How Process Safety Elements Help Improve Safety in any Industry

Presented at

Women in Safety Conference

October 4, 2024

Protecting Operations.

Today we discuss PSM and women in safety

- Introduce myself
- Introduce process safety management concepts
- Provide some real life examples of PSM
- Share my real story
- Turn it over to you
  - Ask questions on either topic
  - Share your story

Source: Michelle Murphy, Top of Silos July 2021

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Michelle Murphy, MSc, CCPSC

- Chemical engineer with over 25 years consulting on process safety
- Over 15 years in combustible dust safety
- CD experience with food and agricultural, plastics, wood, specialty chemical, metal processing, automotive, pharmaceutical, etc. operations
- Designed, built, and managed a combustible dust testing laboratory
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Chemical hazards come in many forms

- Toxic
- Combustible or flammable
- Explosive
- Explosible

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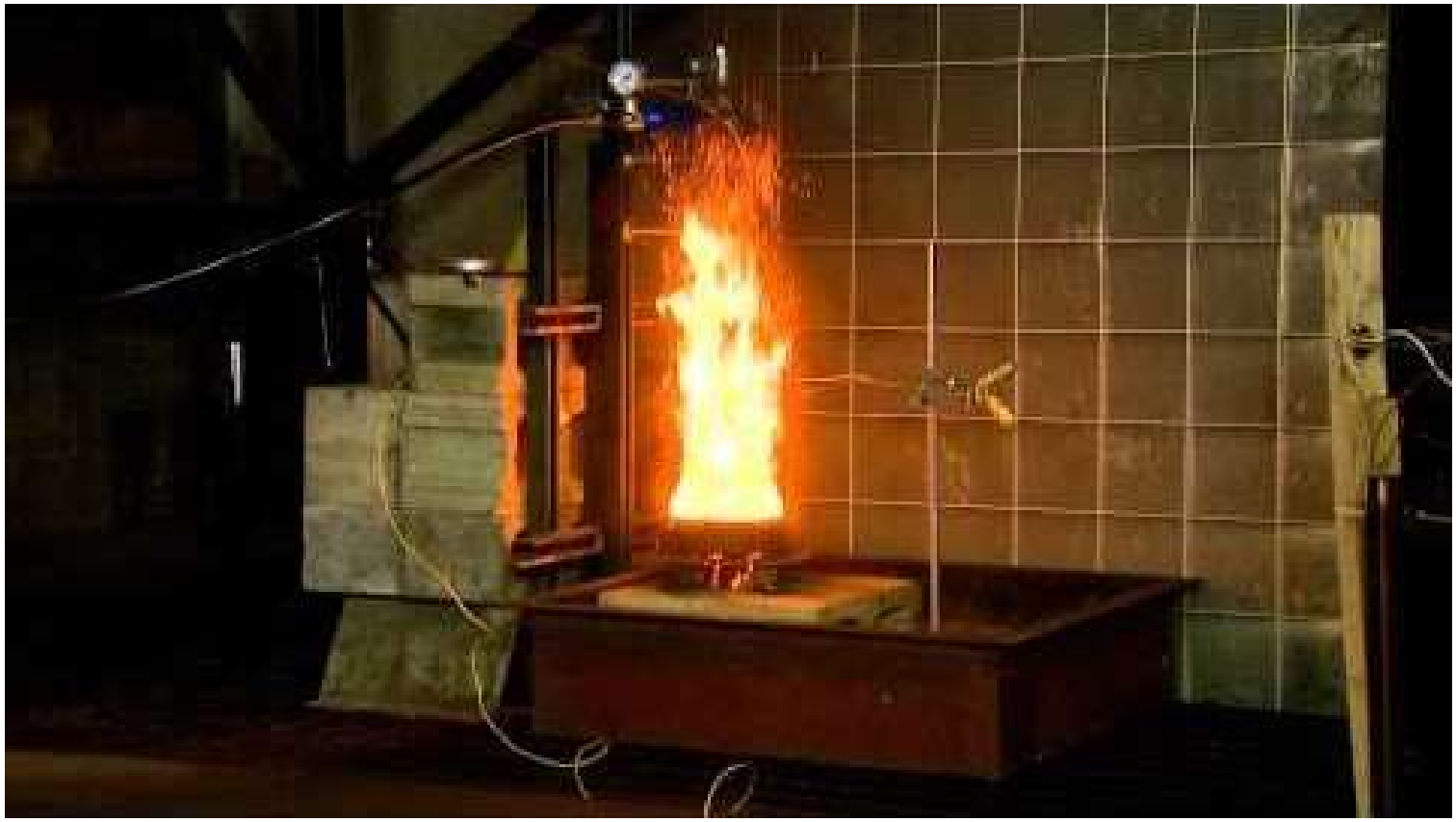
A dust deflagration of an explosible dust can cause a fatality



Source: CSB, https://www.youtube.com/watch?v=HamKcduWeyg&t=3s

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OSHA and EPA each have regulations on high hazard chemicals

- OSHA's Process Safety Management (PSM) Standard 29 CFR 1910.119 – Original promulgated in 1992
  - Focuses on threats to onsite employees and contractors
  - Prevents or minimizes consequences of catastrophic releases
  - Includes toxic, reactive, flammable and explosive chemicals
  - State PSM requirements (i.e., MA, NJ, CA)
- Environmental Protection Agency (EPA's) Risk Management Plan (RMP) – Original Promulgated in 1996
  - EPA's parallel regulation to OSHA's PSM standard w/exceptions
  - Risk Management Plan mandated by Clean Air Act Amendments
  - Focuses on threats to the public and the environment

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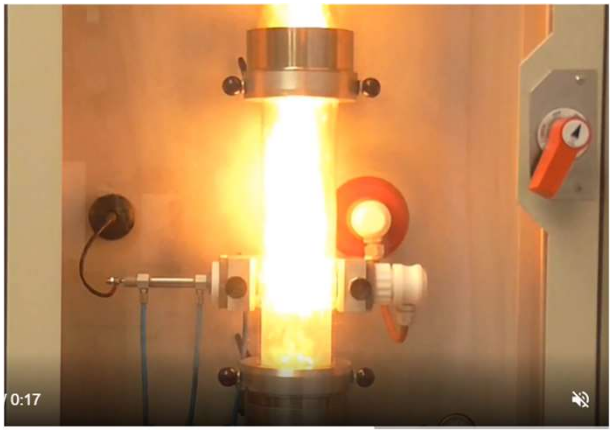
Most materials are combustible in dust form

- Metal dust such as aluminum and magnesium
- Wood dust
- Coal and other carbon dusts
- Plastic dust
- Biosolids
- Organic dust such as sugar, paper, soap, and dried blood
- Certain textile materials
- Candy, sugar, spice, flour, grain
- Rubber
- Fertilizer



Source: ioKinetic.com

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The most widely applied consensus standards on combustible dust come from NFPA

Fundamentals of Combustible Dust

Industry	Installation/Operation
General (Chemical)	Explosion Protection
Agricultural and Food	Deflagration Venting
Metals	National Electric Code
Wood Processing	Electrical Classification
Sulfur	Static Electricity
	Ovens & Furnaces
	Air Conveying

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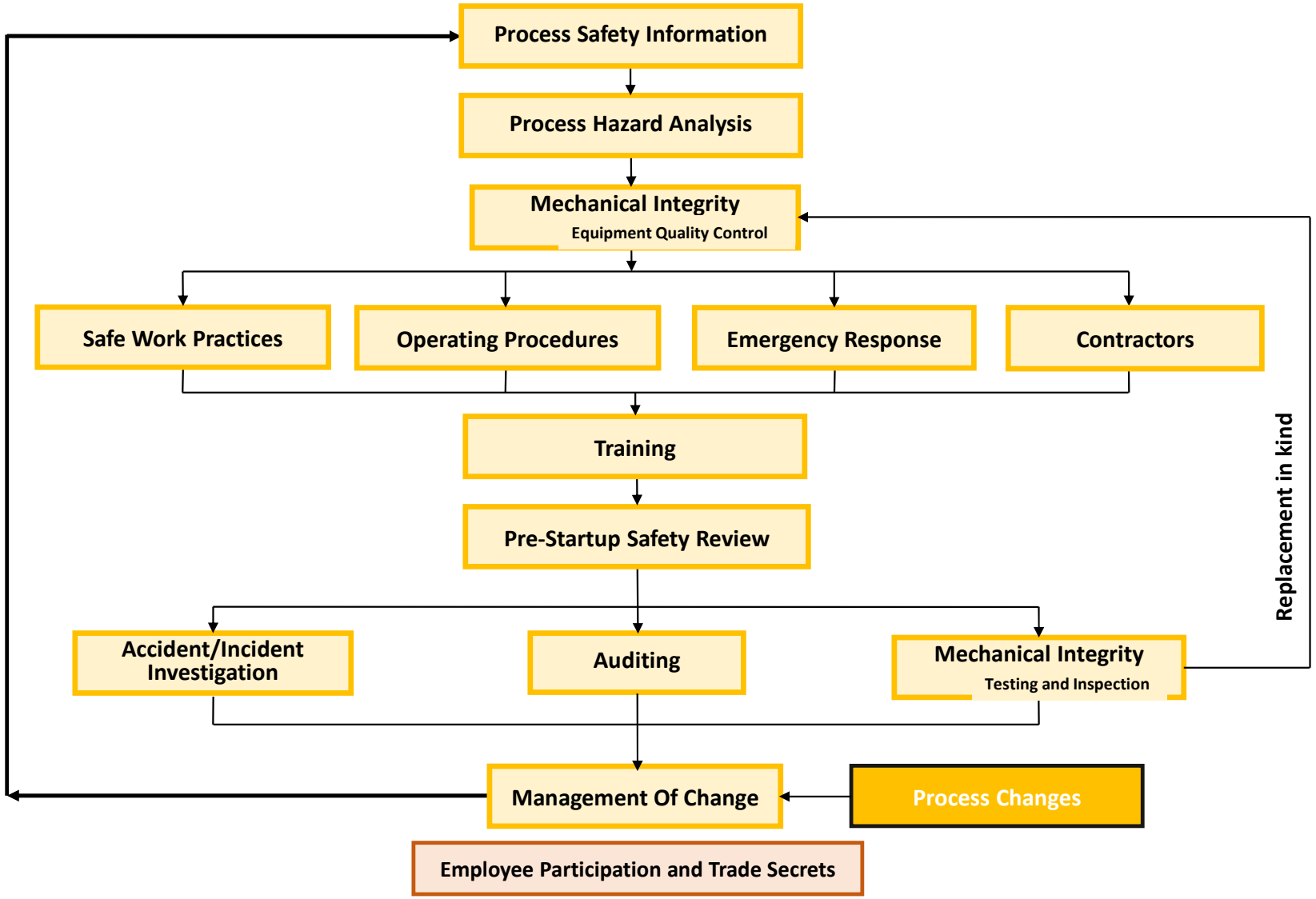
All 14 PSM elements work together



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Most frequently cited elements by % of total citations

Element	Description	Refinery	Chemical
J	Mechanical Integrity (MI)*	19	23
D	Process Safety Information (PSI)*	18	22
F	Operating Procedures (OP)	17	12
E	Process Hazard Analysis (PHA)*	16	18
L	Management of Change (MOC)	10	4
M	Incident Investigation	7	3
O	Compliance Audits (CA)	4	4
H	Contractors	3	4
C	Employee Participation (EP)	2	3
G	Training	2	4

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Information from an OSHA Presentation at the AIChE Global Process Safety Congress in March 2011

** Elements most cited in Chemical NEP inspections*

Implementation of some or all these elements will improve safety

- Process Safety Information
- Process hazard analysis
- Operating procedures
- Management of change
- Mechanical integrity

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PSI is information on the chemical hazards, technology, and equipment in the process

Chemical Hazards

Inadvertent Mixing

Thermal and Chemical Stability

Corrosivity Data

Reactivity Data

Physical Data

Toxicity Exposure Limits

Technology

Process Flow Diagram

Consequences of Deviation

Safe Upper/Lower Limits

Inventory

Process Chemistry

Equipment

Design Codes and Standards

Piping and Instrumentation Diagrams

Mass and Energy Balance

Safety Systems

Electrical Classification

Relief Design and Basis

Ventilation

Materials of Construction

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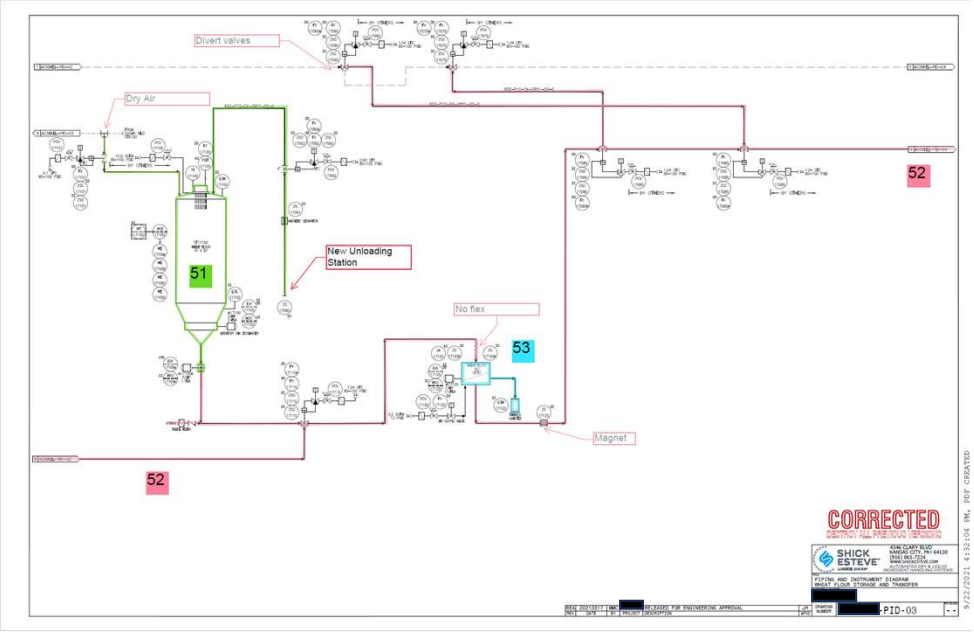
Flows and operating parameters may be found on a Process Flow Diagram (PDF) and heat and Material Balance (H&MB)



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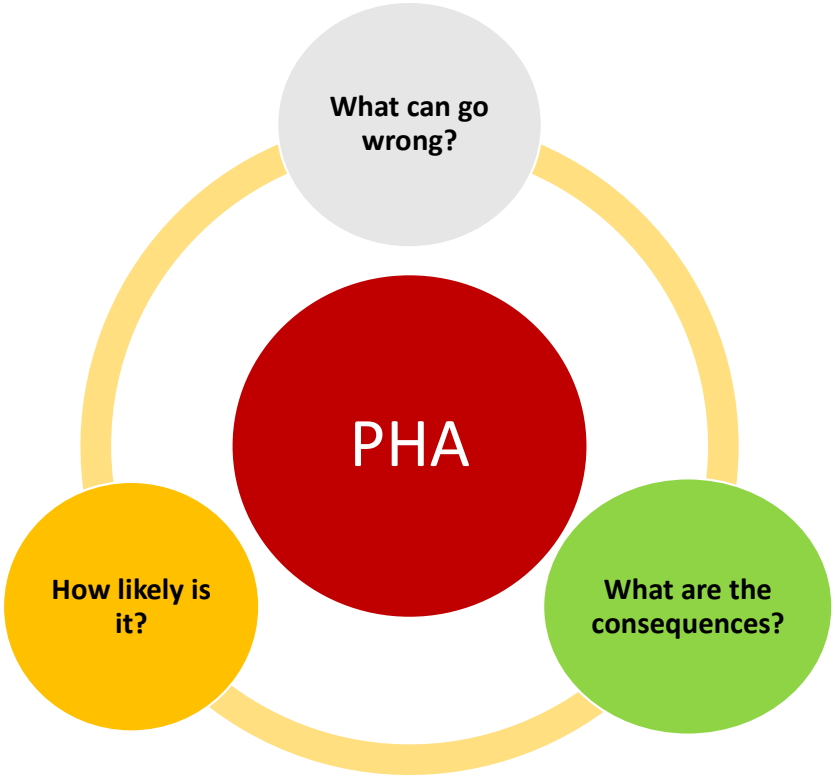
A Process Hazard Analysis (PHA) is the analysis of the significance of hazardous situations associated with a process or activity



Source: CCPS Guidelines for Hazard Evaluation Procedures, Third Edition

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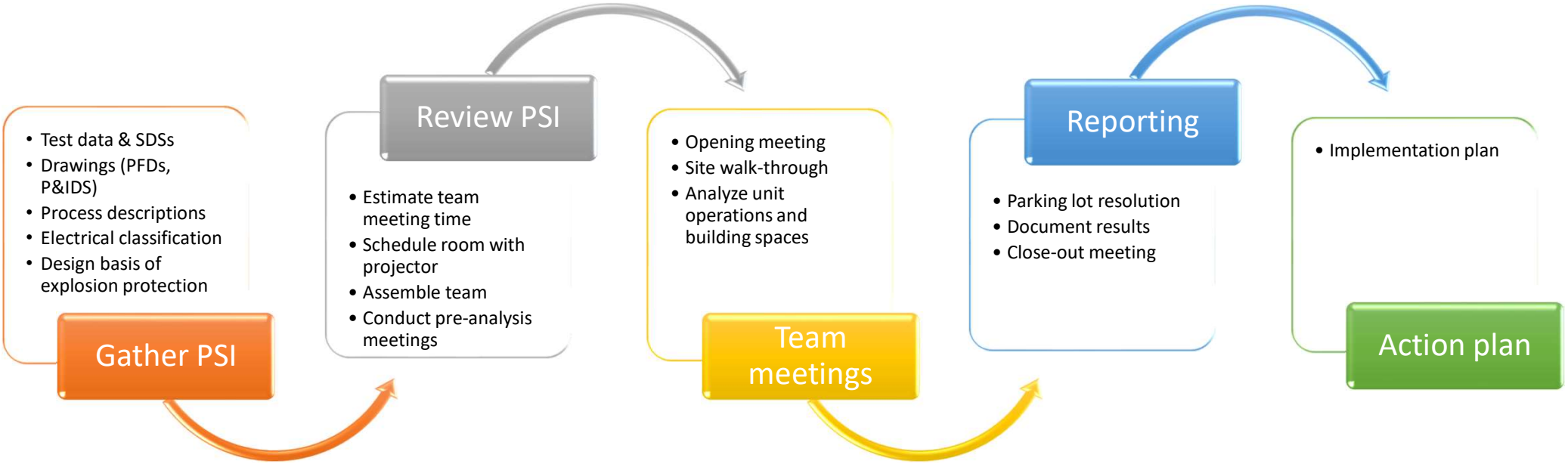
PHAs have a typical cadence



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A PHA is a hazard analysis

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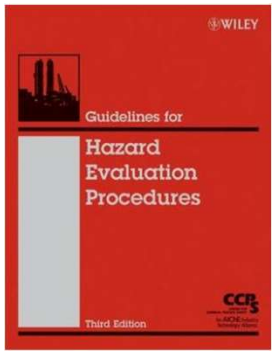
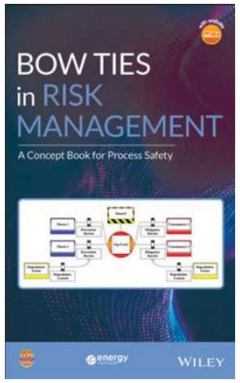
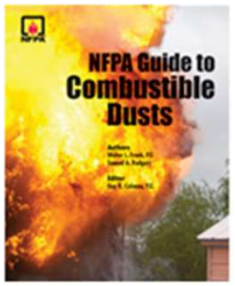
There is no specific methodology required

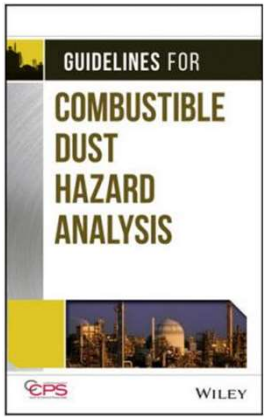
Identify hazards

- HAZOP
- What-if
- Checklist
- FMEA
- FTA
- LOPA
- Bow-Tie
- Consequence analysis









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Operating procedures should provide clear instructions

- Be consistent with PSI
- Include steps for each operating phase
- Document operating limits, consequences of deviation, and steps required to correct or avoid deviation
- List safety and health considerations
- List safety systems and their functions
- Be readily accessible
- Reviewed as necessary
- Include procedures for safe work practices

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MOC is a written procedure to manage change

- Review the technical basis for the change
- Evaluate the impact of change on safety and health
- Update operating procedures and process safety information
- Train employees
- Document length of time for change
- Note the authorization requirements

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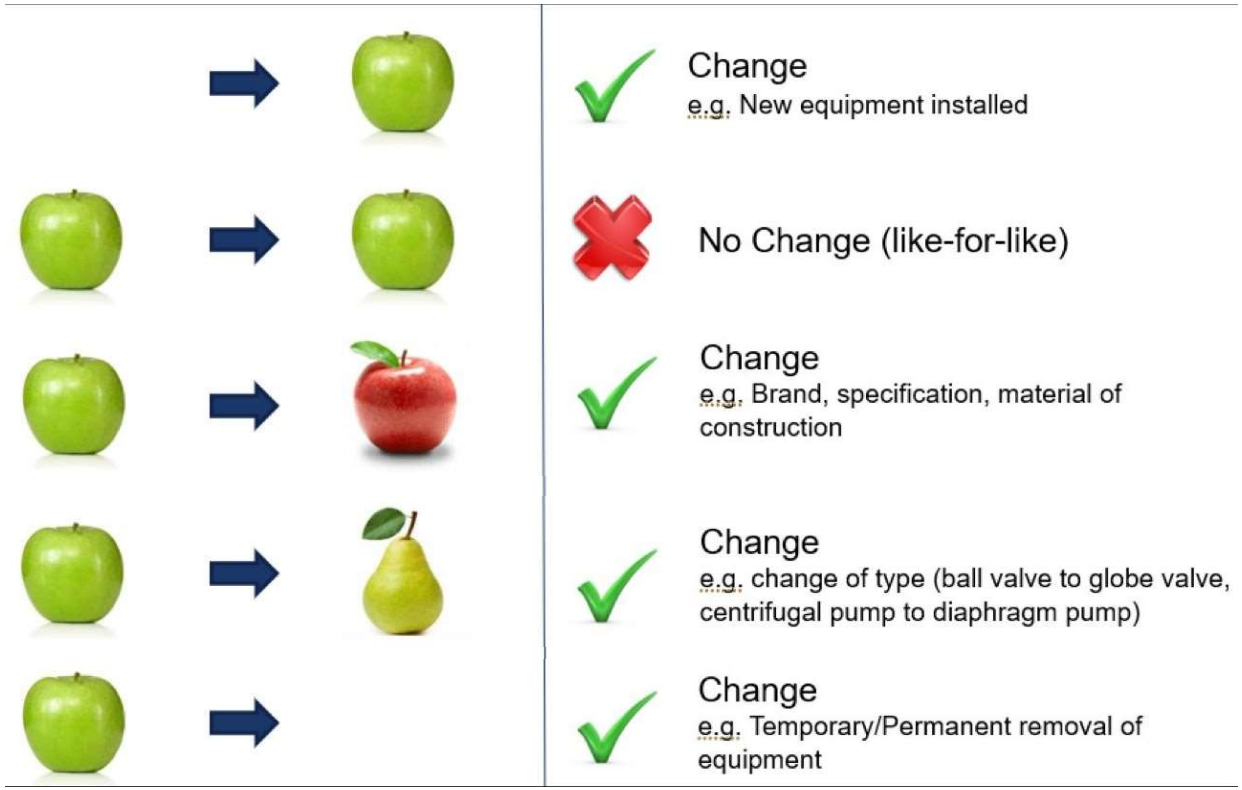
How do you define a change



Source: Seyi Weli, shared on LinkedIn January 29, 2024

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Mechanical integrity

- Written procedures to maintain equipment
- Training for personnel
- Inspection and testing program
- Correct deficiencies
- Conduct quality assurance in construction of new plants

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Incident in non-PSM covered facility

Malden Mills

Methuen, MA

December 2005

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Incident in non-PSM covered facility – PolyCarbon Industries Explosion

Source: Associated Press/Alamy Stock Photo, allowed for editorial uses, accessed 10/3/2024

- Leominster, MA
- March 22, 2005
- 1 injured
- Roof and wall of facility blown off by deflagration
- Nearby residential buildings damaged
- 30+ gal. processor containing xylene, triethylamine
- Findings
  - Process changed & not evaluated, just prior to the explosion
  - Process safety controls deficient

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Michelle Murphy, MSc, CCPSC

Does not disclose path

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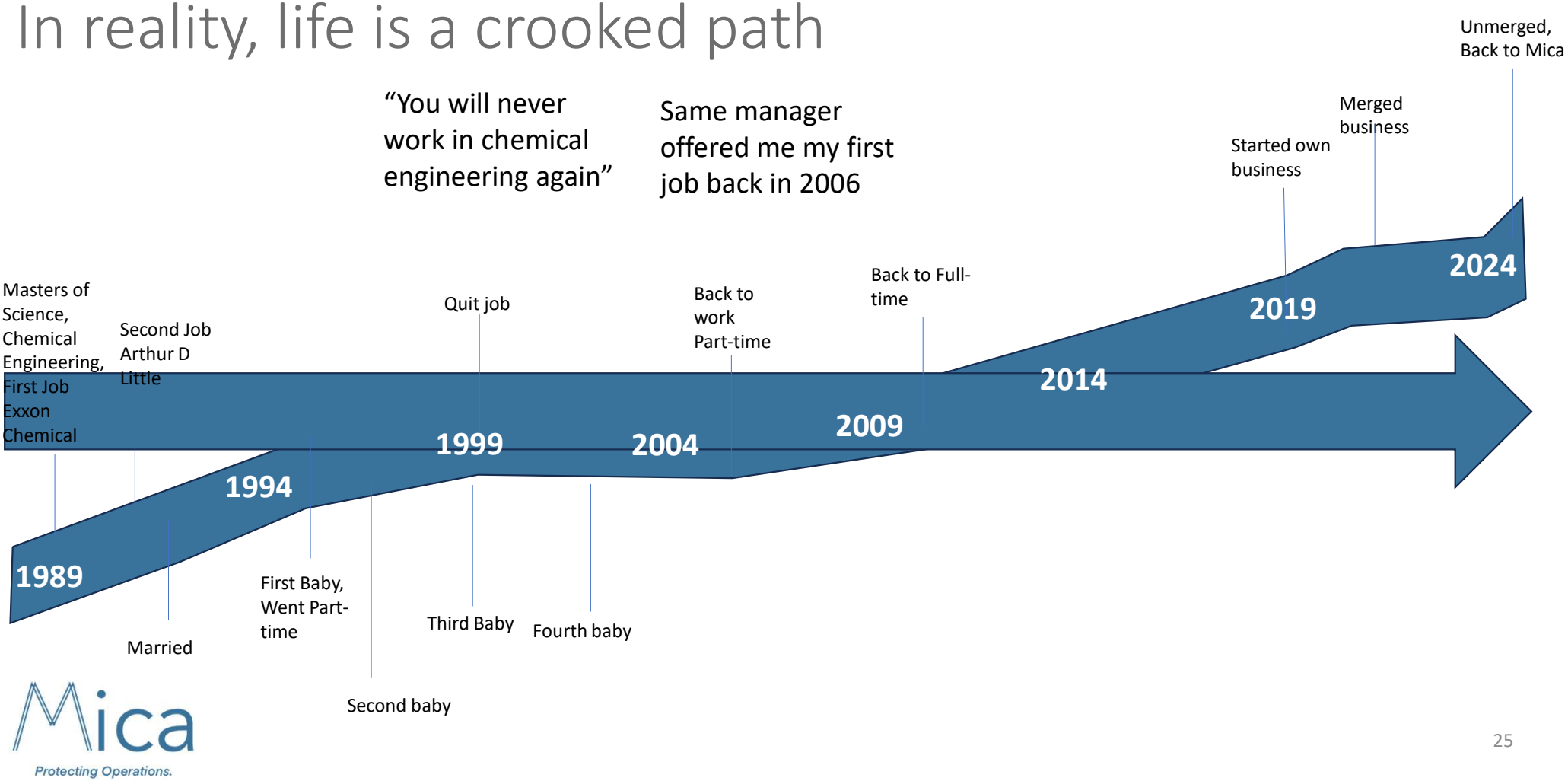
We expect our career to take a straight path
In reality, life is a crooked path



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Women in safety wisdom

- An engineering, science, or safety degree gives you choices
- Do not listen to others, they likely have their own best interest at heart
- It takes a network
  - Leaders
  - Mentors
  - Role models
  - Friends
- While it shouldn't have to, being a women in a male-dominated field has made me better
  - Always overprepared – ready to meet the challenge
  - Work harder – knowing I have to be better
- Unfortunately, it still happens, but it is getting better

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About Mica, LLC

Mica is a small woman-owned business aimed at reducing the incidence of hazardous material handling tragedies. These catastrophic events occur in both new and traditional manufacturing environments. Mica engineers have the experience and knowledge to help you find the most cost-effective solutions for your operations.

Let us put our experience in analysis, testing, and application of hazardous material best practices to work protecting your operations.

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