such as training and reporting) that might be established, maintained, and utilized to raise the overall safety performance of US chemistry research laboratories.

- Determine **key actors required to achieve broad implementation of improved safety performance in research laboratories, especially in the US higher educational system, and provide guidance on their roles and how they might be effectively engaged in improving safe laboratory practice.**

http://dels.nas.edu/Study-In-Progress/Safety-Culture-Academic-Laboratories/DELS-BCST-11-04?bname=bcst

- Meetings with stakeholder input – other than committee deliberations, meeting is open to public
  - May 15-16 Washington DC
  - June 26-27 Berkeley, CA
  - August 28-29 Cambridge, MA
- Similar Format
  - Panels of faculty members and chairs; post-docs and grad students; EHS personnel; industry EHS; National lab reps
- Common theme to date from presentations (my personal observation)
  - Post-docs and grad students believe most important attribute for advancement of safety culture in research group and at the bench top is relationship with and leadership actions by faculty/lab manager

http://dels.nas.edu/Study-In-Progress/Safety-Culture-Academic-Laboratories/DELS-BCST-11-04?bname=bcst

- Ability to evaluate lab safety climate – need for good evaluation tool for gauging and evaluating the lab safety climate in research labs

- Dynamics within the academic research laboratory itself – at the bench and within the research working group

- Interactions between PI/Lab Manager – Lab Researchers – EH&S

EHS

Faculty/
PI

Researchers
Post-docs &
Grad Students
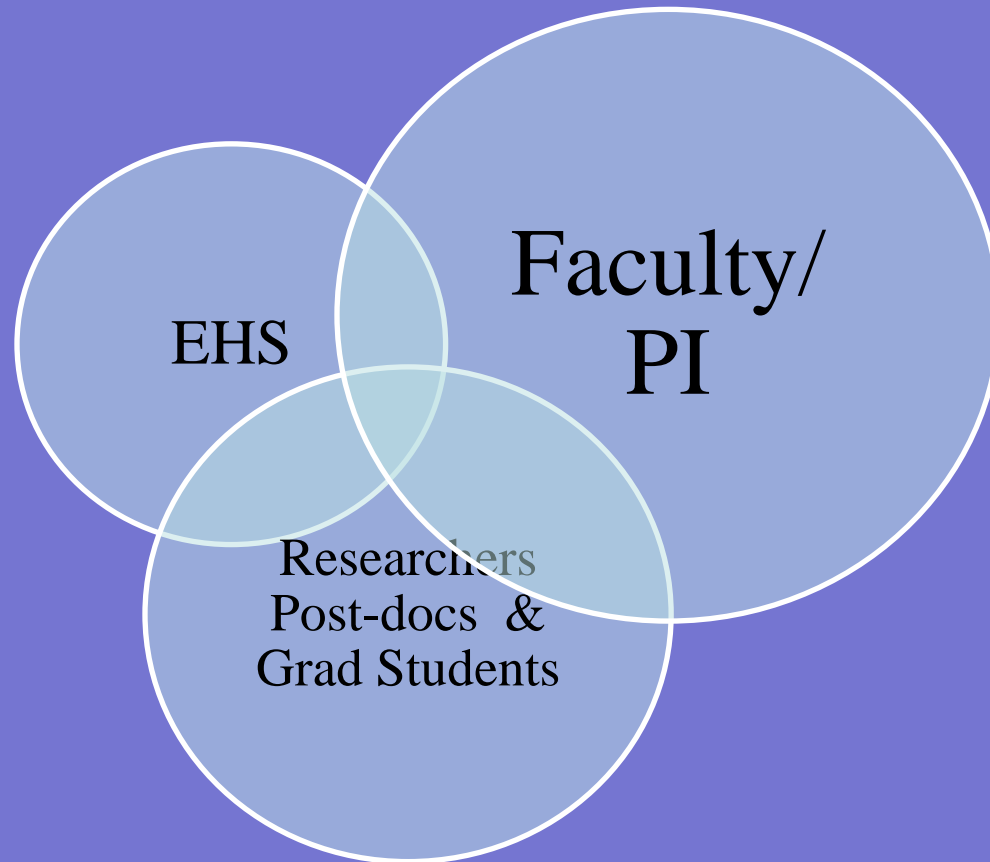
Attributes in the Lab Safety Culture Matrix

- <u>Communication</u> about safety <u>within</u> the lab

- Organizational <u>attitudes about safety within</u> the laboratory

- <u>EH&S program support</u> for lab safety

- <u>Organizational behavior</u> about the lab status

- <u>Working behavior</u> in the lab (individual and group)

Lab Safety Culture Matrix Attributes

Culture Attribute	Pathological	Reactive	Calculative	Proactive	Generative
Safety Communication	Nobody is informed; no feedback; everybody is passive; no care/ knowledge about safety; don't see(k) or ask the problem; collect what is legally required.	PI demands data on environmental health & safety (EHS) failures; lab researcher denial until forced to admit; top-down flow of information; bottom-up incidents; lots of statistics nobody understands; safety is hot issue after lab accident.	Environment of command and control by PI; lots of safety information but no follow up; info goes top down; failures bottom up; little top-down feedback; regular lab safety meetings; safety procedures exist but are only once read; action is delayed after knowledge is transferred	PI/management go out and see/seek lab safety status for themselves; they know what to change and how to manage; the feedback loop on safety issues (bottom-up and top down) is closed (addressed) at supervisory level; safety topics become part of regular lab meetings; near misses reported regularly; safety is asked for by lab members; they need detail to understand WHY lab near misses and accidents happen.	No threshold between PI and lab members; PI participates/shares activities (dialogue); Lab safety is number 1 issue; all feedback loops are used and closed; safety is integrated in other lab and department meetings; no special safety meetings required as lab members keep themselves up-to-date on safety; they demand information so they can prevent problems.

Lab Safety Culture Matrix Attributes

Culture Attribute	Pathological	Reactive	Calculative	Proactive	Generative
Organizational attitudes	No belief or trust in lab; environment of punishing, blaming and controlling the lab members for incidents or safety lapses	Failures caused by individuals; no blame assigned but responsibility accounted for; lab members need to be educated and follow the procedures; PI and management overreact in eyes of lab members.	Lab members are more involved; little effect on procedures, designs, practices; lab members do not understand the problem; PI/management is seen as obsessive with EHS, but they don't 'mean' it. (Walk the-talk).	Lab member involvement is promoted but ruled/organized by PI/supervisory and management staff which is obsessed by EHS reporting and statistics.	PI/management is recognized as a partner by lab members; PI/ management respects lab members; PI/ management fix systematic failures; lab researchers identify them to PI/ management.

Lab Safety Culture Matrix Attributes

Culture Attribute	Pathological	Reactive	Calculative	Proactive	Generative
EH&S Program	No EHS status feedback provided; EHS issues are ignored; minimal requirements; no rewards on good performance; safety is inherited but not known; reliance on each individual's lab safety experience.	Meets legal requirements; collects statistics but no follow up; design or program is changed after accidents; procedures are rewritten to prevent previous accidents; no update or improvements.	EHS well accepted; program collects data and creates own statistics; EHS rewards/responds for positive and negative performance or design; quantitative methods, procedures to solve unsolved problems; standard procedures preferred from the shelf; large numbers of procedures but few checks on use/knowledge.	Central EHS staff promote improvement, but try to reduce the inconvenience to lab members; for good EHS initiatives there is career enhancement for Sr. EHS staff, EHS is in the early stages of design; safety procedures are rewritten by lab members; integration with competency; complaints by lab about externally set targets.	EHS department is small, advising the management on strategy; group gets no special rewards for safety performance; individual pride and fulfillment; safety procedures are integrated into all lab procedures; continuous improvement by lab; small numbers of procedures are integrated in training.

Lab Safety Culture Matrix Attributes

Culture Attribute	Pathological	Reactive	Calculative	Proactive	Generative
Organizational Behavior	Denial that anything is wrong; avoid EHS discussions; PI and lab management is hierarchical and stagnant to changes; focus on productivity, not on lab members; lab members have lots of freedom-> PI/management don't care about safety.	PI/management holds lab members responsible for failures; PI/management overreacts. PI/mgt. states that it takes safety seriously, but is not always believed by lab members.	Detailed and focused on safety; playing with numbers; believe lab is safe in spite of contrary; safety targets are not challenged; inability to admit that solutions may not work the first time.	PI/management know the risks; interested in lab EHS; takes lab culture into account; safety is priority over research production which leads to incompatible goals; lots of PI/management walk-about; regular communication and assessments about lab accidents and near-misses and their consequences.	Safety is equal to lab production, enthusiastic communication between lab members and PI/management-lab researchers have a lot of freedom-> trust to do the right thing and work safely at all times

Lab Safety Culture Matrix Attributes

Culture Attribute	Pathological	Reactive	Calculative	Proactive	Generative
Working Behavior	Workplace is dangerous, messy; no (legal) health requirements; procedures not always followed when others not around; PI/management does not CARE and does not KNOW.	Basic regulatory safety requirements are implemented; housekeeping is temporarily improved when inspection comes; PI/management KNOWS but not always CARES.	Clean and tidy laboratory environment; safety and lab housekeeping is very important (prized); PI/management CARES but not always KNOWS.	PI/management CARES and KNOWS; regular discussion and promotion about lab safety prioritization; time and resources are available for improvements even before accidents happen.	PI/management CARES and KNOWS; lab members furnish and manage their own safety environment; management passes the exemplar experience around to other labs

Attribute \ Culture	Pathological	Reactive	Calculative	Proactive	Generative
Safety Communication					
Organizational attitudes					
EH&S Program					
Organizational Behavior					
Working Behavior					

Dashboard: Lab Safety Culture Matrix Attributes

Attribute \ Culture	Pathological	Reactive	Calculative	Proactive	Generative
Safety Communication	■				
Organizational attitudes		■			
EH&S Program				■	
Organizational Behavior			■		
Working Behavior			■		

- Communication about safety <u>within</u> the lab

- Organizational attitudes about safety <u>within</u> the laboratory

- EH&S program <u>support</u> for lab safety

- Organizational <u>behavior</u> about the lab status

- Working behavior in the lab (individual and group)

- Are their other attributes that you can identify? With spectrum of examples?

Site review/report

➢ Management's support for framework of culture of safety

  ✓ Stanford University's culture of safety has grown from and is supported by a strong framework set in place by the University leadership

➢ Stakeholder perceptions

  ✓ Those in leadership positions hold a favorable view of Stanford's safety culture.

  ✓ Those more involved in the day-to-day research ongoing within the laboratories, for example, postdoctoral scholars and graduate students, are less cognizant of Stanford's framework in support of safety and hold a lesser view of the current safety culture

  ✓ **Disconnect between Post-doc/grad students and PI**

Updated Institutional Health and Safety Policy

"Safety is a core value at Stanford and the University is committed to continued advancement of an institutional safety culture with strong programs of personal safety, accident and injury prevention, wellness promotion, and compliance with applicable environmental and health and safety laws and regulations**."**

HEALTH & SAFETY POLICY AT STANFORD

PRINCIPLES

RESPONSIBILITIES

PRACTICES

October 2012

APPROVALS

REVISIONS

Revision v2.0 Approved and Adopted by Stanford University President (October 2012)
Revision v2.0 Recommended by University Committee on Health and Safety (June 2012)
Original Approved and Adopted by Stanford University Cabinet (April 1991)

Health and Safety Policy at Stanford: Principles, Responsibilities and Practices was developed by Environmental Health and Safety (EH&S) at Stanford University with input and feedback from the campus community. Please direct all questions and comments to EH&S (650) 723-0448 http://ehs.stanford.edu.

Task Force for Advancing the Culture of Laboratory Safety at Stanford University

- Convened under auspice of University Committee on Health and Safety (UCHS is faculty led committee and standing committee that reports directly to University President) and Dean of Research

- Three faculty co-chairs with additional broad stakeholder membership (lab bench researchers/faculty/chairs/deans/EHS)

Task Force Charge: Multi-step process

1. Review and evaluate the existing state/perception of safety and safety culture in academic research laboratories at Stanford by solicitation and gathering of information, perspectives on lab safety, and input from the various stakeholders in laboratory research at Stanford.

2. Identify best practices of a sound, proactive laboratory safety culture within the three critical functional areas:
   a. Within the research laboratory and amongst the research group (PI, Post-docs, grad students).
   b. Within the departmental and schools management systems.
   c. Within EH&S programs and support functions.

3. Identify the roles, responsibilities, authorities and accountabilities within and among each of these functional areas.

4. Identify additional program needs, support functions, new tools and/or other issues for advancing laboratory safety culture in each of these areas.

5. Recommend approaches and programs to address the identified needs/gaps.

- Enhance Outreach and Communications about existing lab safety programs
  - ➢ Complete redo of website – partnering with organization in use of *ethnography* to help design new approaches for outreach and communications with focus on interactive web site.
  - ➢ Enhancing communications capabilities
- Enhancing technical background and capabilities of EHS staff
  - ➢ Newer EHS hires are individuals with terminal degrees with significant lab research experience (PhDs and Post-docs)

Promoting Safety as an Organizational Core Value

- Institutional health and safety policy (updated October 2012)
  - Statement affirming safety as a core value at Stanford
  - Roles and responsibilities for safety management clearly defined
- Human resources
  - "Promotes a culture of safety": identified as a basic competency/skill requirement for all positions (in each job position template)
  - "Attention to Safety:" In all performance review evaluations
- Postdoctoral scholars program (independent researchers)
  - Offer letter inclusion of expectations for attention to safety
  - Orientation involvement by EHS
- Internal Audit reviews
  - Management system reviews include safety elements at local levels – some challenges with technical evaluations by audit staff

Addressing the Lab Safety Culture Challenge

- Need for a good survey tool to provide metric for determining baseline and future movement in area of lab safety culture

- Set a goal and strategy to advance the lab safety culture forward/up the ladder – engagement of core stakeholders

- Understand barriers and provide helpful tools to assist the laboratory leaders (scientists) in moving safety in their laboratories up the value ladder – need for good, relevant case studies as learning tool (lab safety tailgate sessions)

- Provide an EH&S support system that integrates positive learning from incidents (as opposed to solely punitive reactions) into the safety management program

- Demonstrate that safety is integrated as a core organizational value throughout the institution (integrate within other institutional management systems)

"Don't worry that [students] never listen to you; Worry that they are always watching you!"

Robert Fulghum