Rasmussen's Risk Management Framework Applied to Academic Laboratory Safety

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Introduction

Rasmussen's Model of a Dynamic Risk Management Framework

Today, I would like to say a few words about my master's thesis, review Rasmussen's model, and present some ideas how it can be applied to academic laboratory safety.

Introduction

My master's thesis: I compared different laboratory accidents that occurred at **primary educational institutions, colleges, and universities.**

Figure 1 Lab Explosion (Chemical Safety Board, 2019).

Figure 2 Lab Explosion (Phifer, 2014).

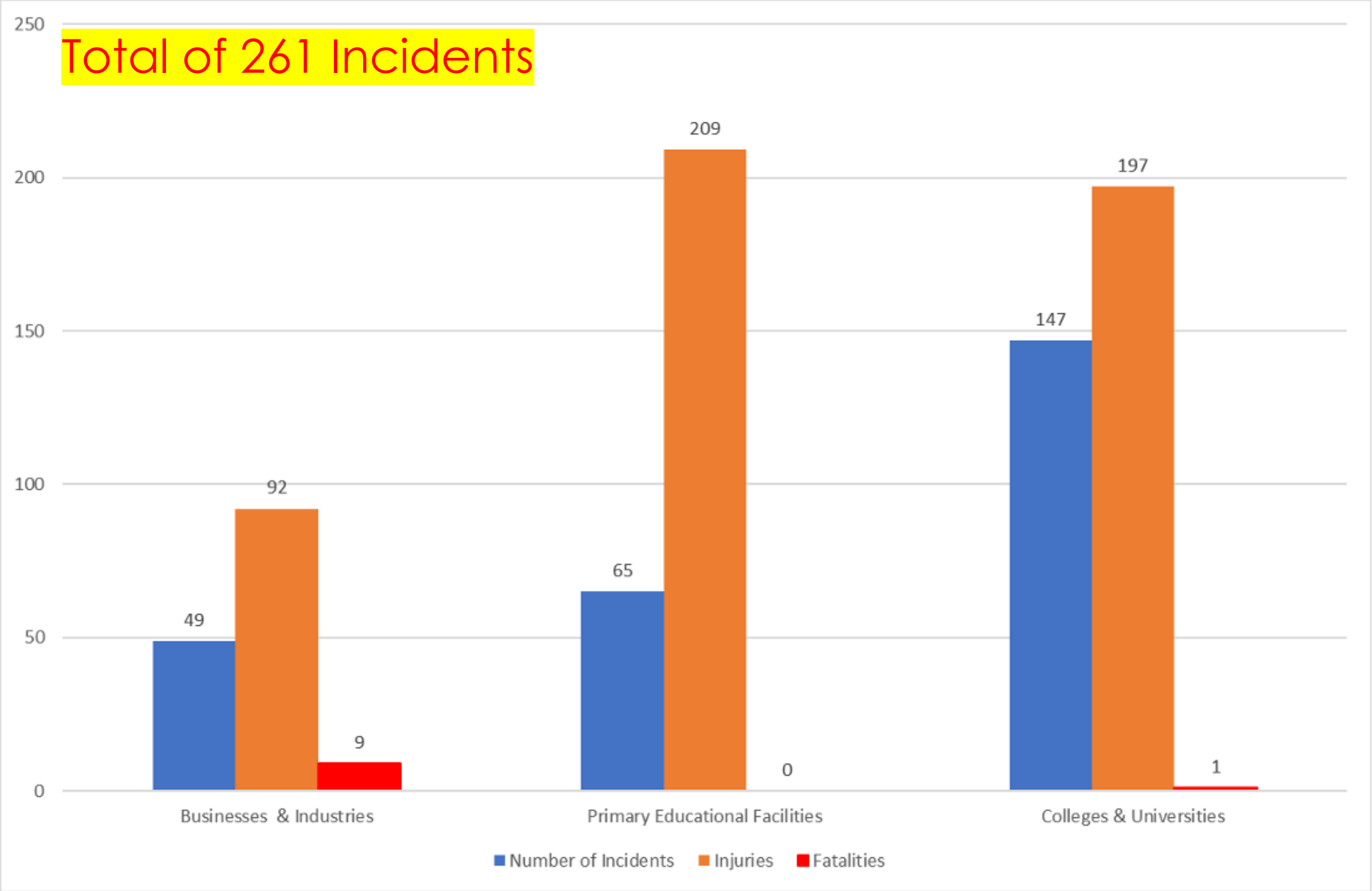
Figure 3 Lab Explosion (Merlic, Ngai, Schroeder & Smith, 2016).

Introduction

Statistics

The **U.S. Chemical Safety Board** published list of incidents that occurred in laboratories.

Information was received from **multiple sources**, the media, and the U.S. Coast Guard's National Response Center (CSB Releases Laboratory Incident Data [Jan. 2001 - Jul. 2018], 2018).



Introduction

Case	Title	Institution Type	Author or Source, Year
1	CXXV. An Accident with Acetic Acid and Bromine	University	Burnett, 1975
2	Hazards in a Photography Lab - A Cyanide Incident Case Study	University	Houk & Hart, 1987
3	Injury and Fire Resulting from Benzene Vapor Explosion in a Chemistry Laboratory	University	University of California, Irvine Independent Accident Investigation, 2002
4	Mercury Spill Decontamination Incident at the Rockefeller University	University	Santoro, 2006
5	Texas Tech University - Laboratory Explosion	University	Chemical Safety Board, 2010
6	Laboratory emergency response: A case study of the response to a 32P contamination incident	University	Ashbrook, 2011
7	Case study -Incident investigation: Laboratory explosion	University	Phifer, 2014
8	Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations	Educational Museum	Chemical Safety Board, 2014
9	Report to the University of Hawaii at Manoa on the Hydrogen/Oxygen Explosion of March 16, 2016	University	Merlic, Ngai, Schroeder & Smith, 2016
10	Case study - A two-liter pyridine spill in an undergraduate laboratory	University	Eichler, 2016
11	Case study: Reaction scale-up leads to incident involving bromine and acetone	University	Chance, 2016

Introduction

- **Bowtie Methodology**
- **Similarities:**
  - Lack of Supervision
  - Deviation from Protocol
  - Inadequate Training
  - Inadequate or Delayed Emergency Response

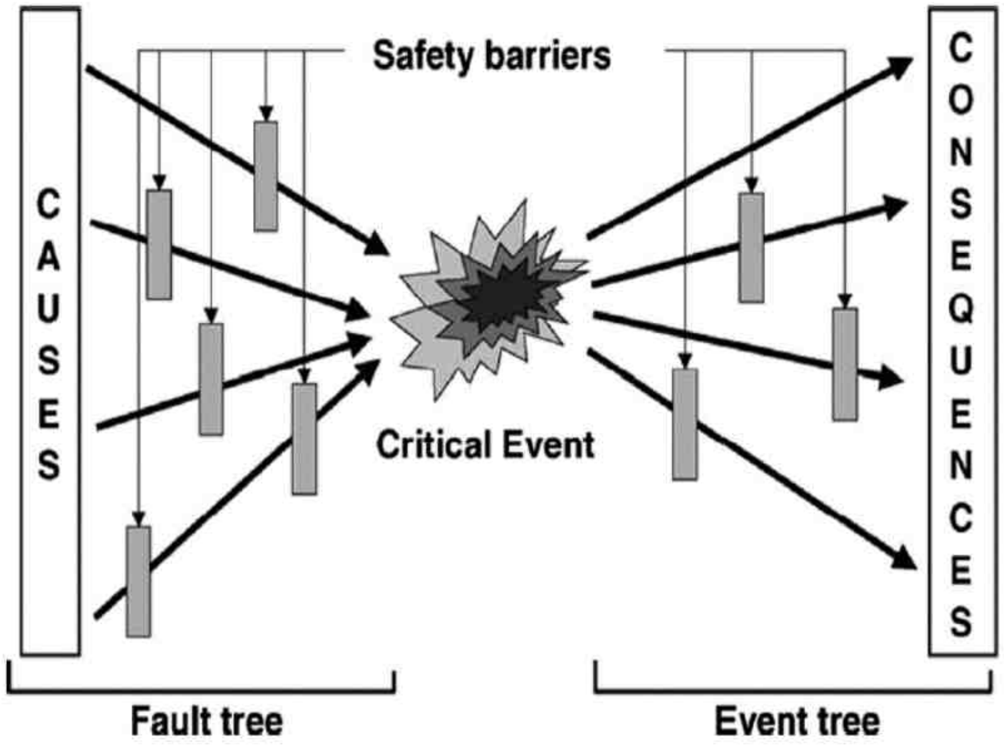


Figure 4 Bowtie Diagram (Dedianous & Fieves, 2006).

Literature Review

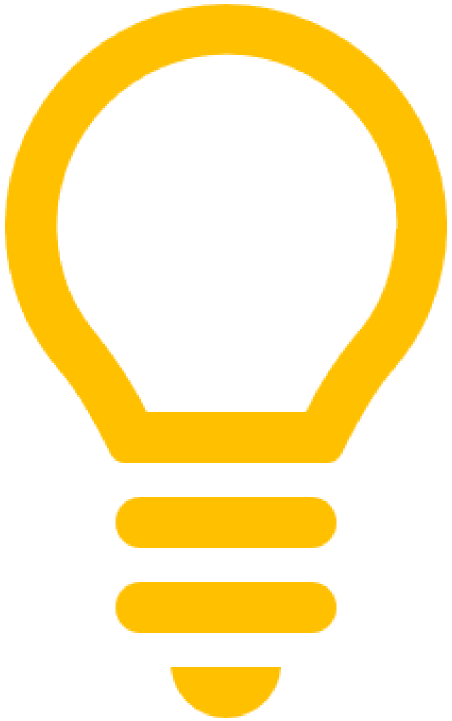
- ACS approved programs **should promote** a safety culture. However, there is **no required chemical safety class** (ACS, n.d.).
- Researchers concluded that the **most effective way** of reducing incidents at academic institutions is the **improvement of engineering controls** (Hellman, Savage & Keefe, 1986).
- Another group evaluated survey results and found that assigning **numerical values** to different **parameters for a safety climate was a difficult task** (Steward, Wilson & Wang, 2016).

Figure 5 Student Conduct (barnard.edu, n. d.).

Literature Review

Some good ideas for improving the safety

- Including a **JHA assignment** to an undergraduate laboratory course (Sigmann & McEwen, 2016).
- Forming student "**safety teams**" and including **hands-on safety training** to the teaching curriculum (Alaimo, Langenhans, Tanner & Ferrenberg, 2010).
- A **laboratory safety trivia game** (Gublo, 2003).



Literature Review

But let's take a look at general system safety.

Literature Review

System Safety - Safety Maturity Level

The organization fixes the situation after undesired incidents occur. This level of a safety culture is defined as "**reactive**" (**2 out of 5**)(Hudson, 2001).

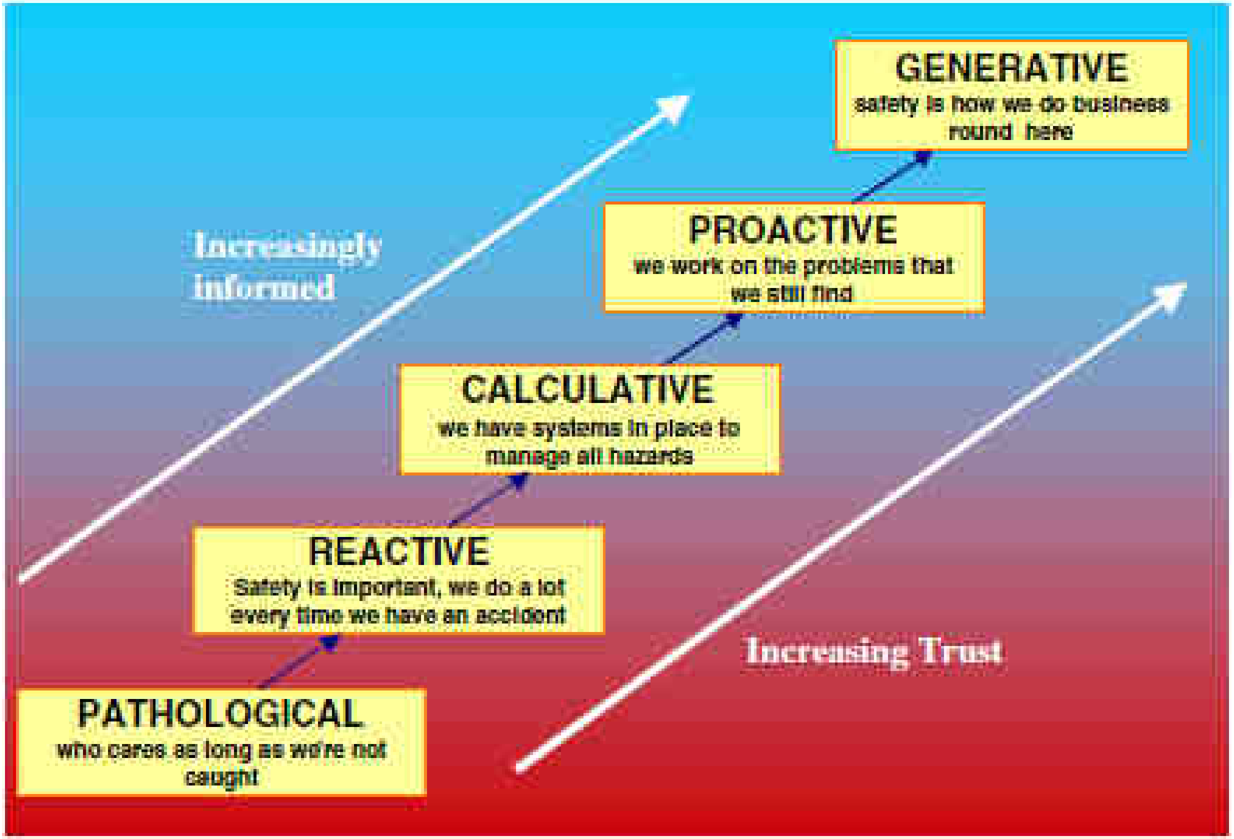


Figure 6 The evolution of safety culture (Hudson, 2001).

Literature Review

Work Safety - General Concepts for Risk Management

Some well established **risk management models** assume **hierarchical** orders and **fixed** positions for different categories of hazard controls.

Figure 7 Pecking Order (www.writeopinions.com, n. d.).

Literature Review

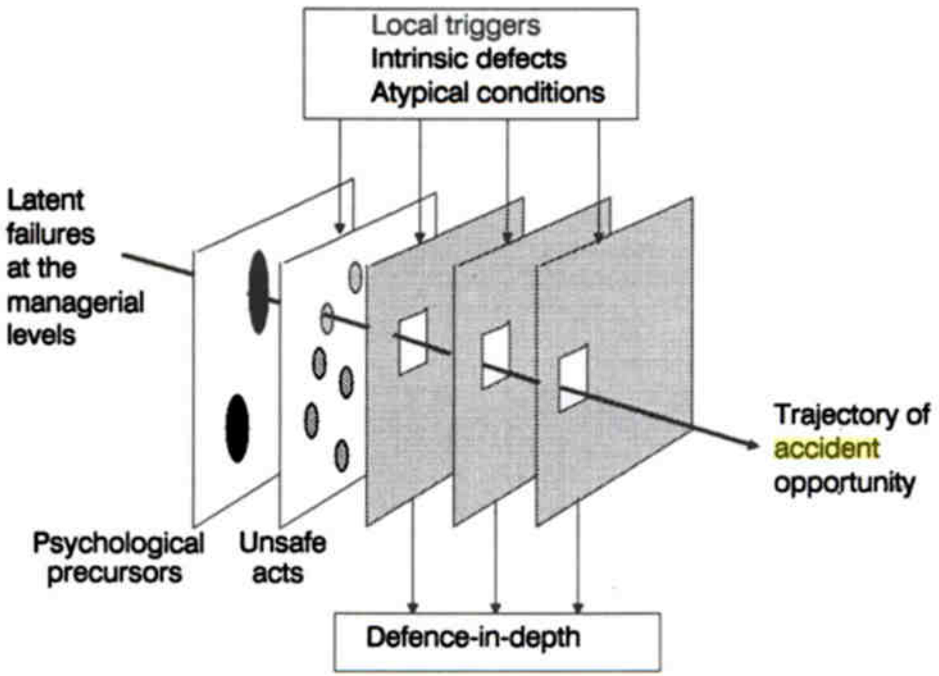


Figure 8 Swiss cheese model of accident causation (Reason, 1990).

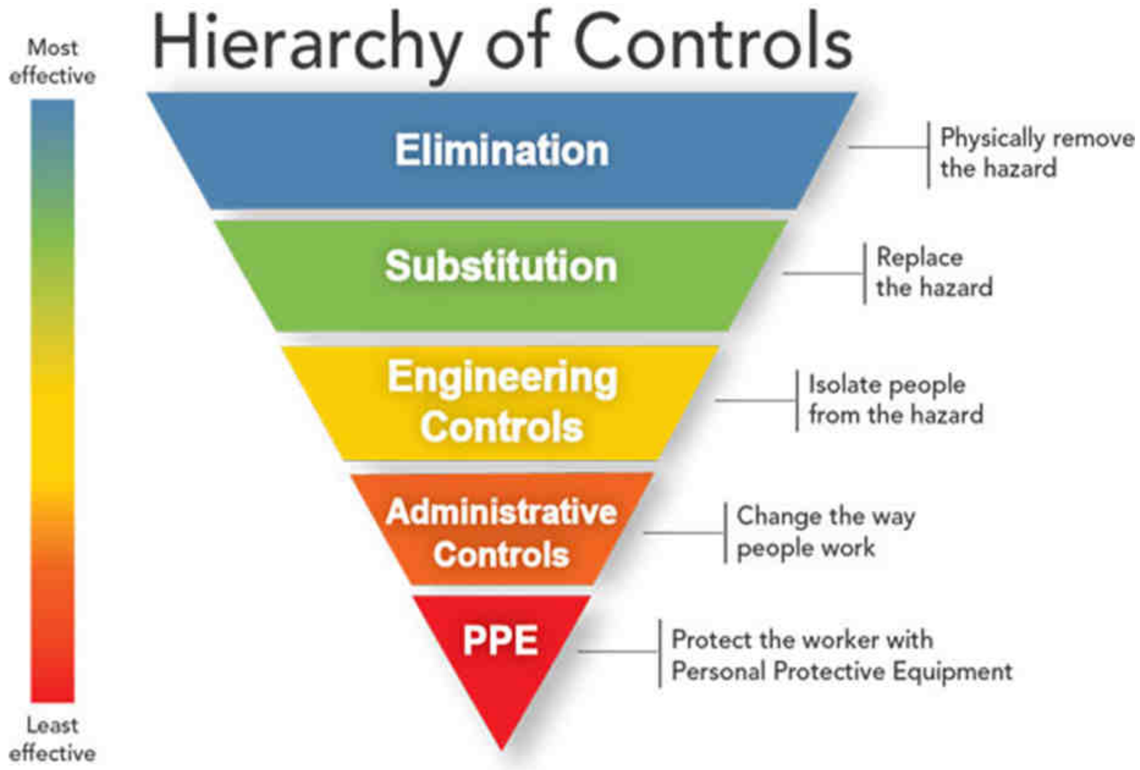


Figure 9 Hierarchy of Controls (Center for Disease Control, 2018).

Rasmussen's Risk Management Framework & Academic Laboratory Safety

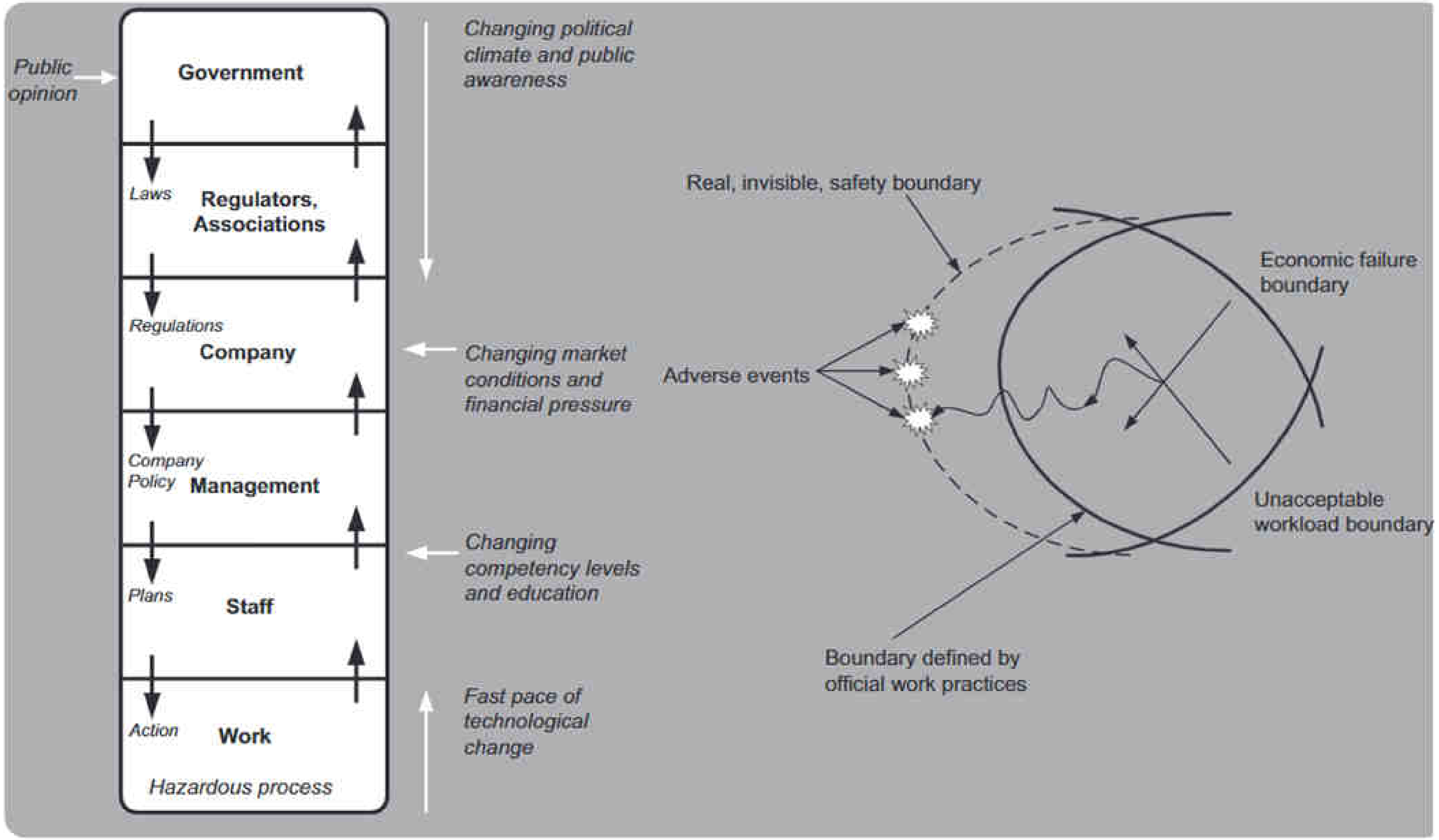


Figure 10 Risk management framework with the migration of work practices (Rasmussen, 1997 as cited by Walker et al., 2012).

Economics and **productions** influence work practices
→ **degradation** of **system barriers** (Rasmussen, 1997 as cited by Walker et al., 2012).

Rasmussen's Risk Management Framework & Academic Laboratory Safety

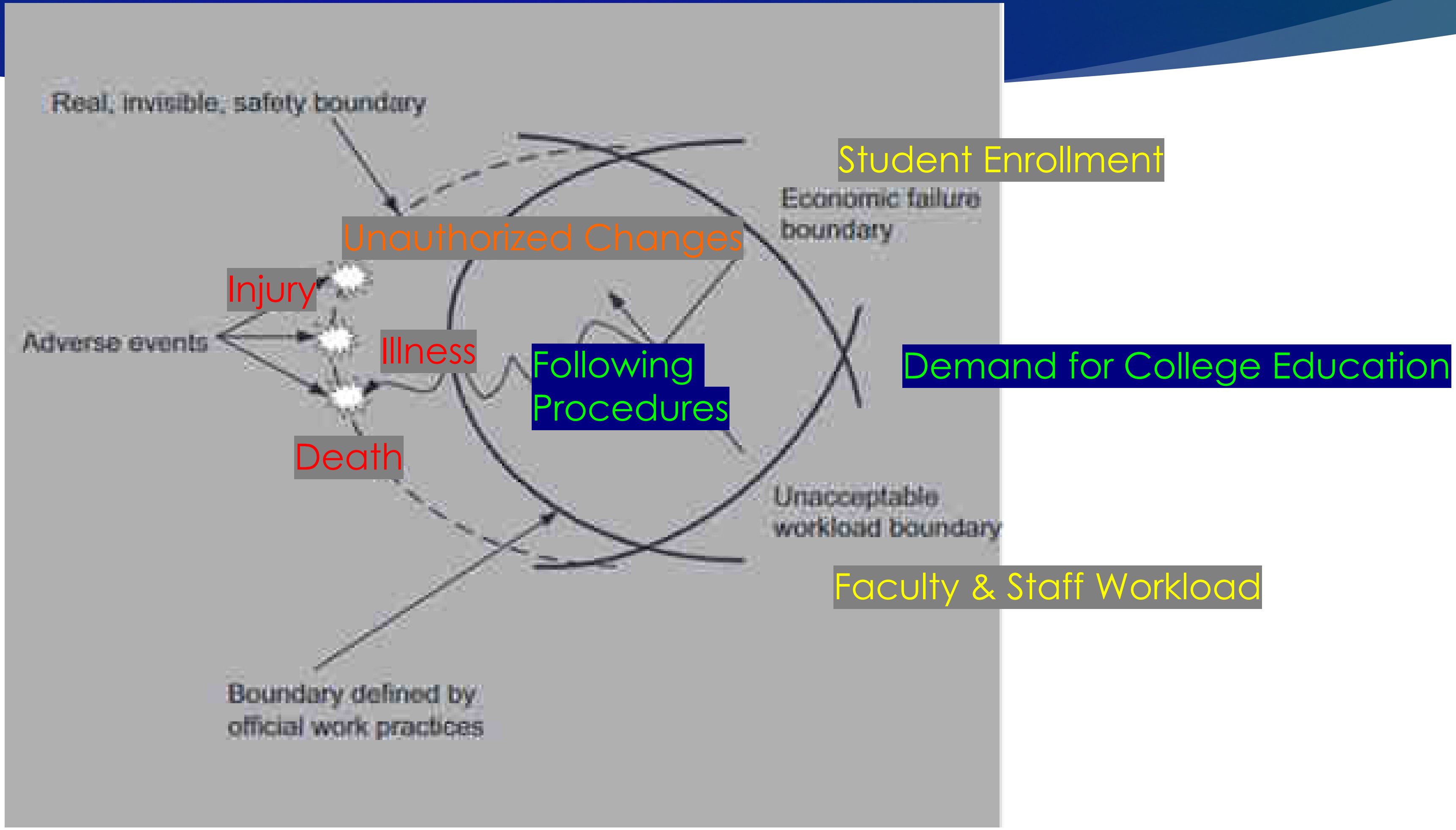


Figure 11 Risk management framework with the migration of work practices (Rasmussen, 1997 as cited by Walker et al., 2012).

Rasmussen's Risk Management Framework & Academic Laboratory Safety

Incident Reporting System

Mandatory Safety Classes for ACS Approved Programs

American Chemical Society

Safety Performance & Providing Resources

University Administration

Department Chair & Personnel Committee

Safety Performance & Providing Resources

Safety Training

Engaging Safety Activities

Faculty & Staff

Students demanding relevant education

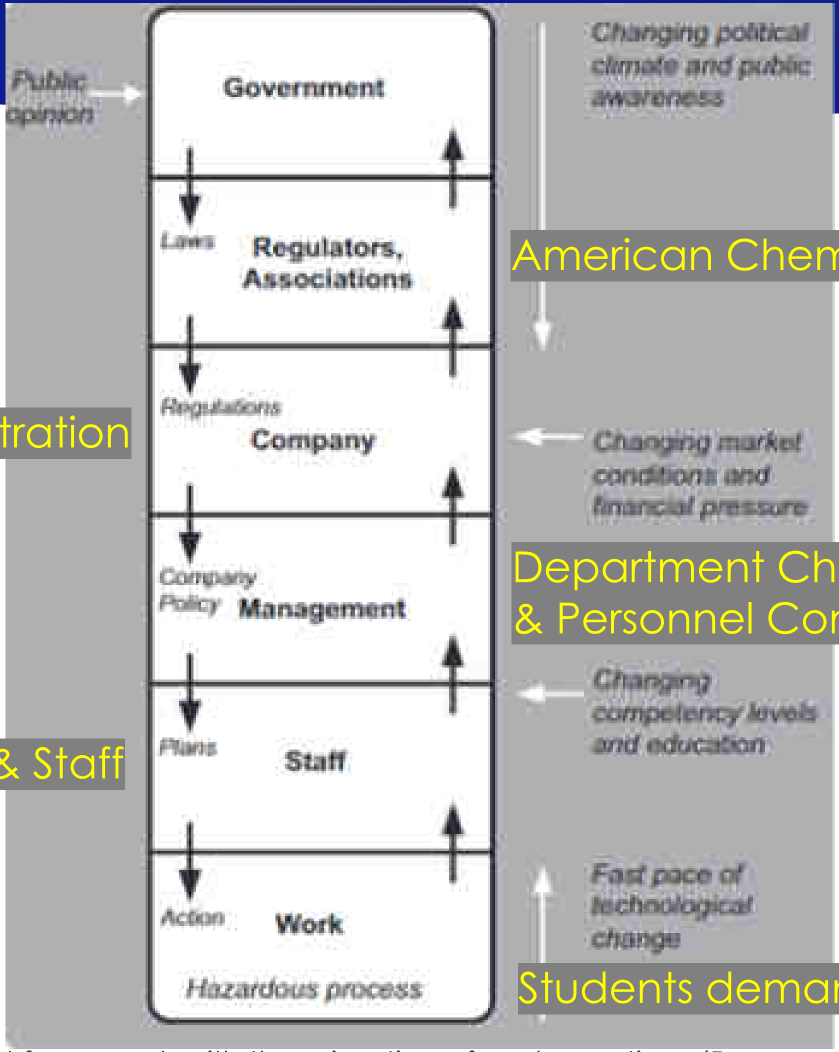


Figure 12 Risk management framework with the migration of work practices (Rasmussen, 1997 as cited by Walker et al., 2012).

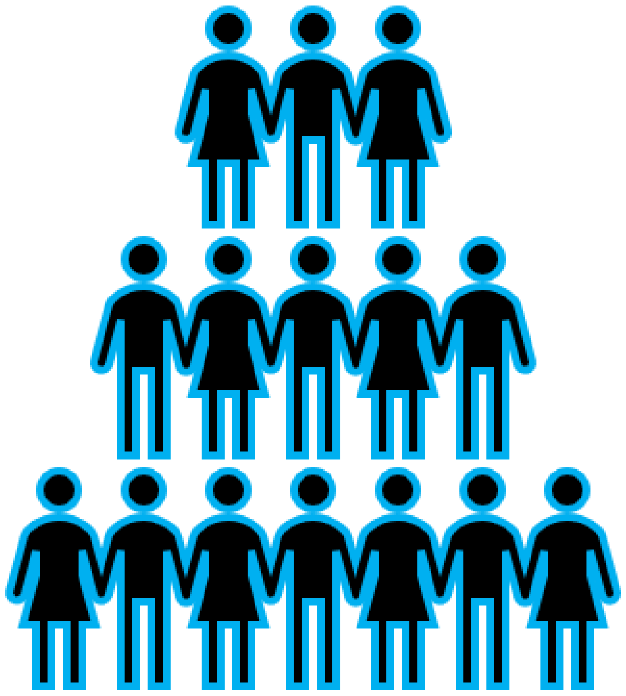
Conclusion & Future Research

- Rasmussen’s model can be **helpful to evaluate the safety cultures of academic institutions**.
- **Future research** could **investigate** how **local adjustments** influence the risk management framework of the system.
- Additionally, **effective communication methods** need to be explored.

Personal Experiences on the Job

As a instructional **support technician** for the **Jordan College of Agricultural Sciences and Technology**, I found that:

- **students** are very interested in learning about safety;
- **faculty and staff** are interested in improving the safety & risk management at their research & teaching laboratories;
- **university administration** is willing to provide resources for improving safety at the academic facilities.



Questions & Discussion

Thank you for your attention!

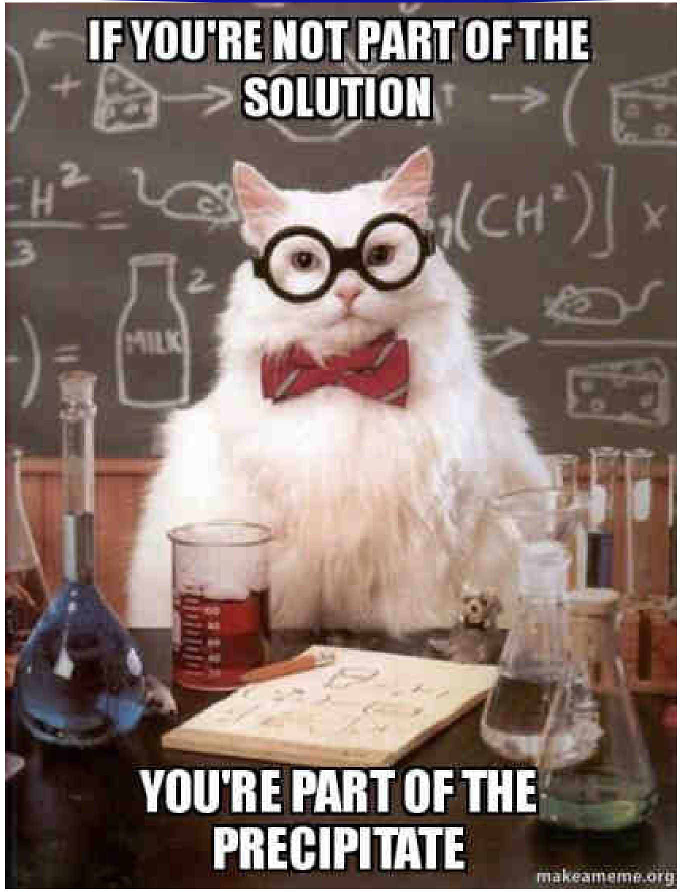


Figure 13 Cat (memegenerator.net, n. d.).

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