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Sustaining Effective Process Safety Programs

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ABS Consulting

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Jim Klein, CCPSC, CPSA

- 40+ years' experience in process safety, engineering
  - ABS Group: Sr. Process Safety Consultant (8 yr)
  - DuPont: PSM Co-lead North American Operations (33 yr)
- AIChE Fellow, AIChE/CCPS Fellow
- 75+ publications and conference/university presentations
- *Process Safety: Key Concepts and Practical Approaches* (CRC Press)
- M.S. Management of Technology, University of Minnesota
- B.S., M.S. Chemical Engineering, MIT, Drexel University

Why is safety so hard? We've been doing it for a long time!

Principle of "safety first" in settling questions in which safety and production appear to conflict (DuBlois, 1926)

What is meant by "performance?"

Performance

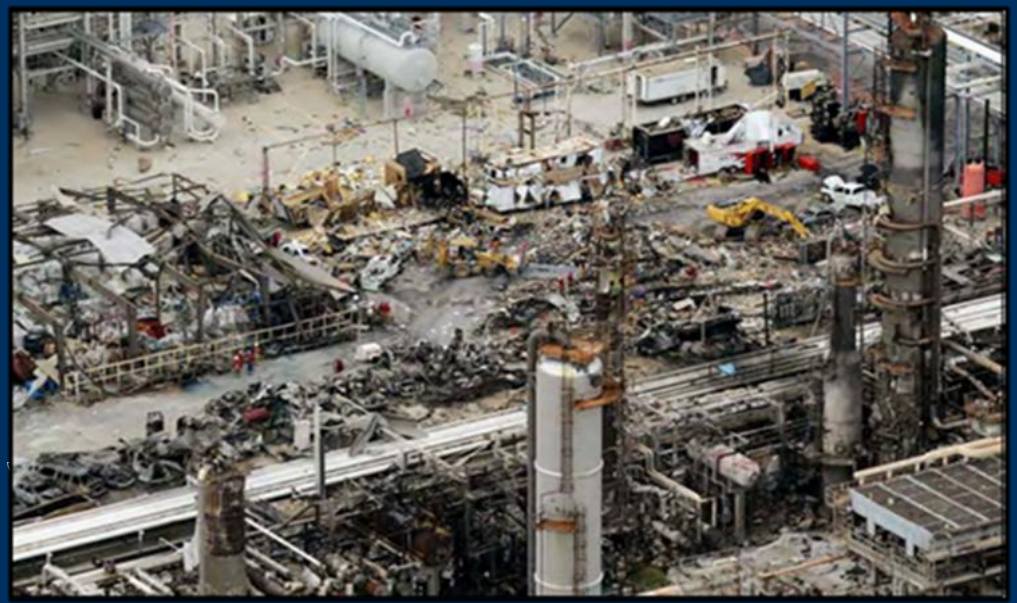
Preventing incidents and injuries

1. Injury rates often mix safety and process safety together
2. Injuries and incidents are *lagging* indicators
3. Injuries and incidents are relatively rare

What is meant by "performance?"
~~Performance~~
~~Preventing incidents and injuries~~
Performance
Achieving process safety program goals and objectives

Some Driving Forces for Improving Process Safety Performance

- Near-miss and incident trends; significant incidents
- Poor or degrading leading and lagging process safety metrics
- Costs associated with poor performance
- New regulations and industry consensus standards and guidance
- New technology, including new hazards as well as new applications
- Corporate restructuring, acquisitions, and mergers
- Stakeholder relations



Klein and Vaughen, 2017

“It does not do to leave a live dragon out of your calculations…”

Toxicity

Flammability

Combustible Dust

Reactivity

Klein and Vaughen, 2017
Tolkien, The Hobbit

"Robbing the Pillar" – Potential Causes of Poor Performance

- Weak safety culture and/or leadership
- Lack of senior leadership operational or safety experience
- Compliance-based mentality rather than risk-based mentality
- Poor awareness, interpretation, and/or implementation of regulations and industry standards and guidance
- Poor hazard recognition/identification

- Poor process safety system design with inadequate risk assessment
- Poor operational discipline
- Cost/staffing/resource pressures
- Poor management of mergers and acquisitions
- Lack of experienced, knowledgeable personnel
- Poorly designed feedback/measurement systems
- Complacency/no sense of vulnerability

Klein and Vaughen, 2017

Effective Process Safety Programs

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Klein and Vaughen, 2017

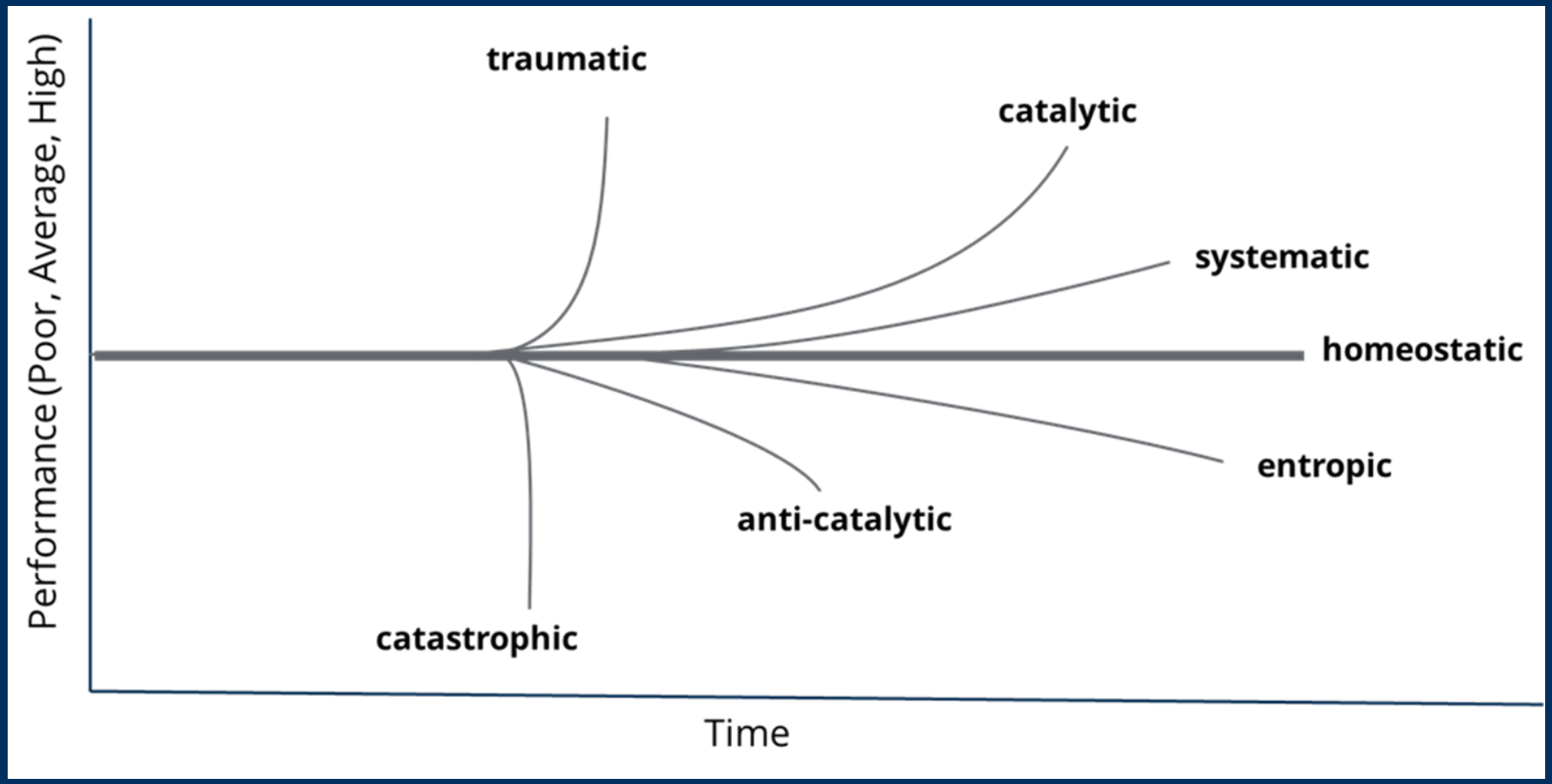
Key questions

What is the current level of process safety performance?

Is performance trending better, about the same, or worse?

How can performance be improved?

What is performance now… and where is it going?



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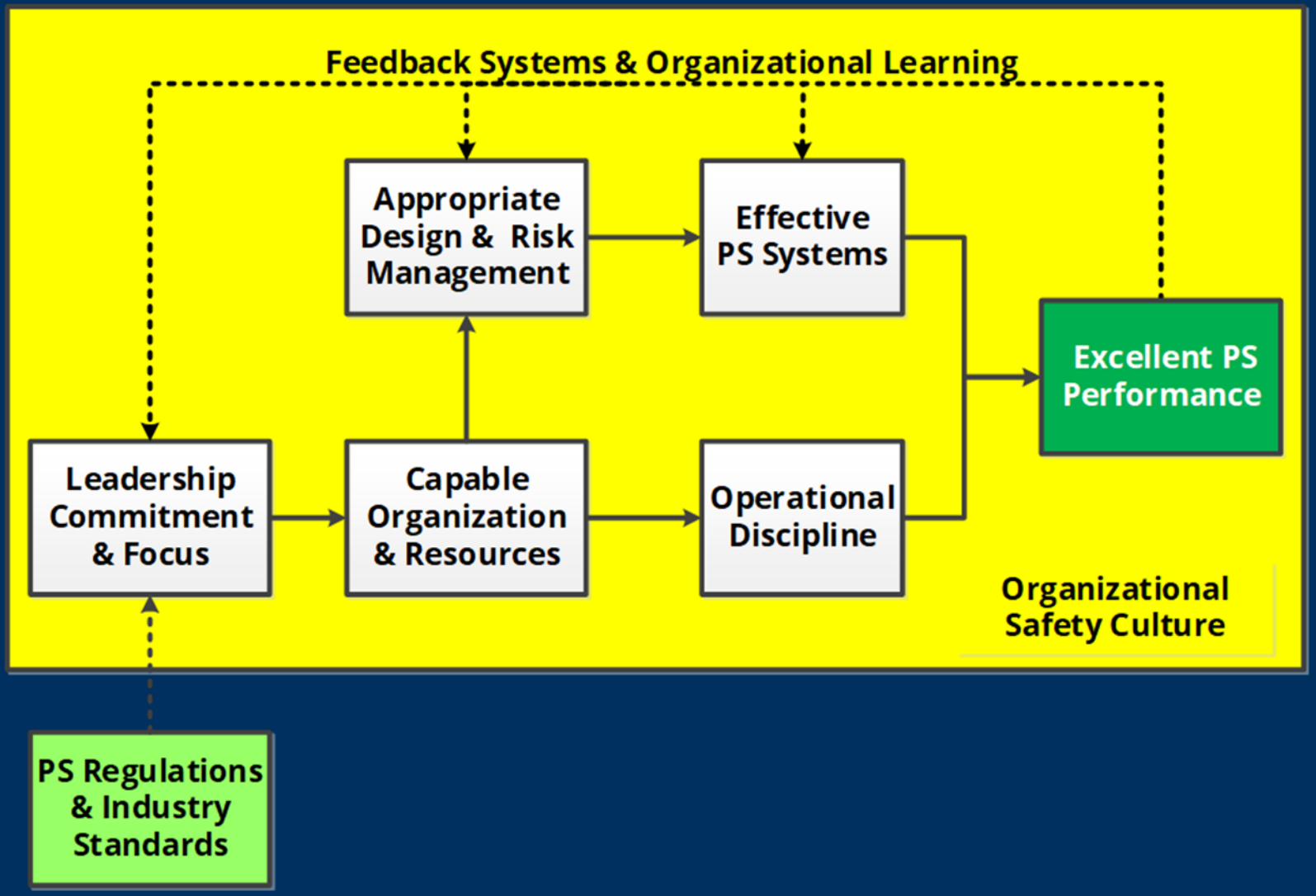
Klein, Chemical Engineering, 2020

Process Safety Performance "Model"



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Klein, Chemical Engineering, 2020

Process Regulations and Industry Standards

- **Regulatory Requirements**
  - OSHA PSM 1910:119 +
  - EPA RMP 40 CFR 68
  - State/Local
  - Global

- **Industry Codes and Standards**
  - ANSI, API, ASME, ISA, NFPA, etc.

- **Industry Guidance**
  - CCPS
  - Journals
  - Conferences

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Organizational Safety Culture

1. Establish safety as a core value
2. Provide strong leadership
3. Establish and enforce high standards of performance
4. Document the safety culture emphasis/approach
5. Maintain a sense of vulnerability
6. Empower individuals to successfully fulfill their safety responsibilities
7. Defer to expertise
8. Ensure open and effective communication
9. Establish a questioning/learning environment
10. Foster mutual trust
11. Provide timely response to safety issues and concerns
12. Provide continuous monitoring of performance

Safety Culture: "The normal way things are done at a facility, company, or organization, reflecting expected organizational values, beliefs, and behaviors, that set the priority, commitment, and resource levels for safety programs and performance."

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CCPS, Risk Based Process Safety, 2007
Klein and Vaughen, 2017

Leadership Commitment and Focus

- **Commitment** – personally committed to achieving excellent safety performance
  - linking safety to other organizational priorities
  - clear vision of desired performance
  - clear goals for specific activities in support of improvement

- **Focus** – ensure they spend time communicating about safety
  - reviewing programs
  - measuring performance
  - providing guidance and resources
  - establishing accountability for results.

- **Involvement** – provide "felt" leadership
  - interacting with and listening to personnel
  - leading by example through visibility and consistent action
  - building trust and employee engagement

Klein and Vaughen, 2017

Capable Organization and Resources

- Provide sufficient resources for implementing and sustaining effective process safety programs to support safe, high-quality, and reliable operations.
  - Staffing and organizational change
  - Training and learning strategies
  - Fitness for duty programs
  - Documentation management strategies and IT systems
  - Leveraging, networking, and mentoring opportunities
  - Other financial and support resources

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Klein and Vaughen, 2017

Appropriate Design and Risk Management

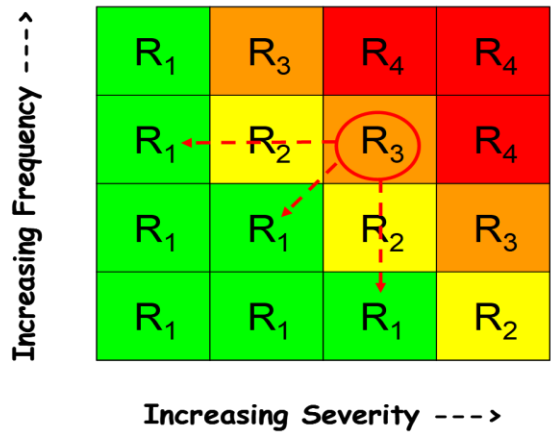
Toxicity

Flammability

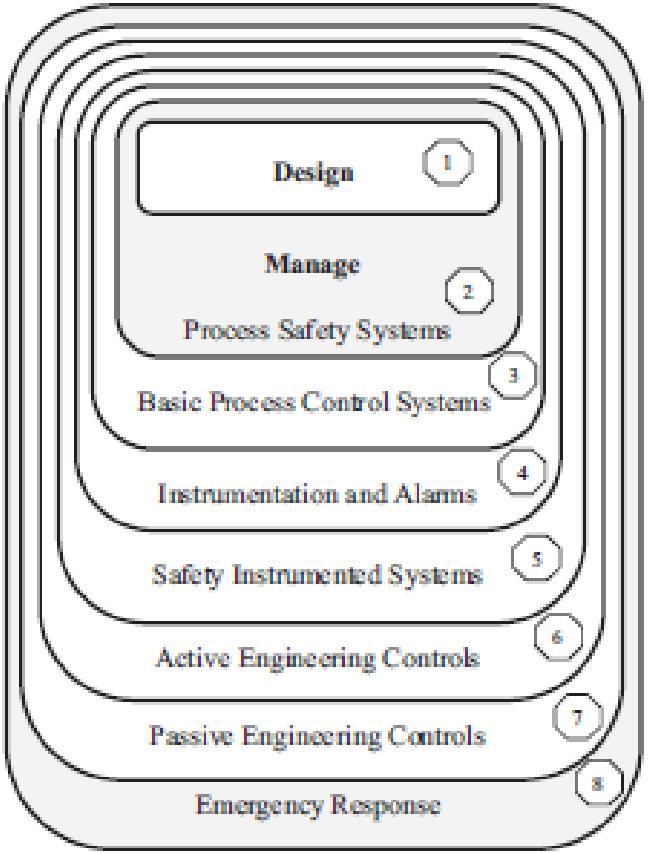
Combustible Dust

Reactivity

Risk = Frequency x Consequences



Managing process risks may involve more than compliance with regulations.



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Klein and Vaughen, 2017

Effective Process Safety Systems

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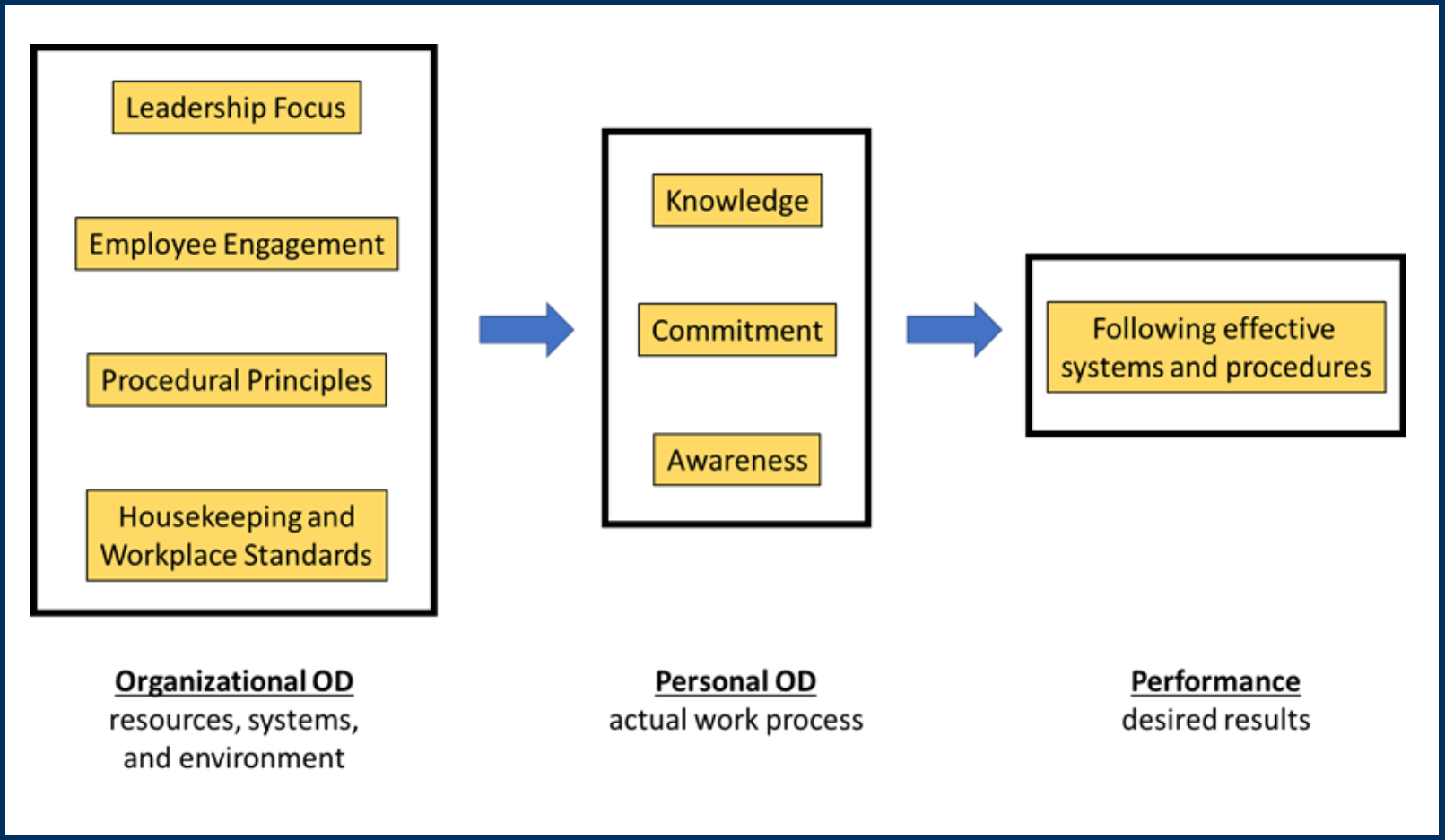
CCPS, Risk Based Process Safety, 2007

Operational Discipline (OD)



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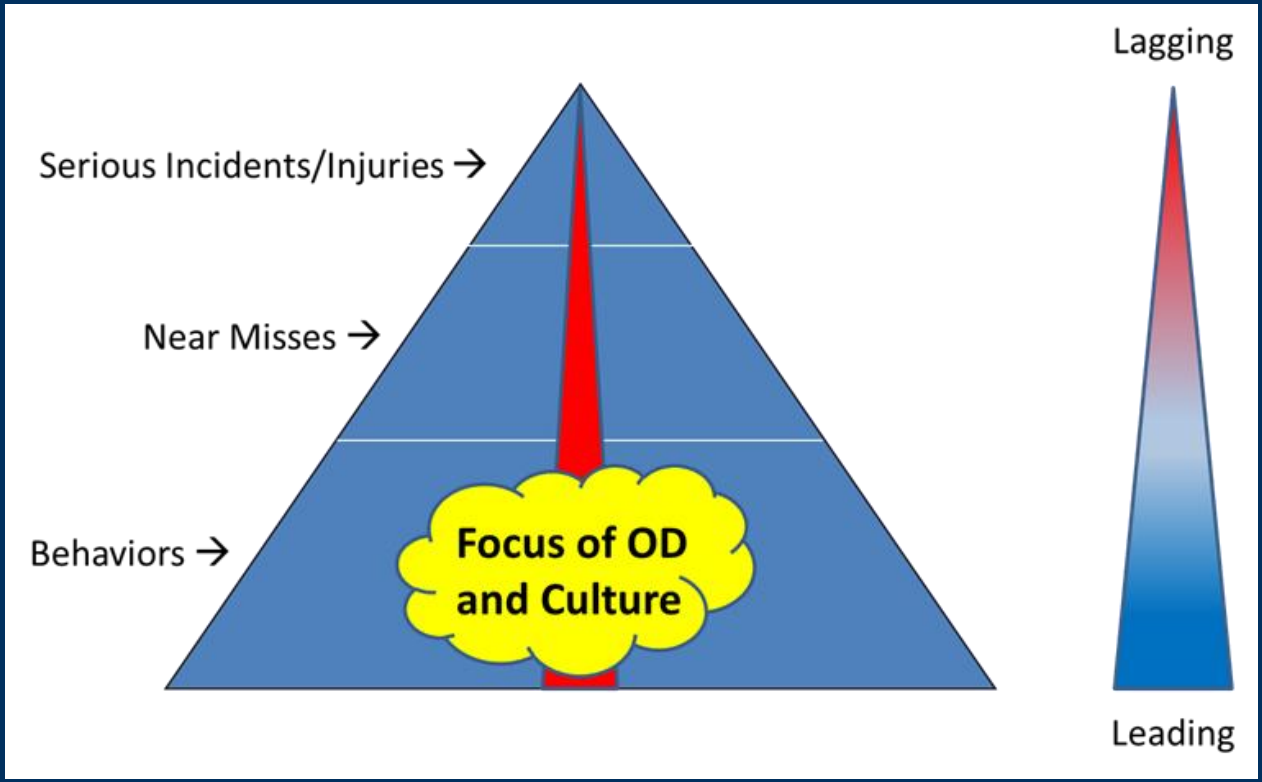
Klein and Vaughen, 2017
Klein, Hydrocarbon Processing, 2021

Feedback Systems and Organizational Learning



Learning organization: "an organization skilled at creating, acquiring, interpreting, transferring, and retaining knowledge, and purposefully modifying its behavior to reflect new knowledge and insights."

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Klein and Vaughen, 2017
Garvin, 2000

Possible Actions for Improving Process Safety Performance - 1

1. Develop systems to ensure proper awareness, access, and use of external process safety regulations and guidance.
2. Periodically conduct safety culture assessments.
3. Develop strategies to maintain a sense of vulnerability in personnel at all levels to help prevent complacency.
4. Set appropriate, actionable, and measurable process safety improvement goals annually.

Ensure appropriate process safety training is provided to all leadership as part of specific job roles and career advancement criteria.

6. Review training strategies to support effective process safety program implementation and performance.

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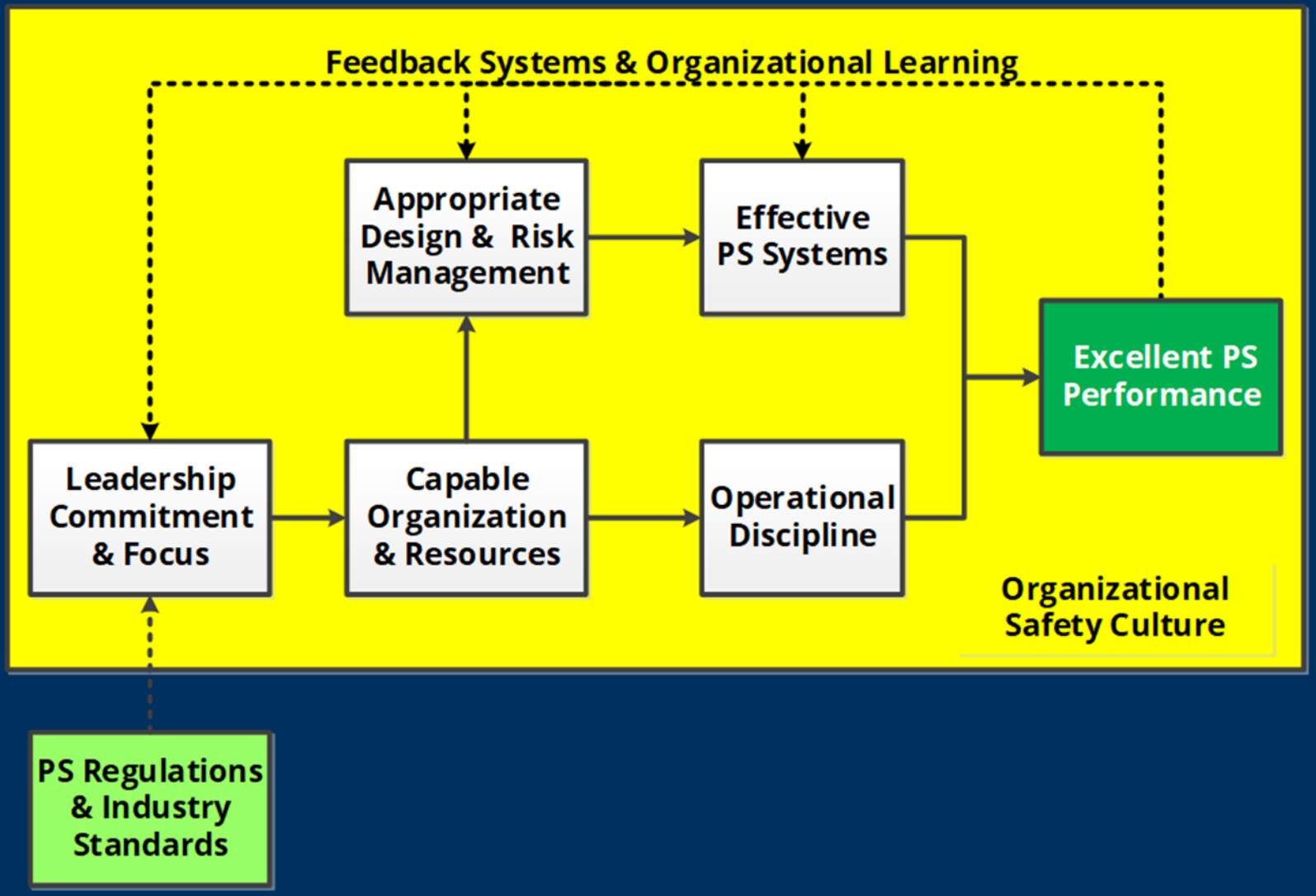
Klein, Chemical Engineering, 2020

Possible Actions for Improving Process Safety Performance - 2

7. Implement an organizational change process to evaluate organizational capabilities and manage personnel changes.
8. Ensure process safety information that serves as the basis for process design (e.g., hazard information, process design basis, equipment design basis) has been properly compiled and is being maintained.
9. Review current risk management practices to evaluate if hazard evaluations are being properly conducted during all stages of the process life cycle (e.g., initial design to decommissioning).
10. Ensure appropriate leading and lagging metrics are being monitored to review process safety system performance.
11. Identify OD improvement opportunities based on implementing an OD program or conducting additional OD evaluations as part of an existing OD program.
12. Develop a process safety learning plan.

Process Safety Performance "Model"



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Klein, Chemical Engineering, 2020

Case Study – Findings from Large Refinery Incident Investigation

15 fatalities, 180 injuries

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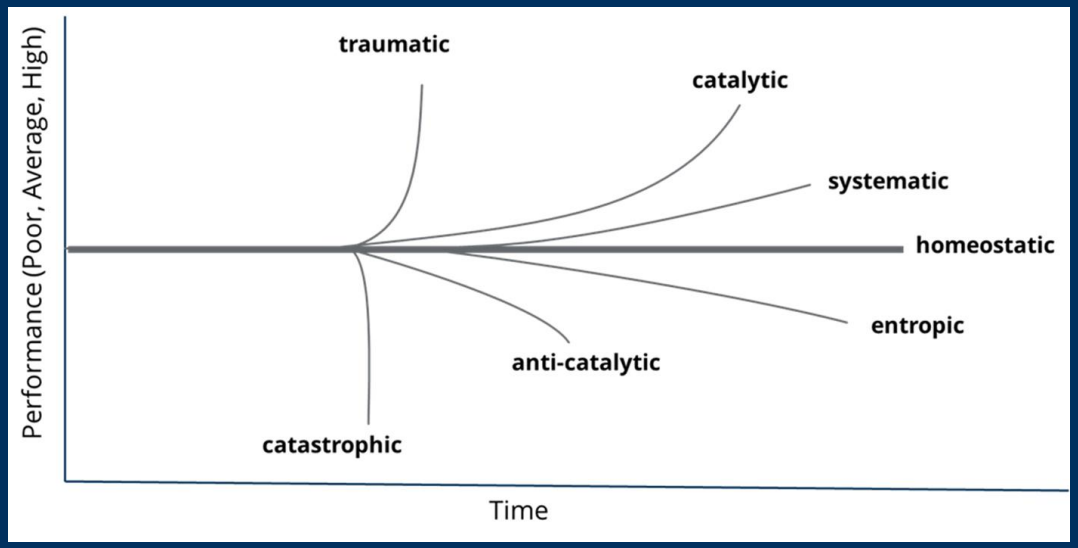
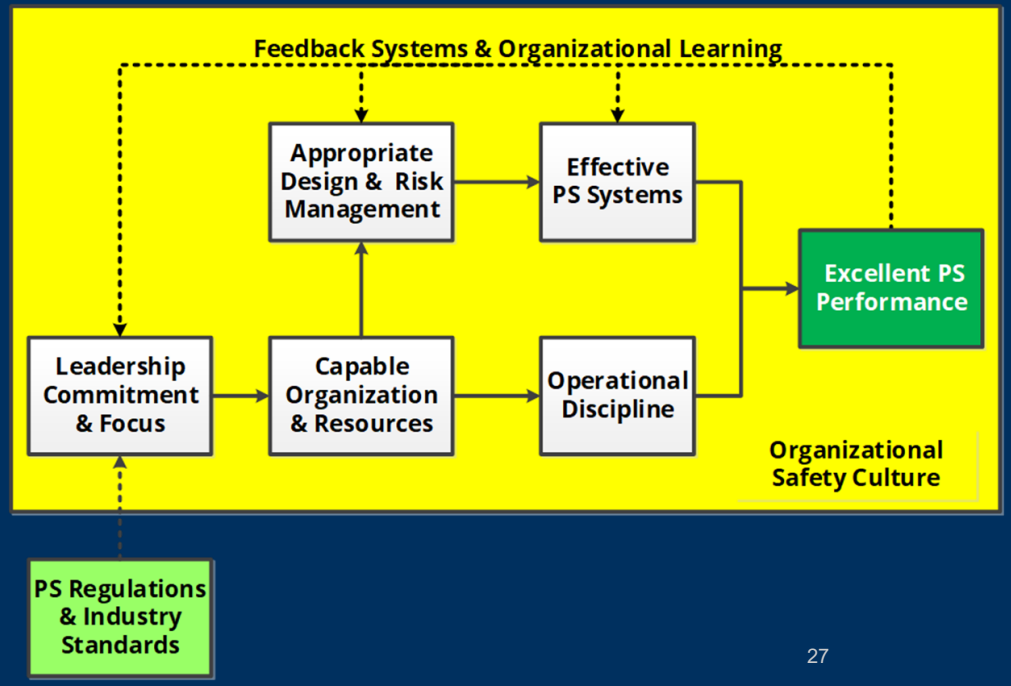
Klein, Professional Safety, 2021

Performance Factor	Findings
Corporate safety management system does not ensure timely implementation of external good engineering practices that support and could improve process safety performance.	
	• Has an incomplete picture of process safety performance because the process safety management system likely results in underreporting of incidents and near misses. • Personal safety is measured, rewarded, and the primary focus of their safety efforts, but the same emphasis is not put on improving process safety performance.
Leadership commitment and focus	• Has not provided effective leadership or established appropriate operational expectations regarding process safety performance. • A lack of supervisory oversight and technically trained personnel during the startup, an especially hazardous period, is an omission contrary to refinery guidelines.
Capable organization and resources	• Good process safety performance requires adequate resources, including funding for inspecting, testing, maintaining, and repairing or replacing equipment; resources for training and educating personnel; resources for keeping operating procedures up to date; and resources for implementing best or good industry practices. If a refinery is under-resourced, maintenance may be deferred, inspections and testing may fall behind, old and obsolete equipment may not be replaced, and process risks will inevitably increase. The company has not always ensured that the resources required for strong process safety performance at its refineries were identified and provided.

Performance Factor	Findings
The system (programs to analyze process hazards) does not ensure adequate identification and rigorous analysis of those hazards. Examination also indicates that the extent and recurring nature of this deficiency is not isolated, but systemic.	
A lack of operating discipline, toleration of serious deviations from safe operating practices, and apparent complacency toward serious process safety risks exists at the refinery.	
	and checked off on safety policy and procedural requirements even when those requirements had not been met, contributing to a culture of "casual compliance."
Feedback systems and organizational learning	• Significant deficiencies exist on site and corporate systems for measuring process safety performance, investigating incidents and near misses, auditing system performance, addressing previously identified process safety-related action items, and ensuring sufficient management and board oversight… • Reliance on lagging, after-the-fact indicators of process safety performance rather than leading, predictive measures impaired the ability to measure, monitor, and detect deteriorating or degraded process safety conditions. • An effective reporting and learning culture has not been created and reporting bad news is not encouraged.

Focusing on the Right Things Can Help Improve Performance





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