Improving Human Performance on the Grid
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Critical Steps™
Managing the Human Risk

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Muschara
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The Certified Performance Technologist (CPT) designation is awarded by the International Society for Performance Improvement (ISPI) to experienced practitioners in the field of organizational performance improvement whose work meets both the performance-based Standards of Performance Technology and application requirements. For more information, visit www.certifiedpt.org

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Video: Is Good Enough?

Good Enough
is good enough
when there is
NOTHING at stake.

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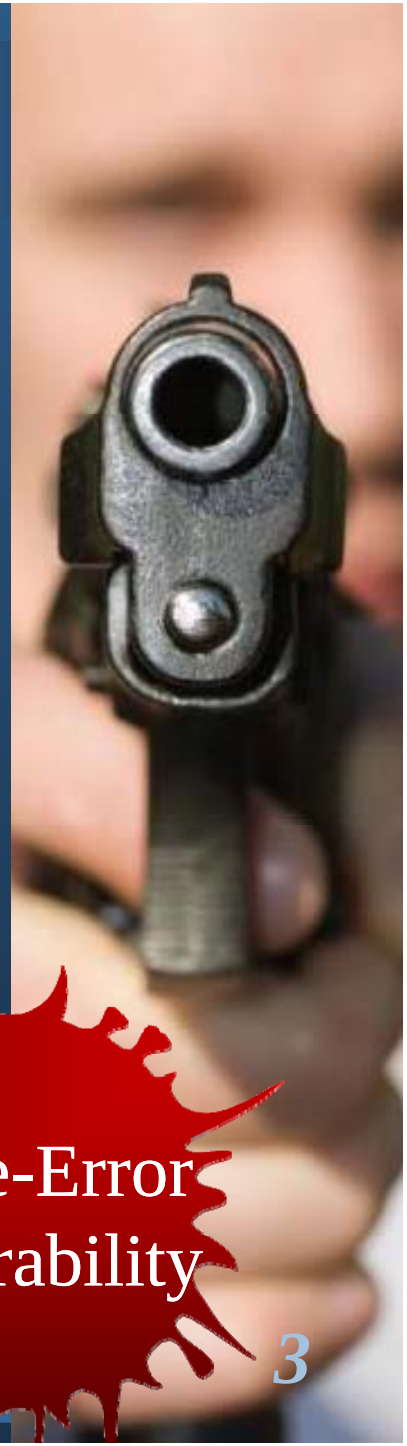
Critical Step™

Any action that ***will*** trigger ***immediate, irreversible, intolerable harm***
(if that action or a preceding action are performed improperly)



Single-Error Vulnerability

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DOD: MIL-STD-882D*

Safety Critical Function:
A function, which if performed incorrectly or not performed, *may* result in death, loss of the system, severe injury, severe occupational illness, or major system damage

* U.S. Department of Defense (2000), "Standard Practice for System Safety" (Issue D).

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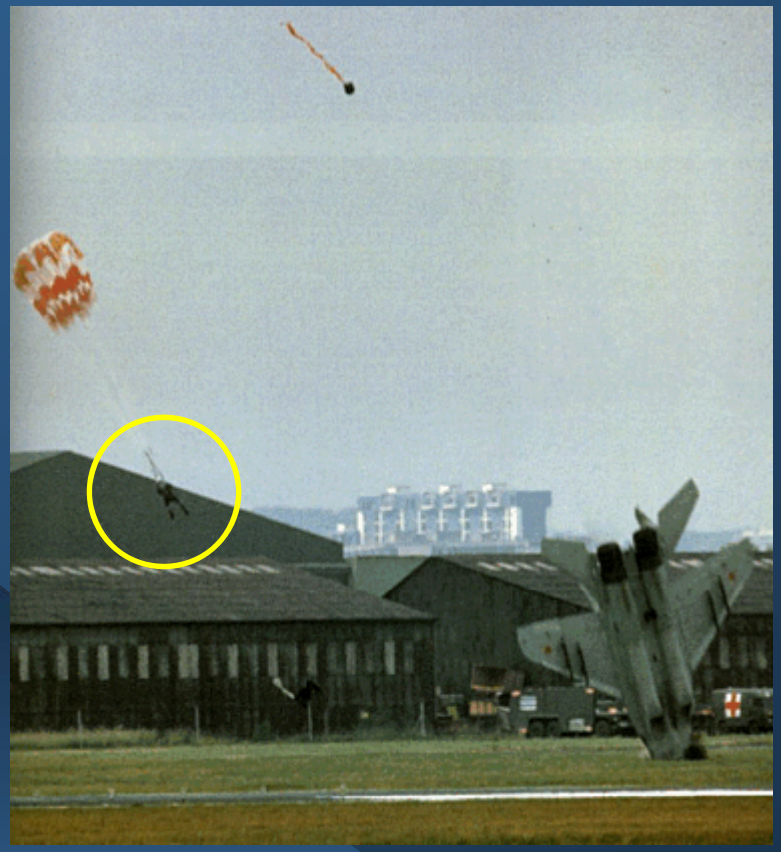
DOT: AC 25.1309-1A*

Life or Safety Critical System – a system whose failure or malfunction may trigger:

- Death or serious injury to people or
- Loss or severe damage to equipment or
- Environmental harm



Supposedly, a life-critical system is designed to lose less than one life per billion (10^9) hours of operation. Photo illustrates when a life-critical system fails (MiG 29 crash at Paris Air Show in 1989).

* U.S. Department of Transportation, Federal Aviation Administration (1988), "System Design and Analysis."

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DOE: Nuclear Explosive Operations*

"Critical Step"

"A procedure step, if skipped or performed incorrectly, will increase the ***likelihood*** of a high-energy detonation …, at some later step in the procedure."

"Hazardous Step"

"A procedure step that, if performed incorrectly, has a ***potential*** to ***immediately*** result in a dominant high-energy detonation, …"

* U.S. Department of Energy Nuclear Explosive Safety Order 452.2A, and Fischer, S. et al (1998), "Identification of Process Controls for Nuclear Explosive Operations."

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Event / Accident*

Event - An outcome involving the unwanted *transfer* (interruption) of: energy, substance (mass), or information that generates harm (instead of value); Examples:

- Injury to people or the public
- Impairment or termination of an asset's or facility's ability to perform its intended function
- Spoilage of the environment
- Prejudicial injury to individuals or organizations

* Adapted from Perrow, C. (1999), *Normal Accidents*, p.66.

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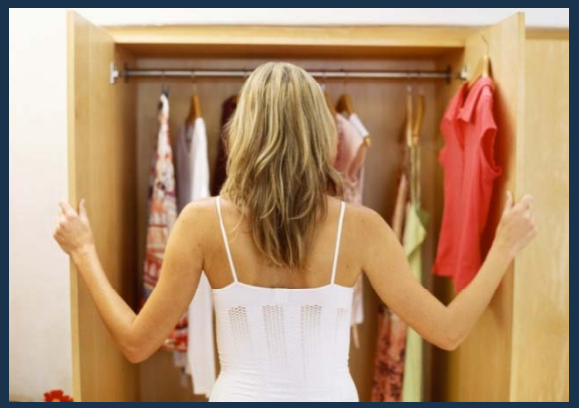
Safety Misunderstood



- Safety is NOT the absence of accidents.
- Safety is the *presence* of defenses in your processes, procedures, facilities, methods, and practices.
- Safety is what you ***DO*** to ensure the integrity of *assets* using a variety of controls, barriers, and safeguards

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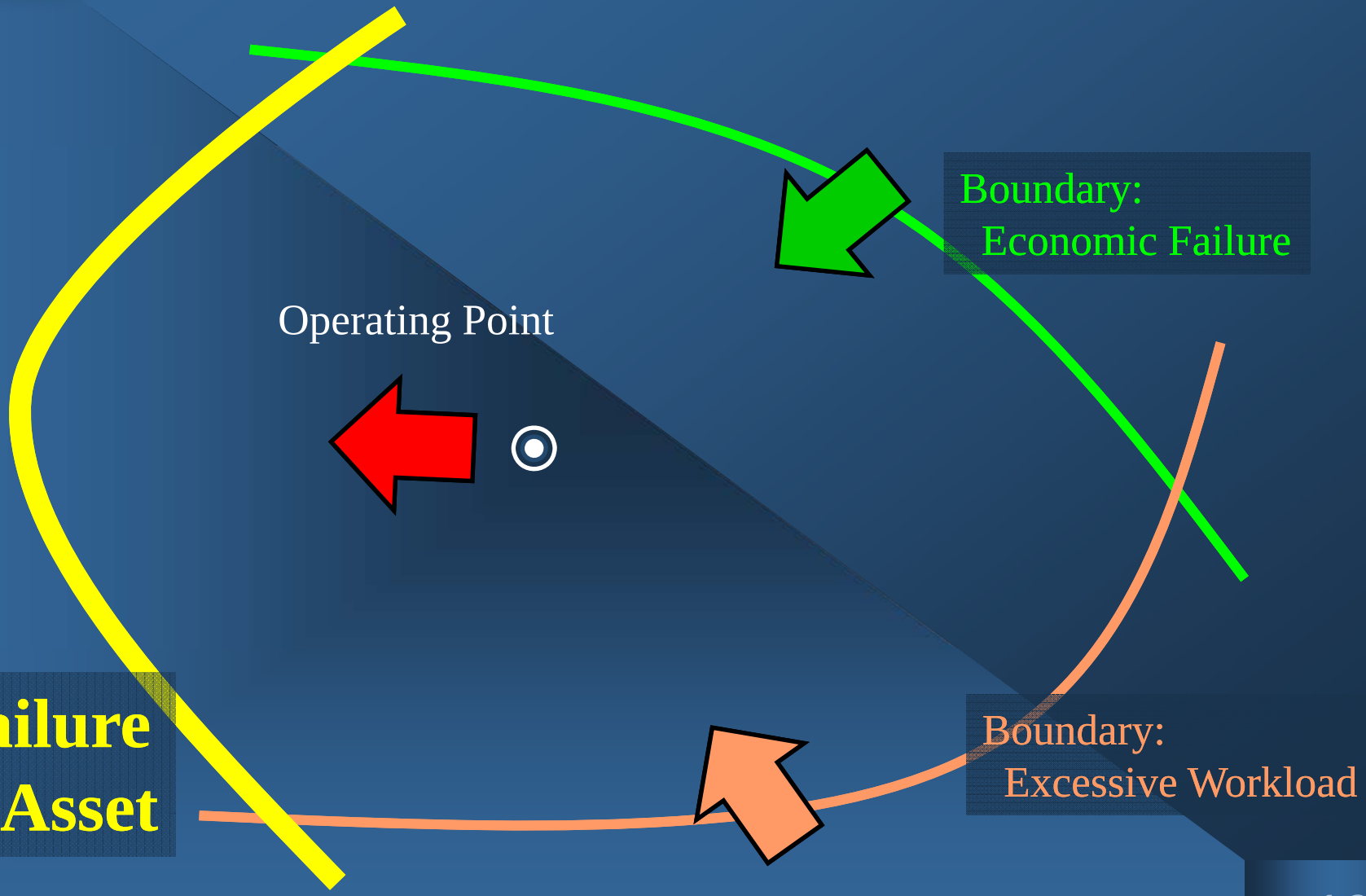
Safety Space – Protect the Asset!*



* Rasmussen, J. (1997), "Risk Management in a Dynamic Society: A Modeling Problem," *Safety Science*, 27(2/3), 183-213.

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Types of Error

- **Active Errors**
  - Physical, observable *actions* that change the state of an asset, resulting in immediate unwanted outcomes (harm)
- **Latent** (sleeping) **Errors**
  - actions, inactions, or decisions that create unsafe *conditions*, going unnoticed at the time, causing no immediate, apparent harm to the work, facility, or personnel (including land mines)

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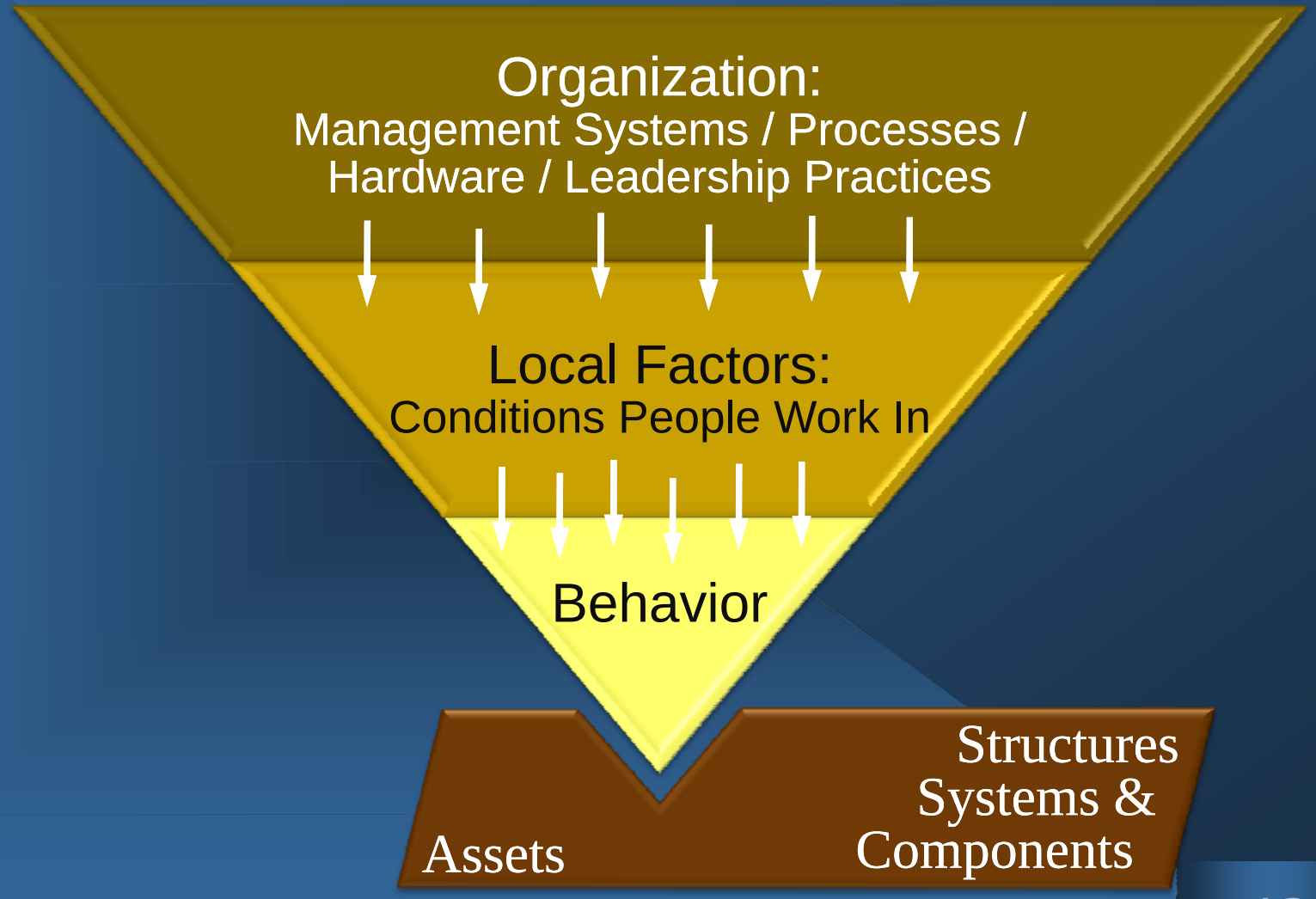
Blunt vs. Sharp End*



* Adapted from Woods, D., et al. (2010), *Behind Human Error*, p.8-11.

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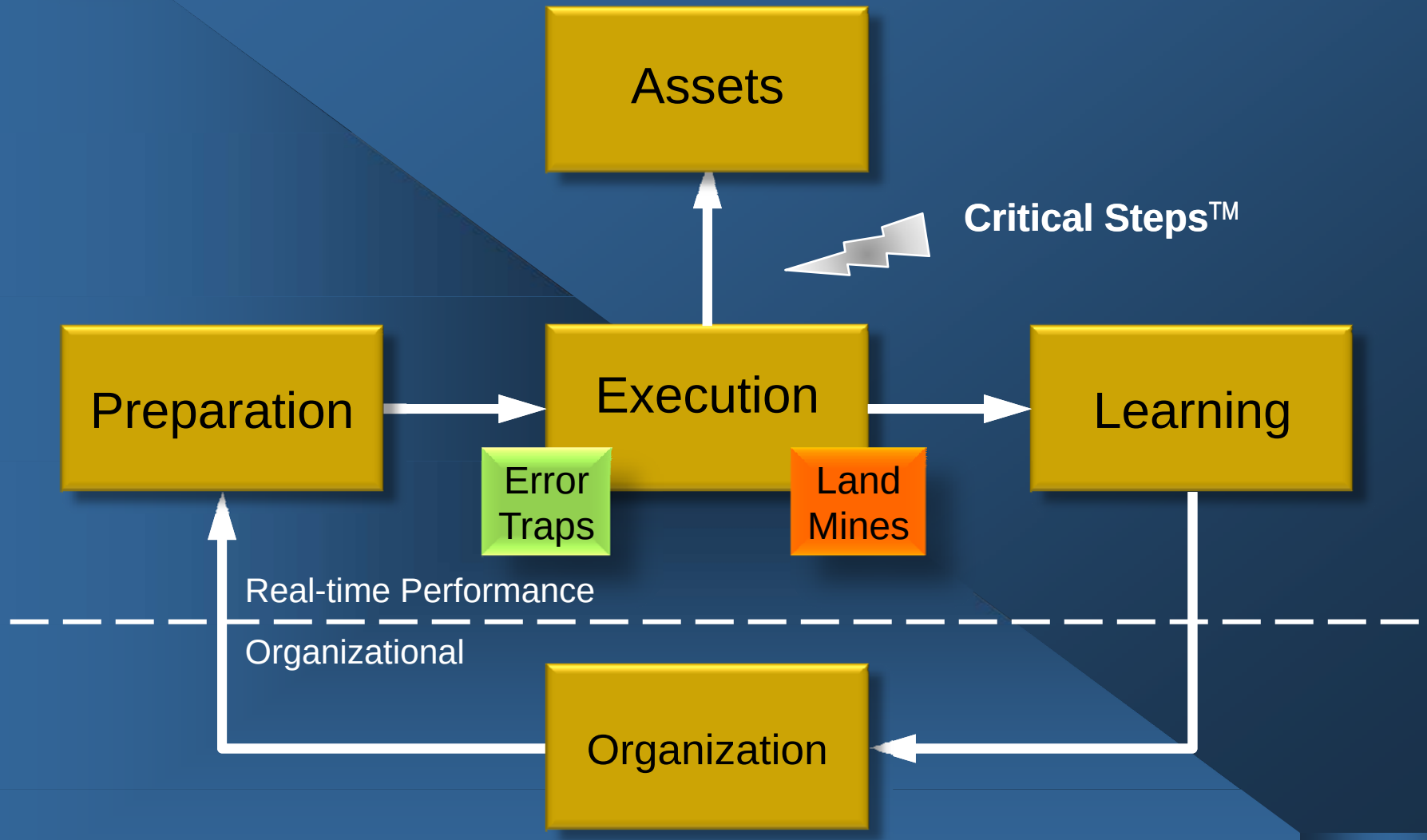
Hu is a System: Work Execution Process



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Error Traps – Examples

- Hurrying
- High workload
- Distractions
- Multiple tasks
- Production pressures
- Change
- Competing goals
- Vague procedure
- Unfamiliarity
- First-time
- Stress / fatigue
- Habit
- “Get-r-done” mindset
- Overconfidence
- Assumptions
- Fear
- Fatalism

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Latent System Weaknesses (LSW)

Undetected deficiencies in management systems, facilities, processes, or leadership practices / values that, in turn, reduce the resilience of the organization.

Land Mines – undetected conditions in the *workplace* that poise the release of energy, substance, or information to cause harm to assets when combined with a human action; LTA defenses against land mines

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Land Mines – Examples

- Unknown configurations
- Long-term equipment deficiencies
- Missing barriers
- Software errors
- Inaccessible controls
- Unanticipated hazards
- Residual process fluid in piping (toxic)
- Burned out lighting
- Inconspicuous holes in the floor; missing railings
- Inoperable emergency systems
- Worn out / lack of tools
- Personal, non-monitored files (proprietary)
- Labeling deficiencies
- Out-of-service indicators or alarms
- Sneak circuits

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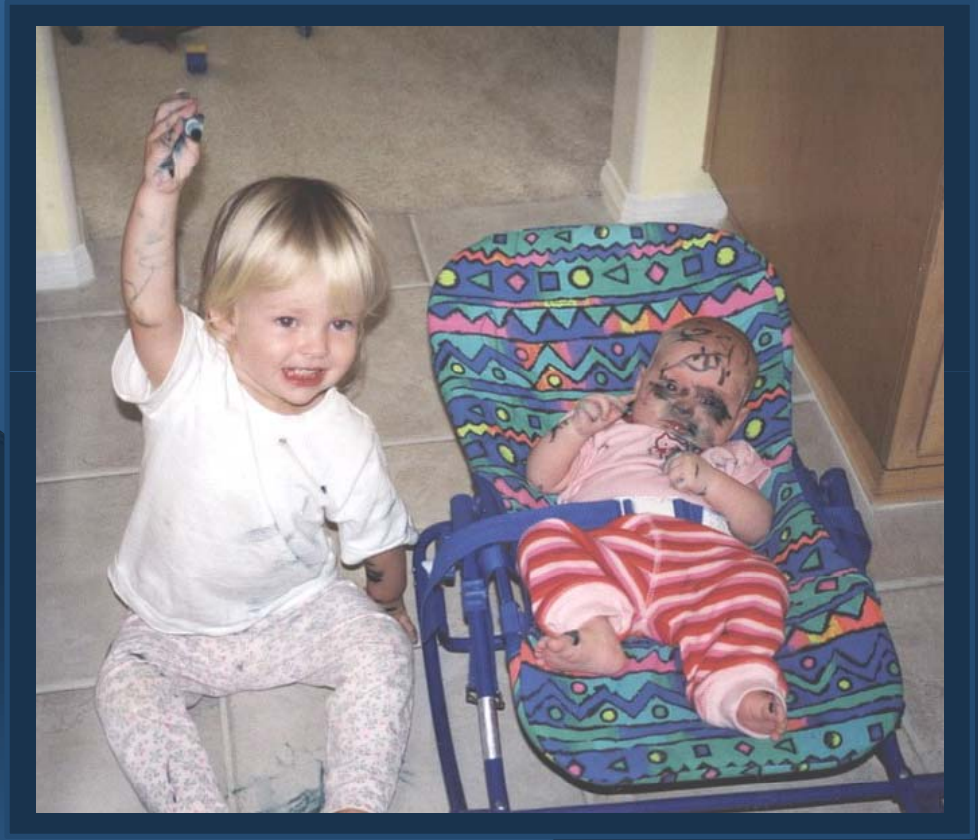
Touching = Risk

- **Asset**
  - Something of value
- **Hazard**
  - People (human failure)
- **Exposure**
  - “Touching” assets
- **Risk**
  - Probability (frequency)
  - Consequence (severity)
- **Event**
  - Adverse Event, Accident, Incident, Mishap, Occurrence, etc.



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Asset

- Linemen
- Power Grid
- Environment
- Customers
- SCADA
- Devices
- Intellectual Property
- Structures, Systems, and Components

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TouchPoint™

A human interaction with an object (asset) that changes the state of that object through work

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TouchPoint™ Characteristics

Tight Coupling

- Irreversible
- Rapid consequences
- Domino effects
- Complex interdependencies
- Hidden interactions
- Proceduralized
- Unpredictable outcomes
- Uncontrollable (volatile) outcomes

Loose Coupling

- Reversible; undo
- Time to think; slack
- Opportunity to stop
- Inconsequential
- Observable
- Simple relationships
- Flexible means of accomplishing task
- Controllable

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Positive Control*

Goal:

- What is intended to happen
- is what happens and
- that is all that happens

* Source: Institute of Nuclear Power Operations (2006), *Human Performance Reference Manual* (INPO 06-003).

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Critical Step™
– Point of No Return

Any action that ***will*** trigger ***immediate, irreversible, intolerable harm***
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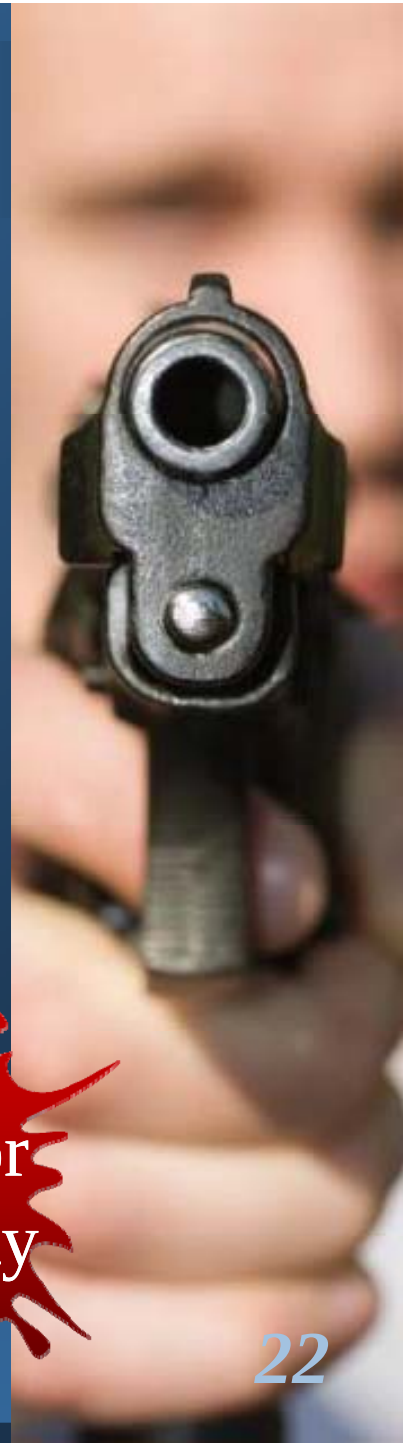

Single-Error Vulnerability

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Critical Step™: Examples

- Opening a circuit breaker
- Grabbing an electrical bus bar
- Directing a switchman to operate a device
- Stepping out of an airborne plane
- Entering a confined space
- Making an incision (surgery)
- Pulling a fuse or IC card
- Selecting ‘open’ for a remotely operated device (control room)
- Clicking “submit” for an Internet purchase

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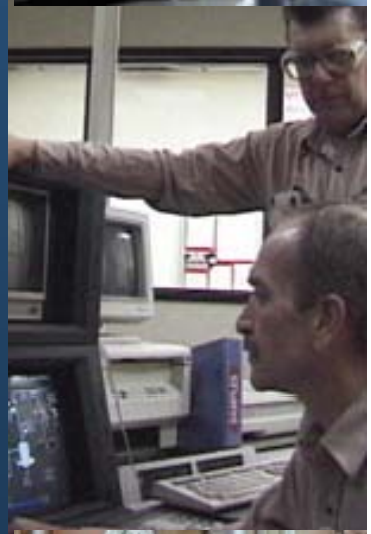
Task – An Example

Remove a drain hose from a header that is one of five identical headers in the area, where the hose is 50 feet long and routed through grating to a floor drain on a lower elevation, and the process fluid in the system is thermally hot and chemically corrosive.

Which is the critical step?

a. Donning PPE
b. Securing the hose
c. Verifying the supply valve is closed
d. Decoupling the hose



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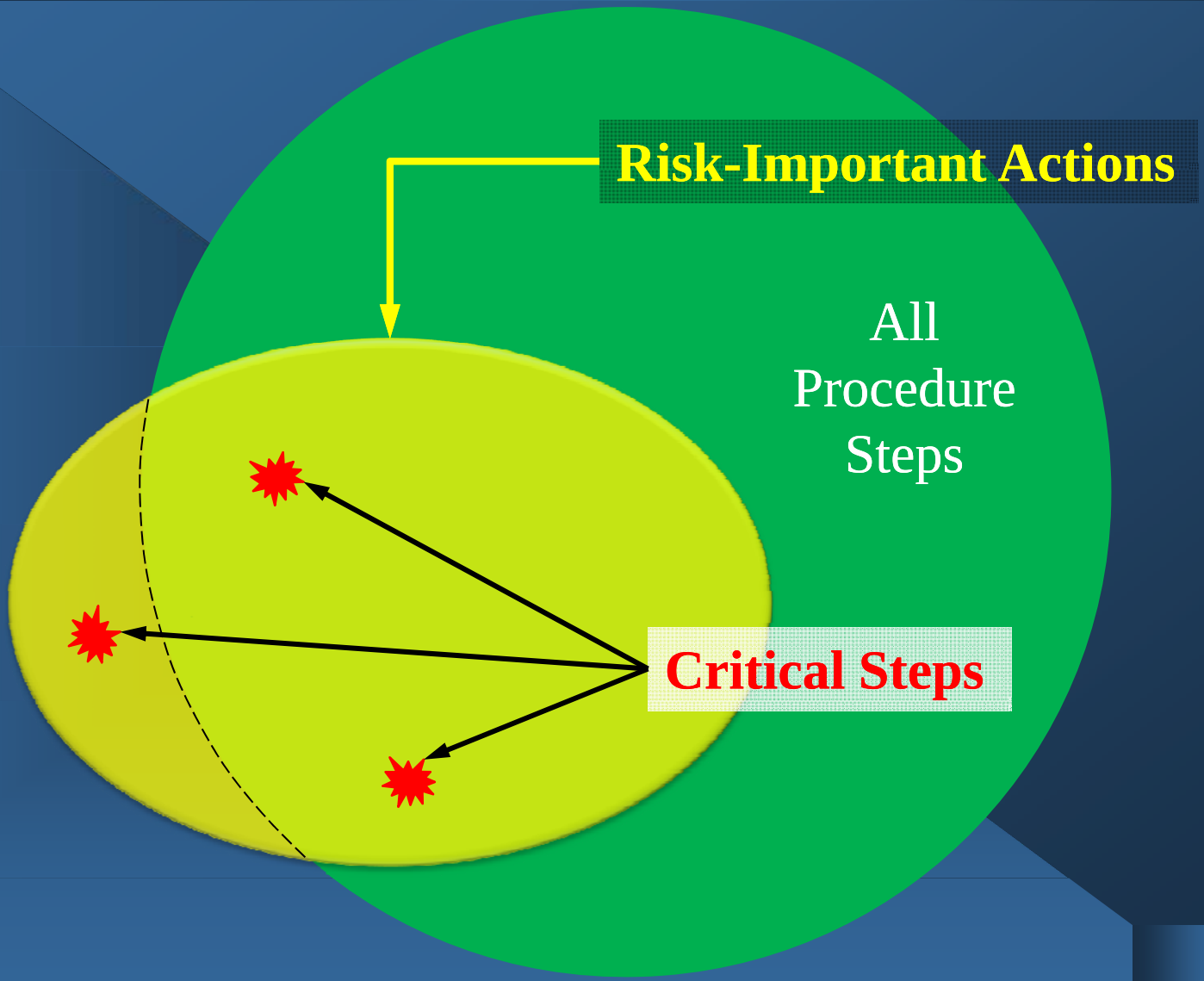
Risk-Important Actions and Critical Steps



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RIA Examples

- Donning personal protective equipment
- Securing the drain plug during oil change
- Setting a rat trap
- Closing water supply valve before disconnecting the hose to the toilet's tank
- Reviewing a move sheet
- Confirming correct substation / line
- Stopping at a Stop Sign
- Depressing selection on snack machine
- Verifying initial conditions
- Pulling the hammer back on a 9mm handgun

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SAFE™ A Risk-Based Method

S	**Summarize** *critical steps / points of no return*
A	**Anticipate** *errors or mistakes at each critical step*
F	**Foresee** *consequences at each critical step (each asset)*
E	**Evaluate** *defenses, contingencies, & abort criteria*

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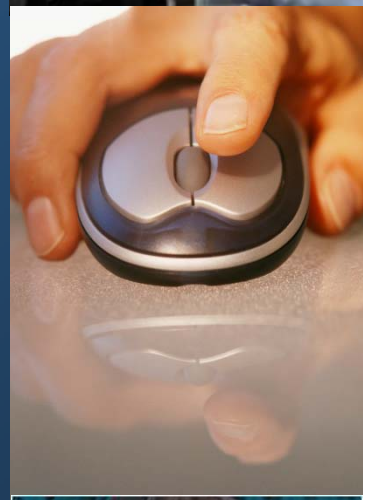
Hu Tools*

Definition

Mental and social skills that complement worker's technical skills to promote *safe* and *efficient* task performance, carving out ***time to think*** at critical steps™

Tool Groups

- Situation Awareness
- Task Action
- Communication
- Decision-making
- Teamwork
- Leadership



* Flin, R., et al. (2008), *Safety at the Sharp End, A Guide to Non-Technical Skills*, p. 1.

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Chronic Sense of Uneasiness*

A Preoccupation with Failure

An attitude of *mindfulness* regarding:

1) one's capacity to err, i.e., **error traps**
2) the presence of hidden threats, i.e., **land mines**

how you perceive, think, feel, and behave about hazards

* Reason, J. (2008), *The Human Contribution*, p.274.

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Lessons Learned w/ Implementation

- Asset – know what you're trying to protect
- Definition – no uncertain terms
- Understanding vs. awareness
- Posters – where PJBs occur
- Deviations – none
- Terminology – doesn't matter what you call it
- Perennial – always critical for procedures
- Harm – reserved for serious outcomes
- Coach – monitor and provide feedback

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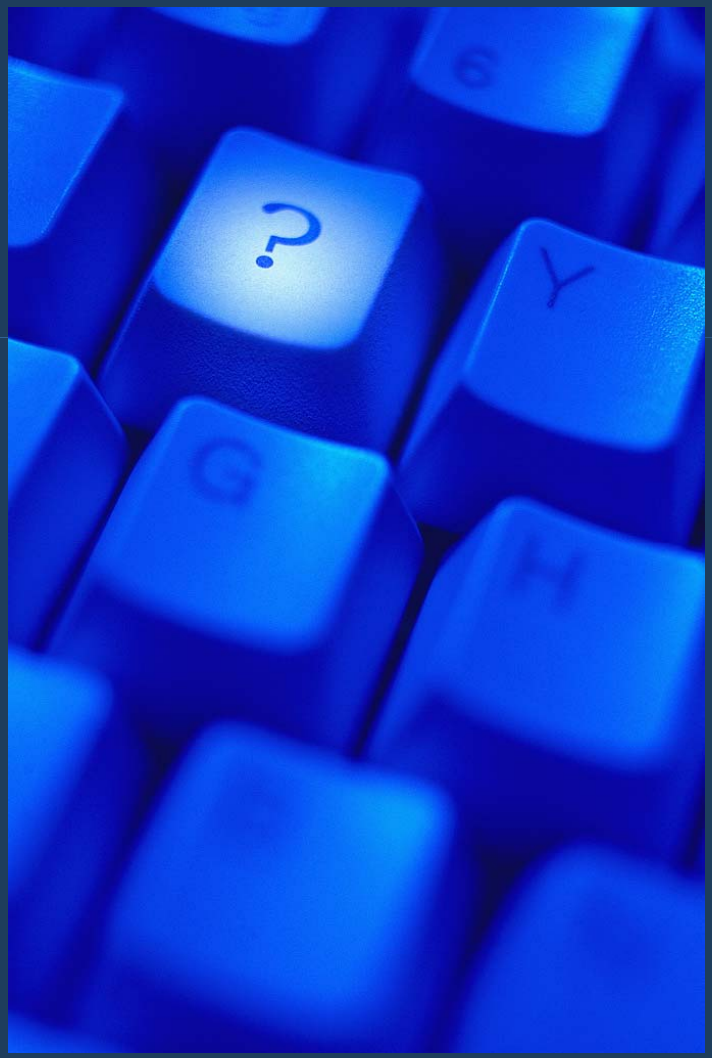
Questions and Comments



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