The Importance of Teaching Risk Assessment to Engineering Students

by

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Why?

- They will be making decisions within 6 months of joining a company which will have an immediate or long term impact on the company.
- If you think of any new employee as someone who increases the level of risk in your company once they enter the door for the first time. Unless you do something about it the risk will remain high and probably be unacceptable. The company does not want their operations to be put at risk.
- By adding new thinking on this topic to the entry level and by consciously nurturing the growth these individuals will quickly begin to impact the company culture in a positive way.
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Why?

- Technical topics with no to very little practical applications
- Job experience, no matter what the job, has guided them in management systems to date.
- The experienced person will impact them significantly in the early stages of their careers often setting the standards for the rest of their careers.
- Peer pressure to conform and be involved still exists.
- They want to be successful and maybe make an impact in order to advance. They will buy into the company culture and ways.

What Do They Know?

- Very little about risk or risk management.
- They know lots of technical details.
- Very little about the people side of things
- Very little about consequences & frequency.
- Very little about regulations, and ethics.
- Very little about company policy
- And finally very little about a complex topic such as “Risk Management”.

How?

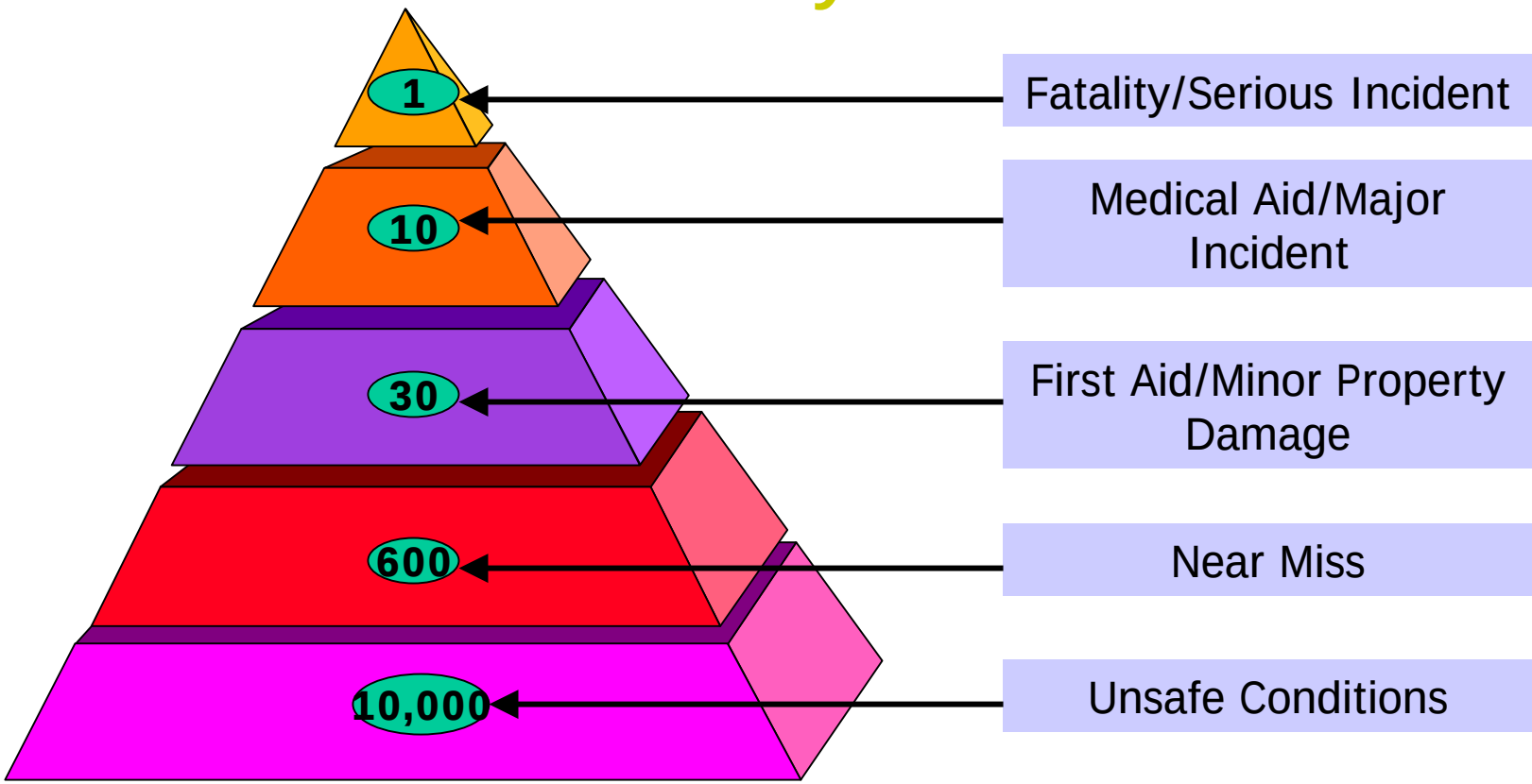
To engage them at the right time in their education.

To fit a course into the other courses they are taking such as a plant design project.

To bring them along with the globally accepted fundamentals so they can apply them no matter where they begin their careers.

To encourage them to analyze the companies they are interviewing for sound practices.

Incident Pyramid



Culture

Course Objectives (cont'd.)

"PROACTIVE

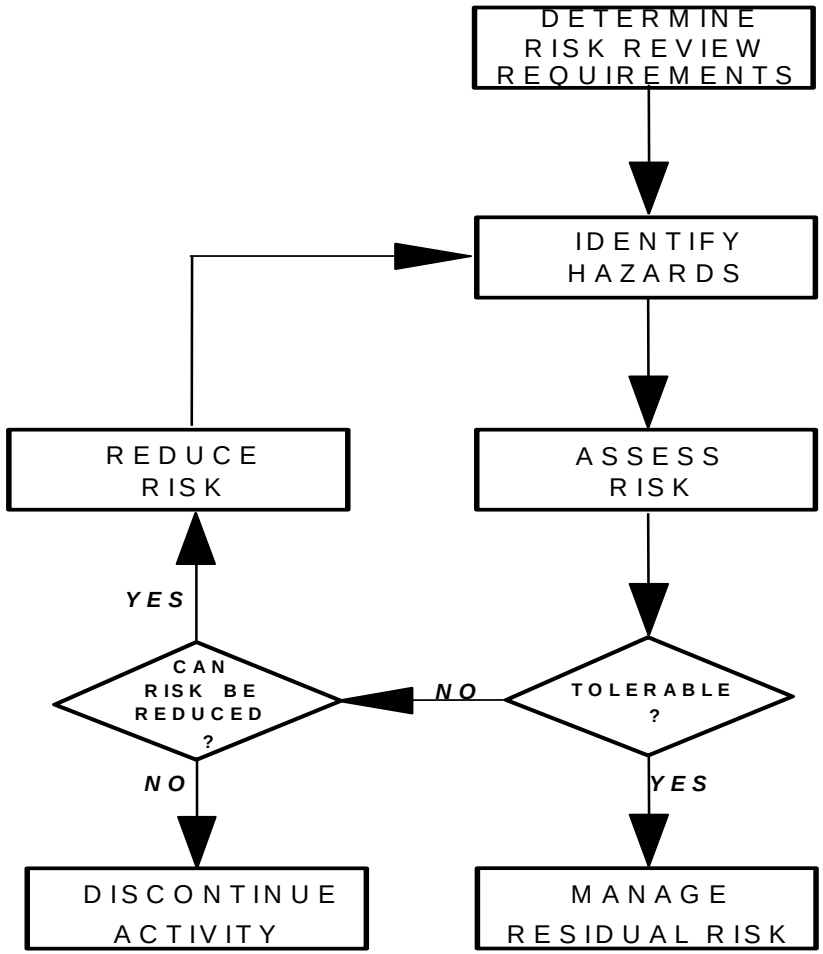
versus

REACTIVE"

Risk Management Flowchart

- Globally accepted approach to risk management.
- It is a management process.
- A logical orderly approach to managing risks in the workplace.
- Several very different activities done in an orderly way.
- Assures the *"proper"* data is used to make effective decisions.
- Very much a *"grey area to work in".*

RISK MANAGEMENT PROCESS



Risk Management Steps

1. Recognize needs

2. Select process

3. Select appropriate team with the proper skills and experience

4. Perform risk analysis

5. Prioritize and select the key action items

Risk Assessment/Analysis (cont'd.)

Consequence Analysis

Type of Incident	Odour or Irritation Threshold	Irreversible Effects Threshold	Life Threatening Effects Threshold
Toxic Gas Release (1 hour exposure)	ERPG - 1	ERPG - 2	ERPG - 3
Fireball - Immediate Ignition (60 second exposure)	1st degree burns 2 kw/m2	2nd degree burns 5 kw/m2	3rd degree burns 8 kw/m2
Flash Fire - Delayed	"no low level Ignition consequence	1/2 of lower flammable limit	1/2 of lower flammable limit
Unconfined Vapour Cloud Explosion	Window Breakage 0.02 bar	Partial demolition of a structure 0.07 bar	Ear drum rupture Major structural damage 0.16 bar

A Consequence Analysis

- Is a process set up to identify possible hazards and to evaluate the ***"worst case scenarios"***.

- It requires and open minded approach.

- The process requires skilled and experienced people to take part

- It is not just one event. Usually a single event is escalated by something so it becomes like a chain of events.

The Consequence Route:

Protective feature(s) fail

→ The incident is escalated

→ The incident is escalated further

→ The likelihood of fatalities due to toxic exposure and /or fire

→ The resulting fatality frequency

- Tools are available to model consequences.
- Experiences, if documented, aid in refining the consequence model.
- The result is a very real view of what could happen.

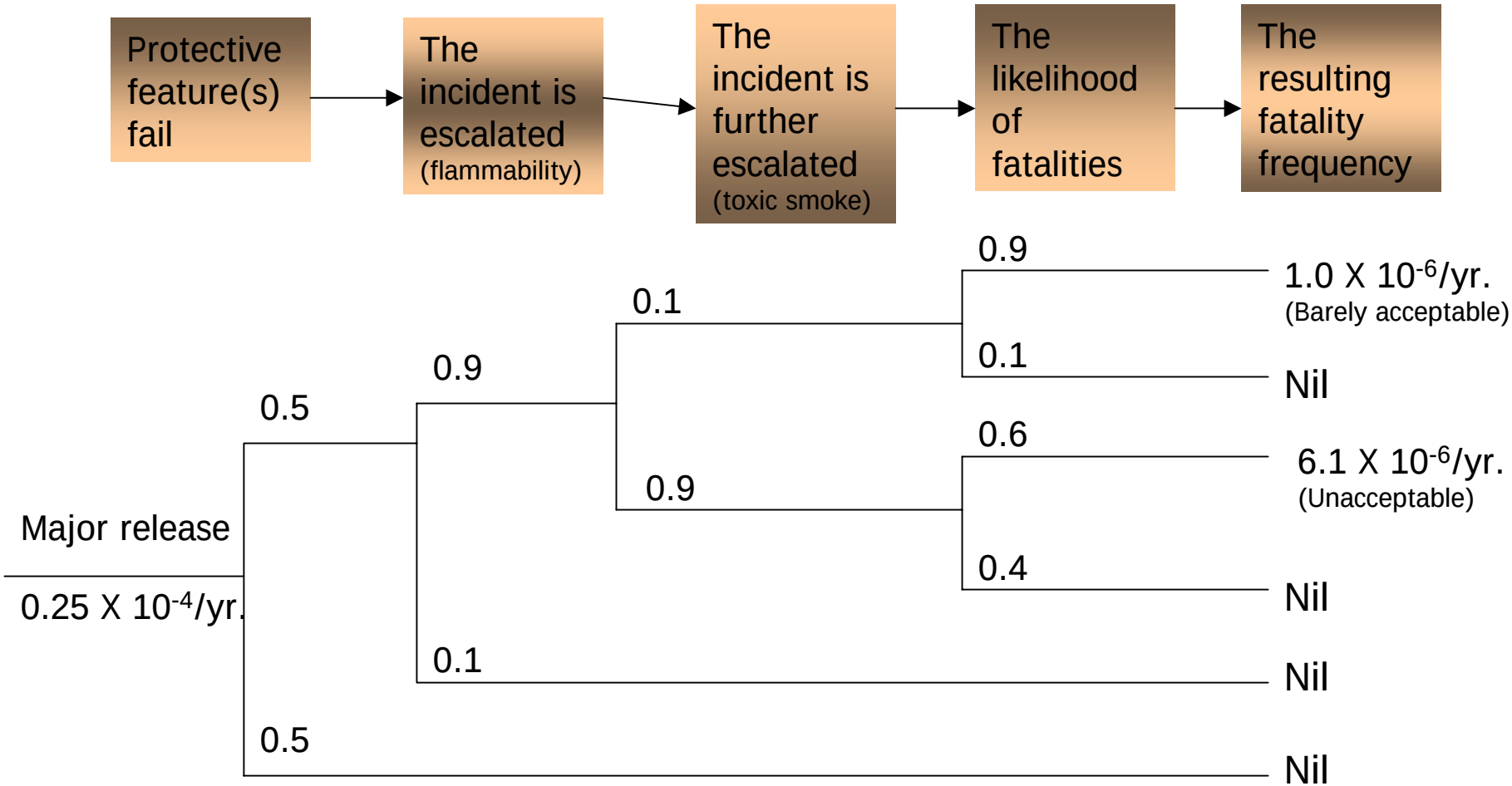
Risk Assessment/Analysis (cont'd.)

Frequency Analysis

There are two ways of gathering the data:

- Historical to your operation (this is where it really pays to be out gathering data and logging it).
- Manufacturers data or published data applied to the *"consequence route".*

Frequency Analysis



Risk Assessment/Analysis (cont'd.)

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Risk Analysis/Assessment Tools

- Field Risk Observation
- Check Lists
- Logic Tree
- Simple Risk Assessment
- Hazard Indices (Dow Fire & Explosion, Chemical Exposure, Mond, Indices)
- FMEA (Failure Modes and Effects Analysis)
- HAZOP (Hazard and Operability Reviews)
- Health Hazard Assessment
- Fault Tree Analysis
- QRA (Quantitative Risk Analysis)

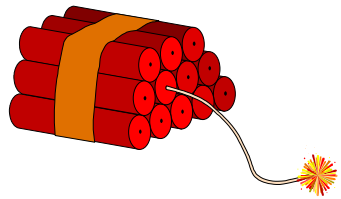
Acceptable Level of Risk

- That level of risk a company is willing to accept.

- Legal opinion says the public is willing to accept a risk of 1×10^{-6} fatalities if exposed to an involuntary risk.

- Set by understanding regulations, the local environmental issues, financial issues, public priorities.

Types of Risk



Voluntary - versus - Involuntary Risk

Individual - versus - Societal Risk

Risk Criteria

Ratings	Impact	Probability
H	**HIGH** P Disabling injury, loss of body part or fatality. E Reportable violation, toxic release. A High repair cost (Typically > $100k). P * Loss of function of facility for extended period, with business consequences, major quality deviation.	**HIGH** - Repetitive event. - At least once per year. - Several times in the life cycle of a project. - Has happened frequently in similar circumstances.
M	**MEDIUM** P Medical aid injury. E Non-reportable spill, non-toxic release. A Moderate repair cost (typically > $10k). P * Short duration loss of function, serious quality deviation, medium business impact.	**MEDIUM** - Infrequent event. - May only happen occasionally (less than once per year). - Has been observed in similar circumstances. - 10 to 50% chance of occurring.
L	**LOW** P First aid injury. E Minor lead, non-toxic fugitive emission. A Low repair cost (typically < $10k). P * Brief interruption or minor quality deviation.	**LOW** - Unlikely event. - Never happened to date. - May happen less than once in 10 years. - Has never been observed but is still felt to be a possibility. - Less than 10% chance of occurring.

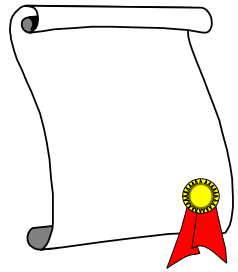
Simple Risk Matrix

Severity of Consequence	L	M	H
H	M	H	H
M	L	M	H
L	L	M	H

Probability

Risk Level Assessment

Recommendations



- Documentation is critical
- They must be realistic and achievable.
- A person must be assigned to each one to follow it through to completion.
- A due date must be included.

** This is the road to Due Diligence**

Incident Investigation

- Be prepared with a team and tools to conduct investigations before they happen.
- Interview eye witnesses very shortly after.
- Protect the evidence from the scene quickly
- Locate log documentation quickly
- Computer data needs attention as it can decrease in value.
- Follow a process like “Root Cause Analysis”
- Substantiate each step of the investigation with credible data to support the path you are going down.

Immediate& Basic Causes

Immediate Causes

- Substandard Practices
- Substandard Conditions
- Substandard Quality and Design

Basic Causes

- Personal Factors
- Job Factors
- Design Factors

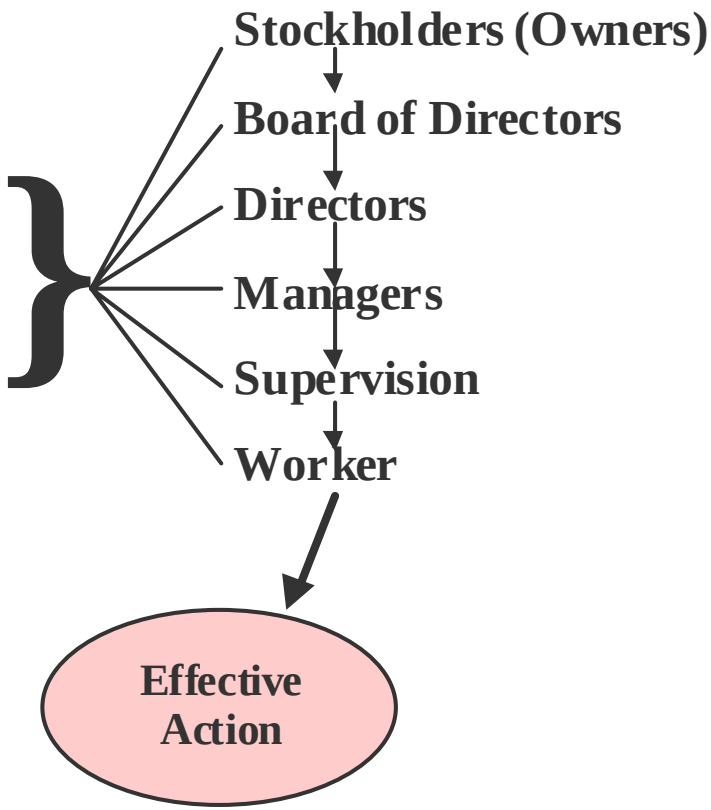
The Human Side of Safety and Loss/Risk Management

Line Management

What Human Factors are at play here?

Functional Expertise:

- Occupational Health
- Safety
- Loss Prevention
- Industrial Hygiene
- Environmental



Case Studies

- Flixborough
- Bophal
- Piper Alpha
- Phillips
- Exxon Valdez Oil Spill