



# Fundamentals for Human Performance Improvement

Sam McKenzie



# *Purpose of HPI*



To minimize the  
frequency and  
severity of  
events

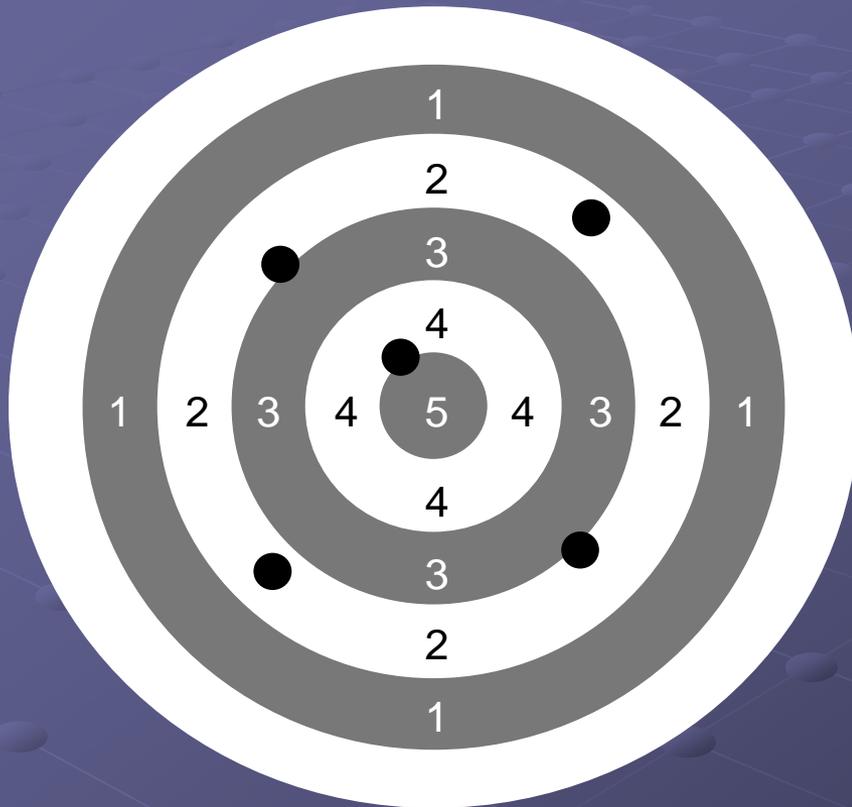


# Course Objectives

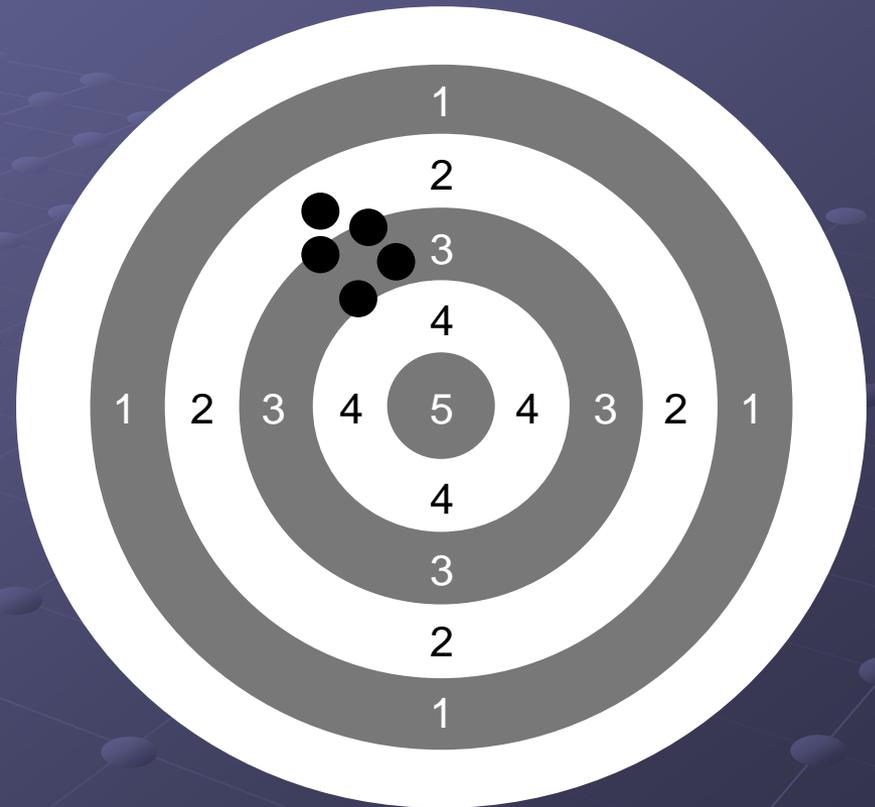
- ❖ Why HPI events occur
- ❖ Error-likely Situations & error precursors
- ❖ HPI Models
- ❖ Jobsite tools
- ❖ Leadership practices
- ❖ Behavior reinforcement
- ❖ Mental framework
- ❖ Leadership roles
- ❖ Strengths, obstacles, key learnings, & actions



# Human Performance



**Target No.1**



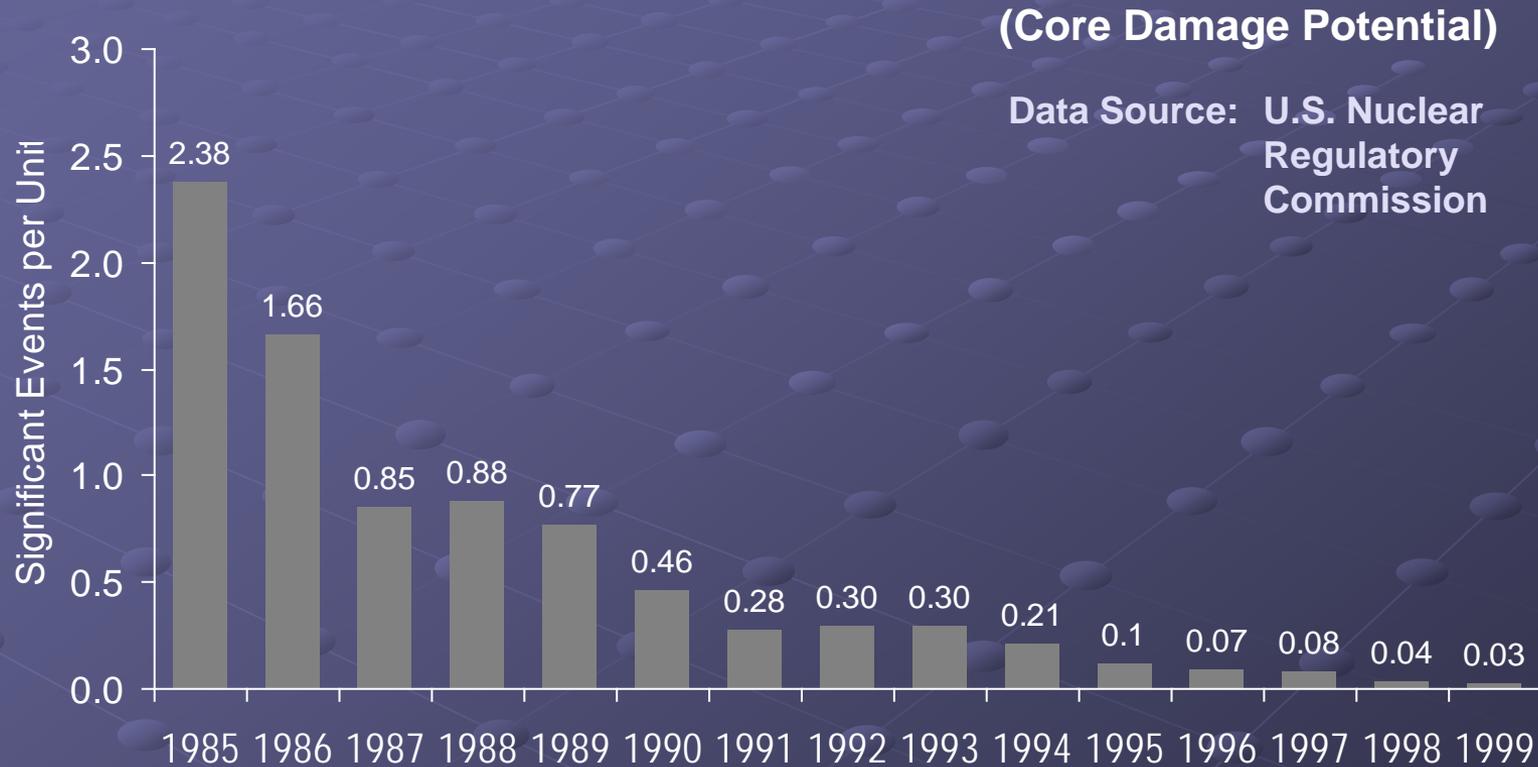
**Target No.2**





# Significant Events

## *Annual Industry Averages*

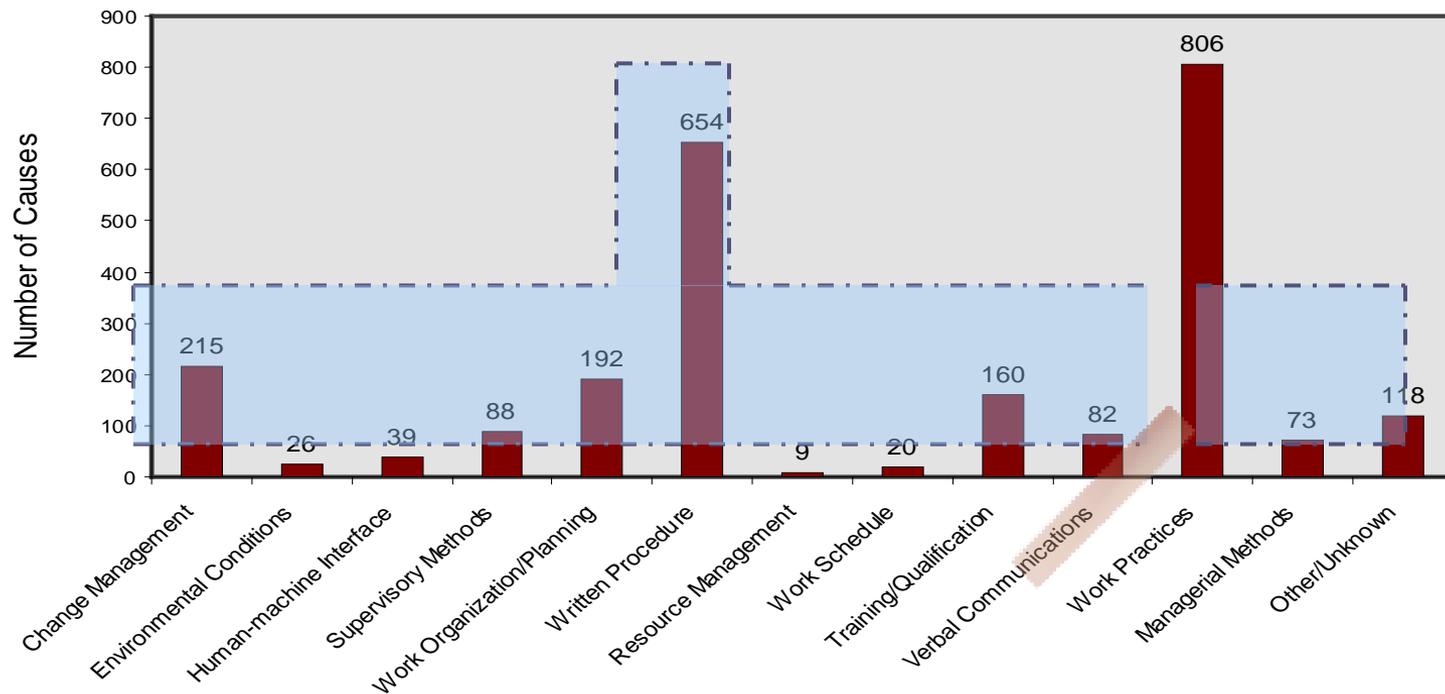


# Nuclear Industry Event Causes *due to human performance*



**1,676 = Organizational  
Behavior (68%)**

**806 = Individual  
Behavior (32%)**



Source: INPO, Event Database, March 2000. For all events during 1998 and 1999.



# Is 99.9% Good Enough?

**1 hour of unsafe drinking water per month**

**2 unsafe landings per day in Atlanta, GA.**

**50 dropped babies per day**

**116,000 lost pieces of mail per hour**

**20,000 incorrect drug prescriptions per year**

**22,000 checks deposited in wrong accounts per hour**



# Two Kinds of Error

Active Error ←



→ Latent Error

(leading to latent conditions)

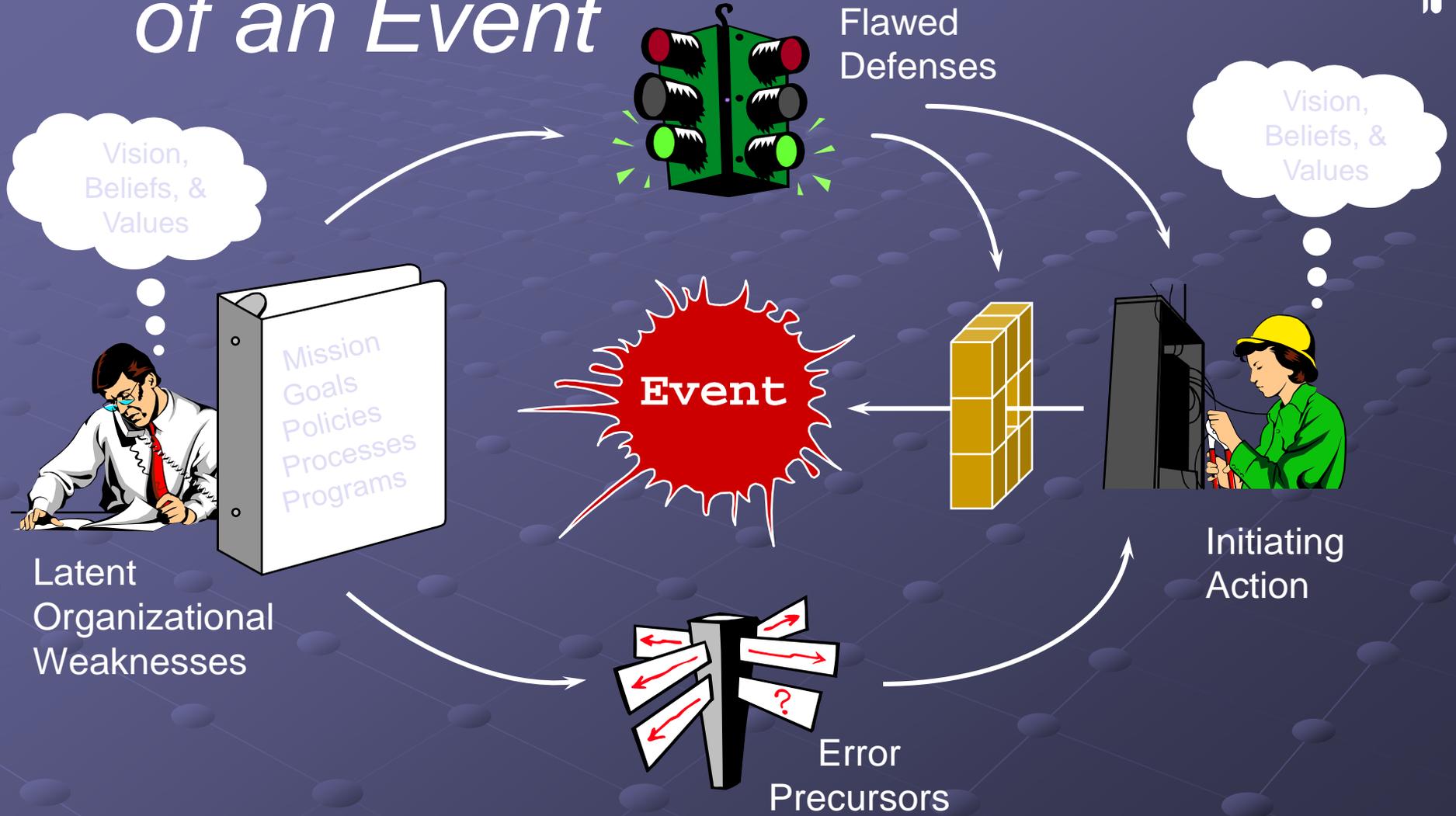
# Principles of Human Performance Management



- ❖ Humans are fallible . . .
- ❖ Error is predictable. . .
- ❖ Organization influences behavior.
- ❖ Behaviors are reinforced.
- ❖ Events are avoidable.



# Anatomy of an Event



# Strategic Approach



1. Anticipate and prevent active error at the job-site.
2. Identify and eliminate latent organizational weaknesses.

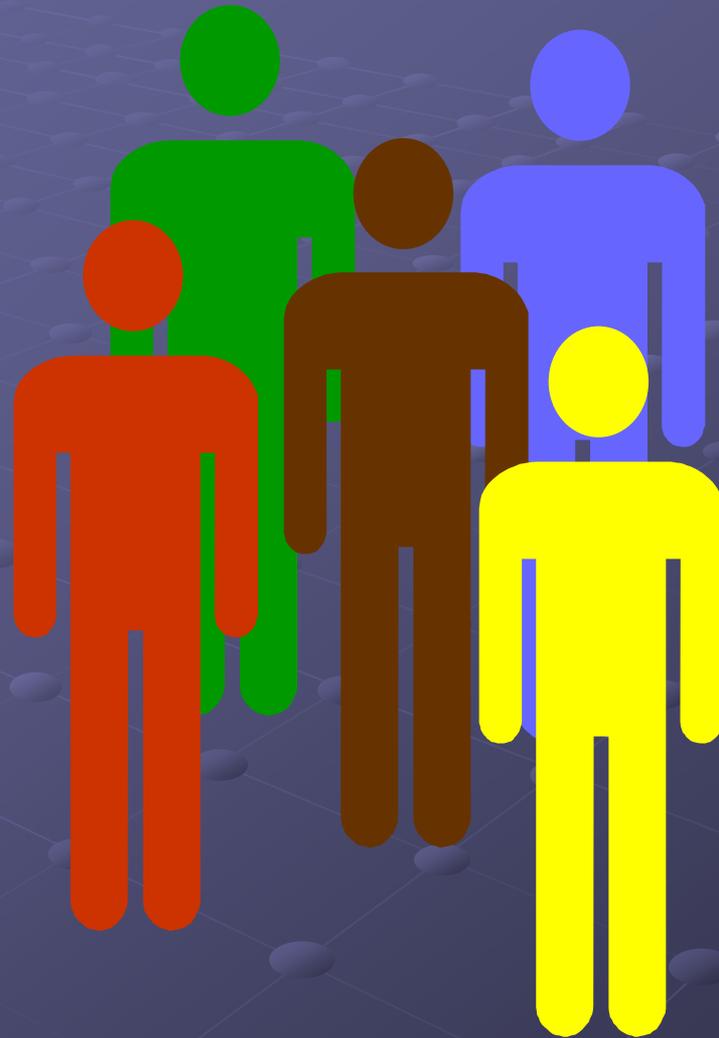
# Essential Elements for Achieving Reliable Human Performance



- Organizational Attributes
- Process Contributors
- Individual Values and Behaviors



# The Jobsite and The Individual





# Traps of Human Nature



- ❖ Stress
- ❖ Avoidance of mental strain
- ❖ Inaccurate mental models
- ❖ Limited working memory
- ❖ Limited attention resources
- ❖ Mind set
- ❖ Difficulty seeing own errors
- ❖ Limited perspective
- ❖ Susceptible to emotion
- ❖ Focus on goal
- ❖ Fatigue





# Phrase Recall Exercise





# Phrase Recall Exercise (Cont.)

PARIS  
IN THE  
THE SPRING

ONCE  
IN A  
A LIFETIME

BIRD  
IN THE  
THE HAND



# Error Precursors



- ❖ Task Demands
- ❖ Work Environment
- ❖ Individual Capabilities
- ❖ Human Nature



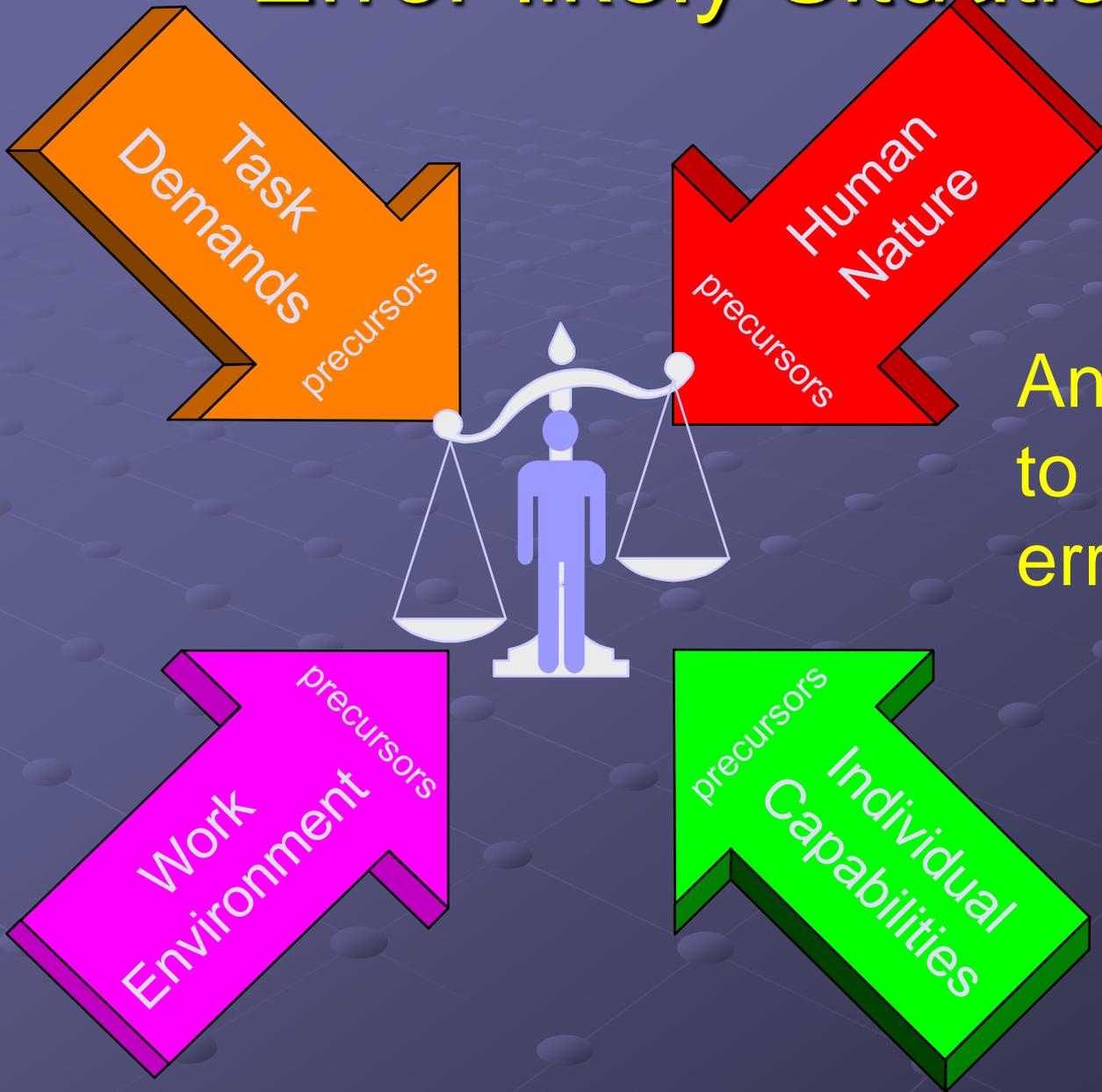


# Count the F's

**Finished Files are the Result of Years  
of Scientific Study Combined with the  
Experience of Many Years.**



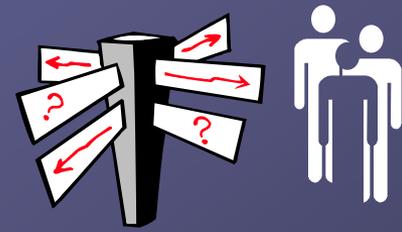
# Error-likely Situation



An error about to happen due to error precursors

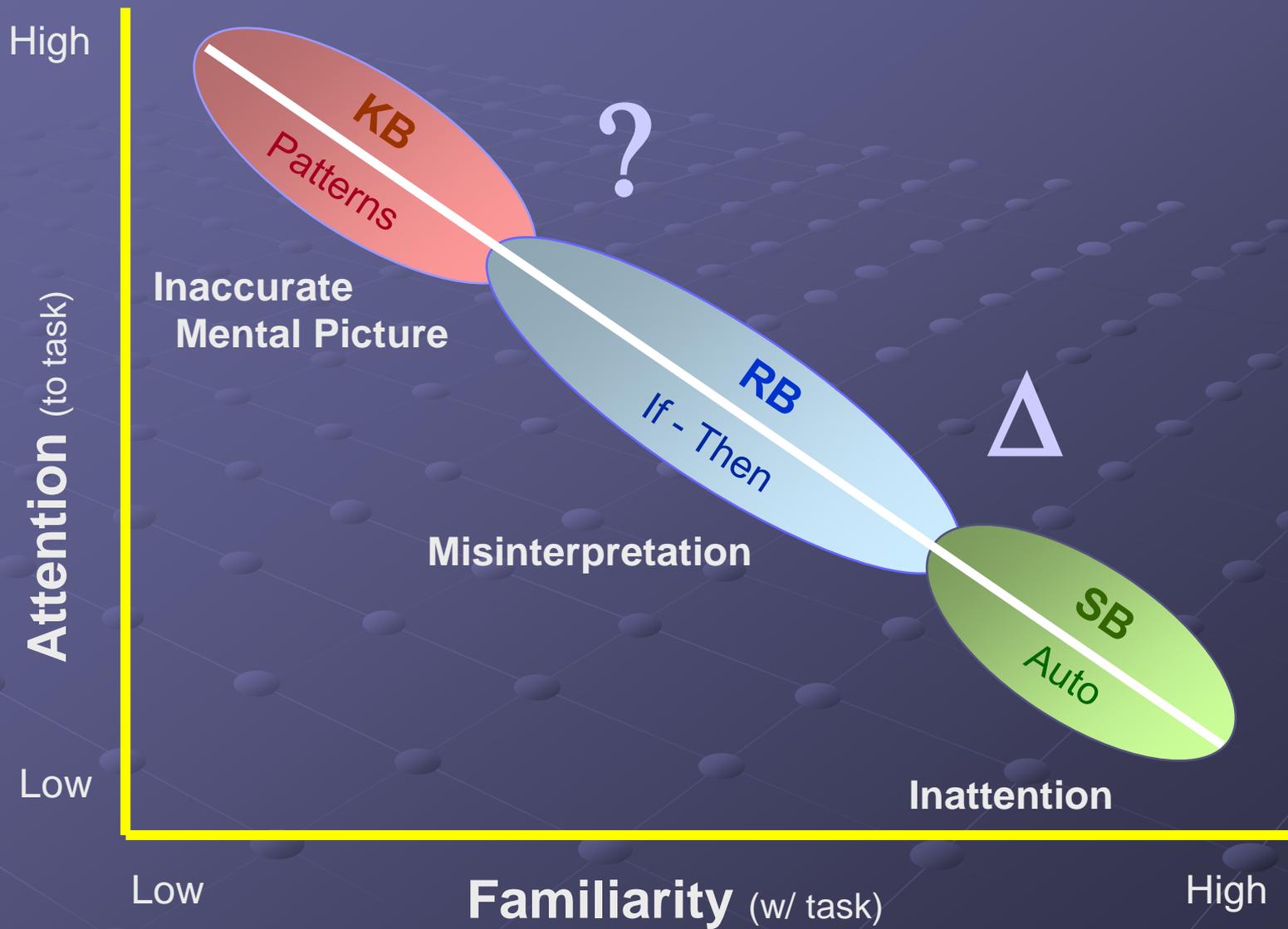
# Error Precursors

## short list



Task Demands	Individual Capabilities
<ul style="list-style-type: none"> <li>Time pressure (in a hurry)</li> </ul>	<ul style="list-style-type: none"> <li>Unfamiliarity w/ task / First time</li> </ul>
<ul style="list-style-type: none"> <li>High Workload (memory requirements)</li> </ul>	<ul style="list-style-type: none"> <li>Lack of knowledge (mental model)</li> </ul>
<ul style="list-style-type: none"> <li>Simultaneous, multiple tasks</li> </ul>	<ul style="list-style-type: none"> <li>New technique not used before</li> </ul>
<ul style="list-style-type: none"> <li>Repetitive actions, monotonous</li> </ul>	<ul style="list-style-type: none"> <li>Imprecise communication habits</li> </ul>
<ul style="list-style-type: none"> <li>Irrecoverable acts</li> </ul>	<ul style="list-style-type: none"> <li>Lack of proficiency / Inexperience</li> </ul>
<ul style="list-style-type: none"> <li>Interpretation requirements</li> </ul>	<ul style="list-style-type: none"> <li>Indistinct problem-solving skills</li> </ul>
<ul style="list-style-type: none"> <li>Unclear goals, roles, &amp; responsibilities</li> </ul>	<ul style="list-style-type: none"> <li>“Unsafe” attitude for critical task</li> </ul>
<ul style="list-style-type: none"> <li>Lack of or unclear standards</li> </ul>	<ul style="list-style-type: none"> <li>Illness / Fatigue</li> </ul>
Work Environment	Human Nature
<ul style="list-style-type: none"> <li>Distractions / Interruptions</li> </ul>	<ul style="list-style-type: none"> <li>Stress (limits attention)</li> </ul>
<ul style="list-style-type: none"> <li>Changes / Departures from routine</li> </ul>	<ul style="list-style-type: none"> <li>Habit patterns</li> </ul>
<ul style="list-style-type: none"> <li>Confusing displays or controls</li> </ul>	<ul style="list-style-type: none"> <li>Assumptions (inaccurate mental picture)</li> </ul>
<ul style="list-style-type: none"> <li>Workarounds / OOS instruments</li> </ul>	<ul style="list-style-type: none"> <li>Complacency / Overconfidence</li> </ul>
<ul style="list-style-type: none"> <li>Hidden system response</li> </ul>	<ul style="list-style-type: none"> <li>Mindset (“tuned” to see)</li> </ul>
<ul style="list-style-type: none"> <li>Unexpected equipment conditions</li> </ul>	<ul style="list-style-type: none"> <li>Inaccurate risk perception (Pollyanna)</li> </ul>
<ul style="list-style-type: none"> <li>Lack of alternative indication</li> </ul>	<ul style="list-style-type: none"> <li>Mental shortcuts (biases)</li> </ul>
<ul style="list-style-type: none"> <li>Personality conflicts</li> </ul>	<ul style="list-style-type: none"> <li>Limited short-term memory</li> </ul>

# Performance Modes





# Error-reduction Techniques

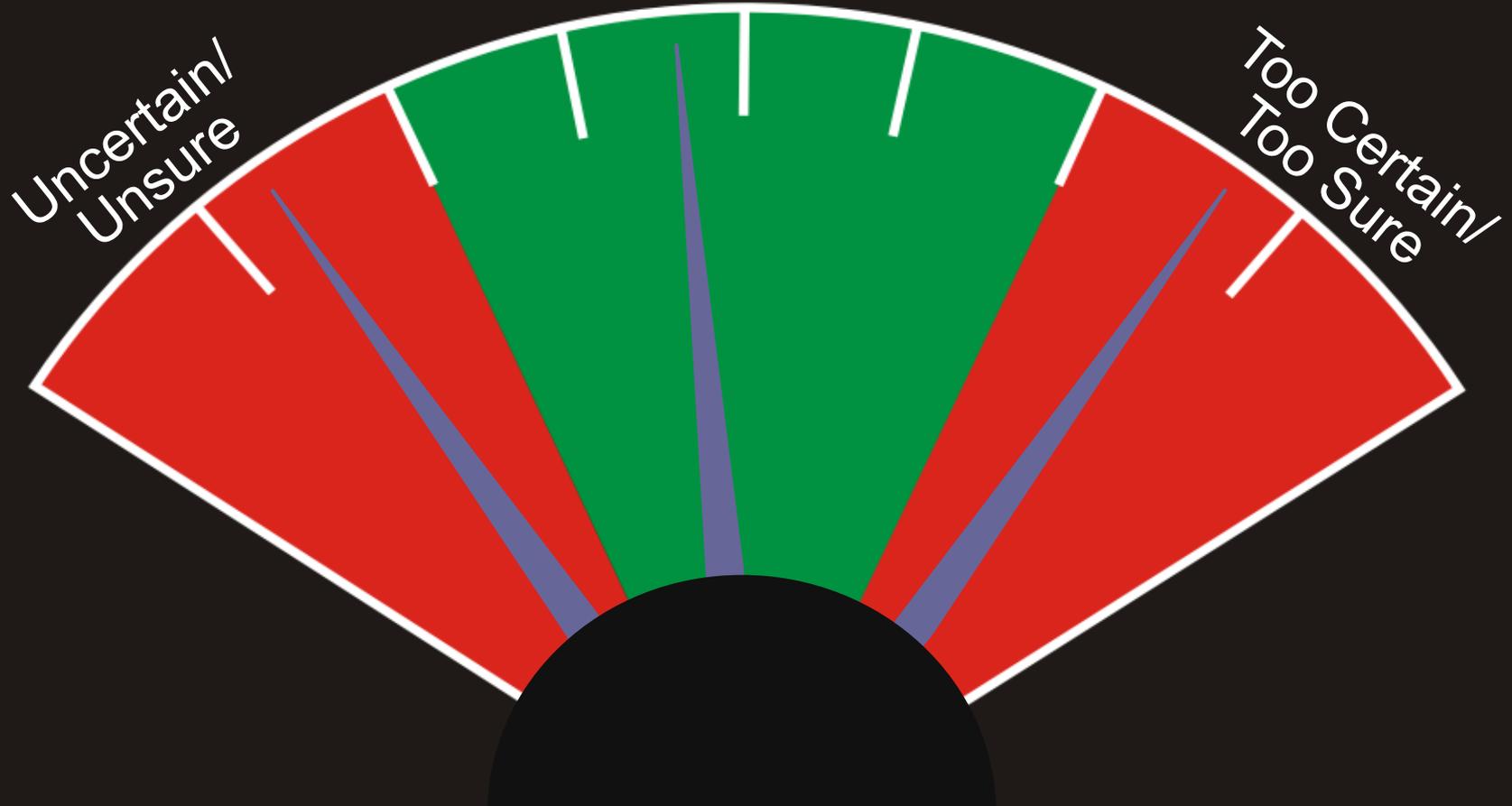
@ jobsite



- ✓ Conservative decision-making
- ✓ Change management
- ✓ Three-way communication
- ✓ Concurrent verification
- ✓ Independent verification
- ✓ Meetings
- ✓ Peer-checking
- ✓ Placekeeping
- ✓ Prejob Briefing
- ✓ Problem-solving
- ✓ Procedure use & adherence
- ✓ Questioning attitude
- ✓ Self-checking
- ✓ Stop & collaborate
- ✓ Two minute walkdown

# Questioning Attitude Meter

Healthy Uneasiness/  
Wariness/Alertness



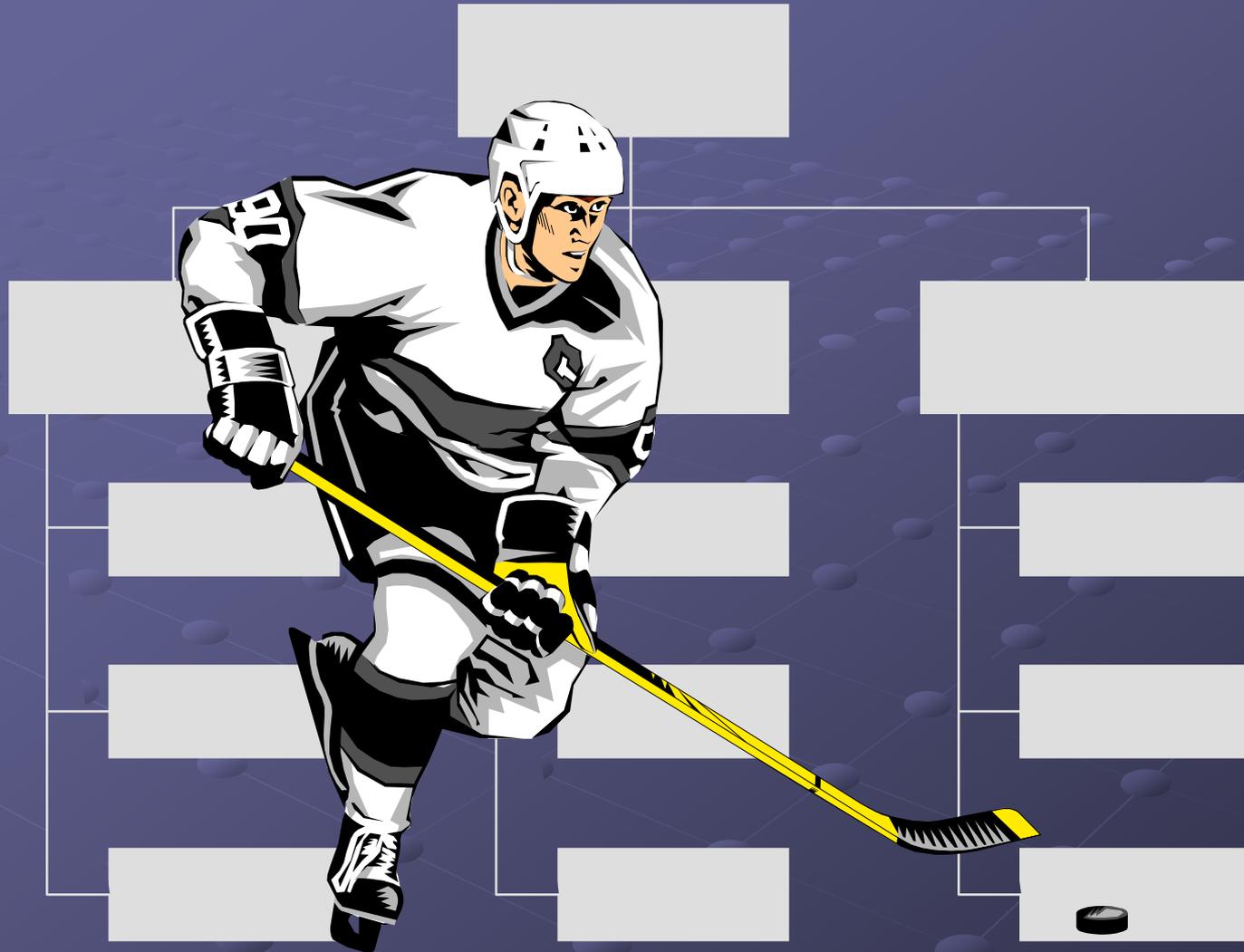
# Team Errors



- ❖ Social Loafing
- ❖ Halo Effect
- ❖ Pilot / Co-pilot
- ❖ Free Riding
- ❖ Groupthink
- ❖ Risky Shift



# Organization



# Terry Tate Clip



# Breaking The Human Performance Paradigm



Minimum frequency and severity of plant events, with high safety margins and reliability and no fuel-damaging events.

**Re + Md → ØE**

*[reducing error*

*AND*

*managing defenses*

*leads to*

*zero events]*

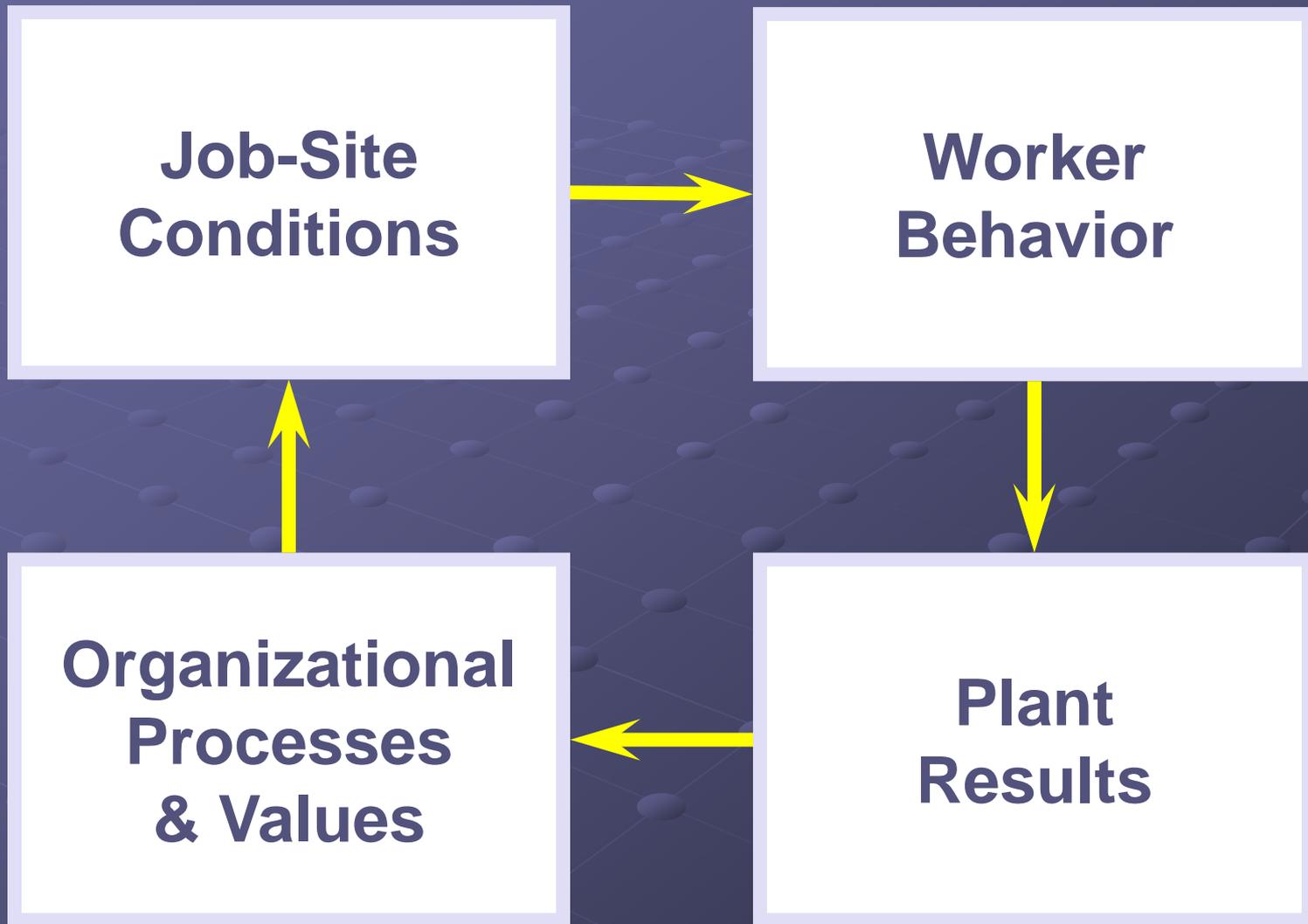
*[Aka: Individual*

*+*

*Organization & Processes >>>>*

*Performance Improvement]*

# The Performance Model





WHEN GOOD PETS

GO BAD

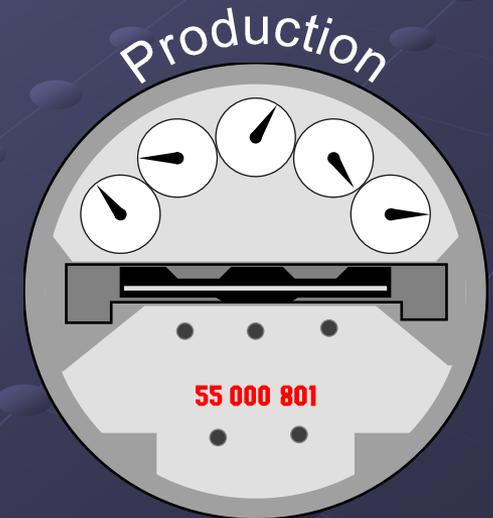


# Dual Purposes

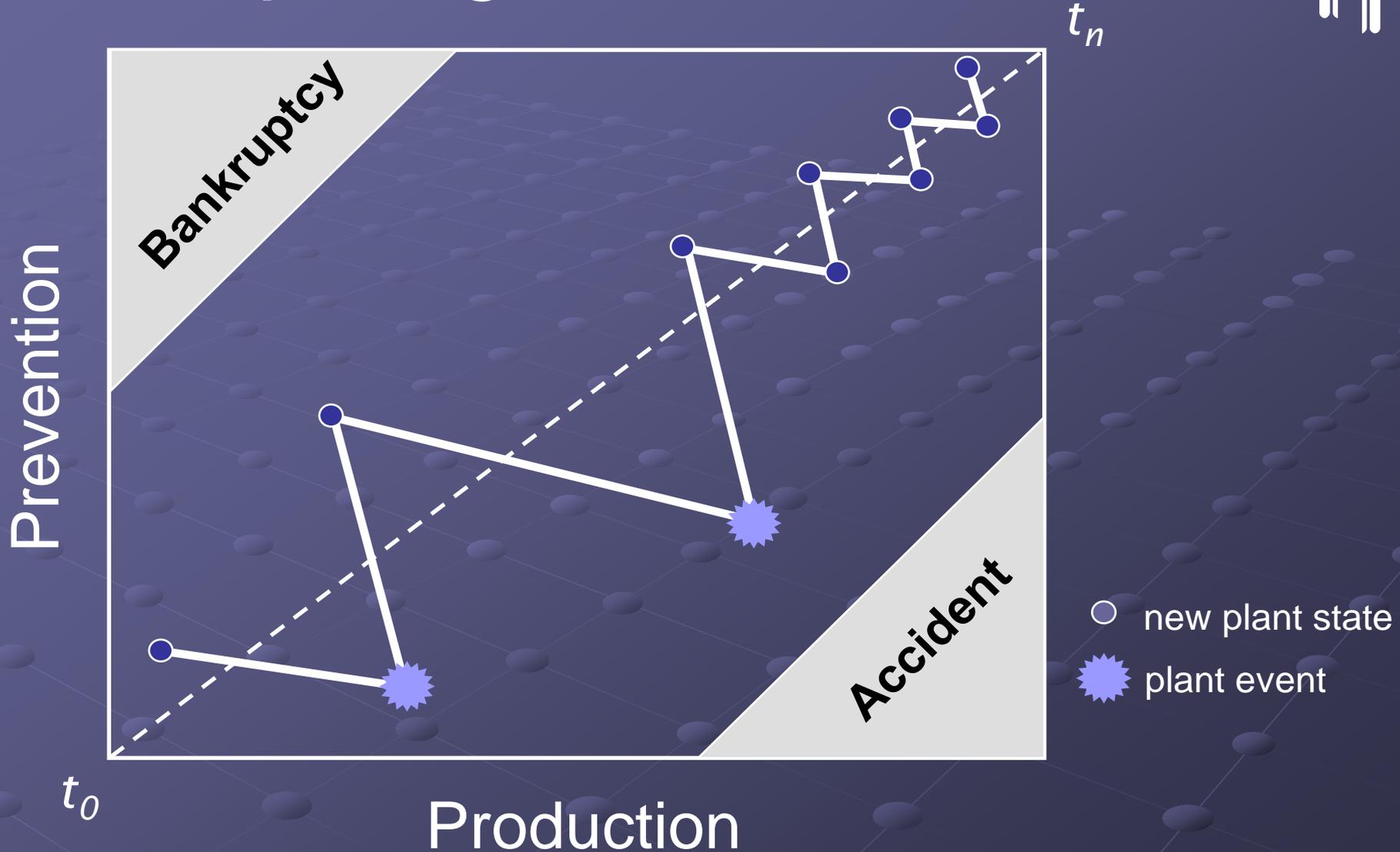


To consistently search for and eliminate conditions that provoke human error while reinforcing defenses.

To facilitate the accomplishment of the organization's mission in accordance with its norms, values, and strategies.



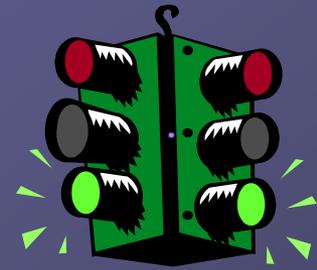
# Competing Resources



Source: James Reason. *Managing the Risks of Organizational Accidents*, 1997 (in press).

# Defenses

Flawed defenses allow active errors or their consequences to occur.



## Functions:

- ❖ Create Awareness
- ❖ Detect and Warn
- ❖ Protect
- ❖ Recover
- ❖ Contain
- ❖ Enable Escape

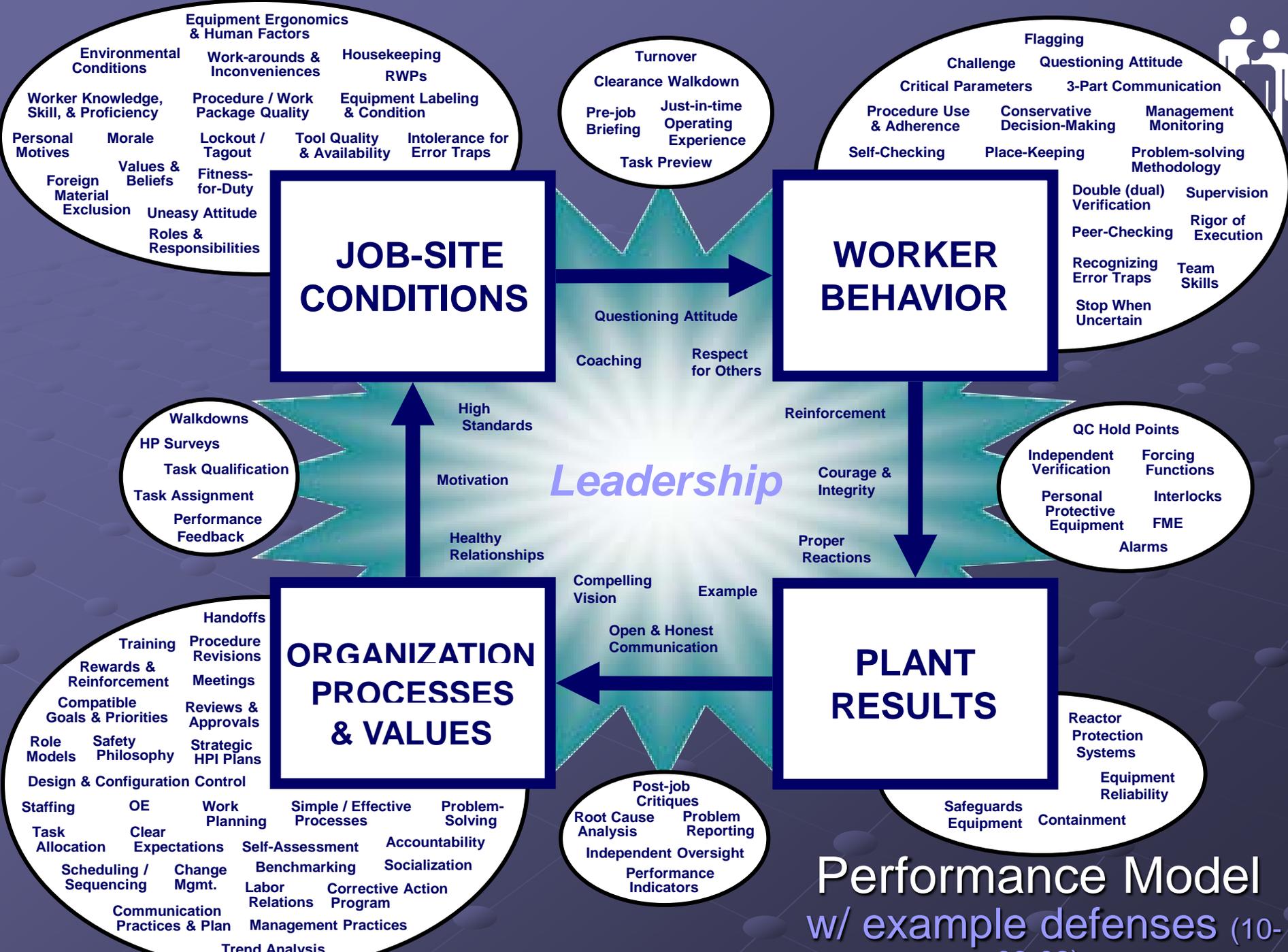
Physical

Administrative



# Defense -in- Depth





# Latent Organizational Weaknesses (sources)



## Processes (structure)

- ❖ Work control
- ❖ Training
- ❖ Accountability policy
- ❖ Reviews & approvals
- ❖ Equipment design
- ❖ Procedure development
- ❖ Human resources

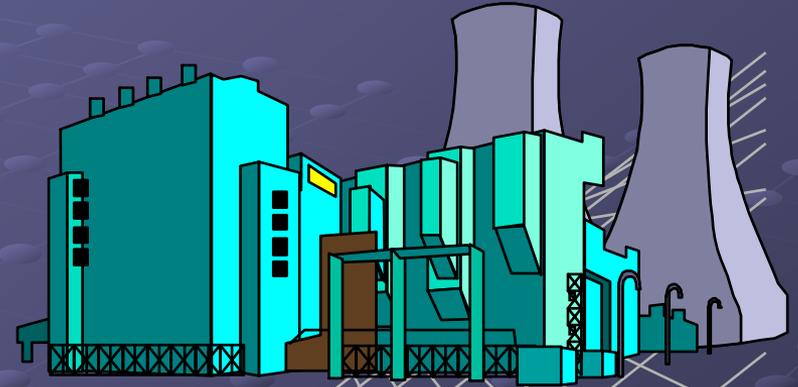
## Values (relationships)

- ❖ Priorities
- ❖ Measures & controls
- ❖ Critical incidents
- ❖ Coaching & teamwork
- ❖ Rewards & sanctions
- ❖ Reinforcement
- ❖ Promotions & terminations

# Finding Latent Organizational Weaknesses



- ❖ Self-Assessments
- ❖ Benchmarking
- ❖ Post-job Critiques
- ❖ Trending
- ❖ Surveys and Questionnaires
- ❖ Observations
- ❖ Root Cause Analysis



# Air Ontario Flight 363 Fokker F28 Dryden, Canada



# *Leadership*



# Leadership Practices



- 1. Facilitate open communication*
- 2. Promote teamwork*
- 3. Reinforce desired behaviors*
- 4. Eliminate latent organizational weaknesses*
- 5. Value prevention of errors*

# Reinforcement



## *Consequences that Increase Behavior*

1. GET SOMETHING YOU WANT
2. AVOID SOMETHING YOU DON'T WANT

**BEHAVIOR  
INCREASES**

**Behavior**

1. GET SOMETHING YOU DON'T WANT
2. LOSE SOMETHING THAT YOU HAVE

**BEHAVIOR  
DECREASES**

## *Consequences that Decrease Behavior*

# Task Preview





# Guidance for Level of Pre-job Briefing

	Low-Risk	High-Risk
Simple or Repetitive	SAFER Dialogue	Preplanned Prejob Briefing Forms Plus SAFER
Complex or Infrequent	Generic Prejob Briefing Checklist Plus SAFER	Infrequently Performed Test or Evolution Plus SAFER

# Post-Job Critique



1. Purpose: Organizational improvement (OE)
2. Quick and easy
3. Production and Prevention
4. Management acknowledgement
5. Follow-through



Human  
Error

More flawed defenses  
& error precursors

Individual counseled  
and/or disciplined

# *Blame Cycle*

Latent organizational  
weaknesses persist

Reduced trust

Management less  
aware of jobsite  
conditions

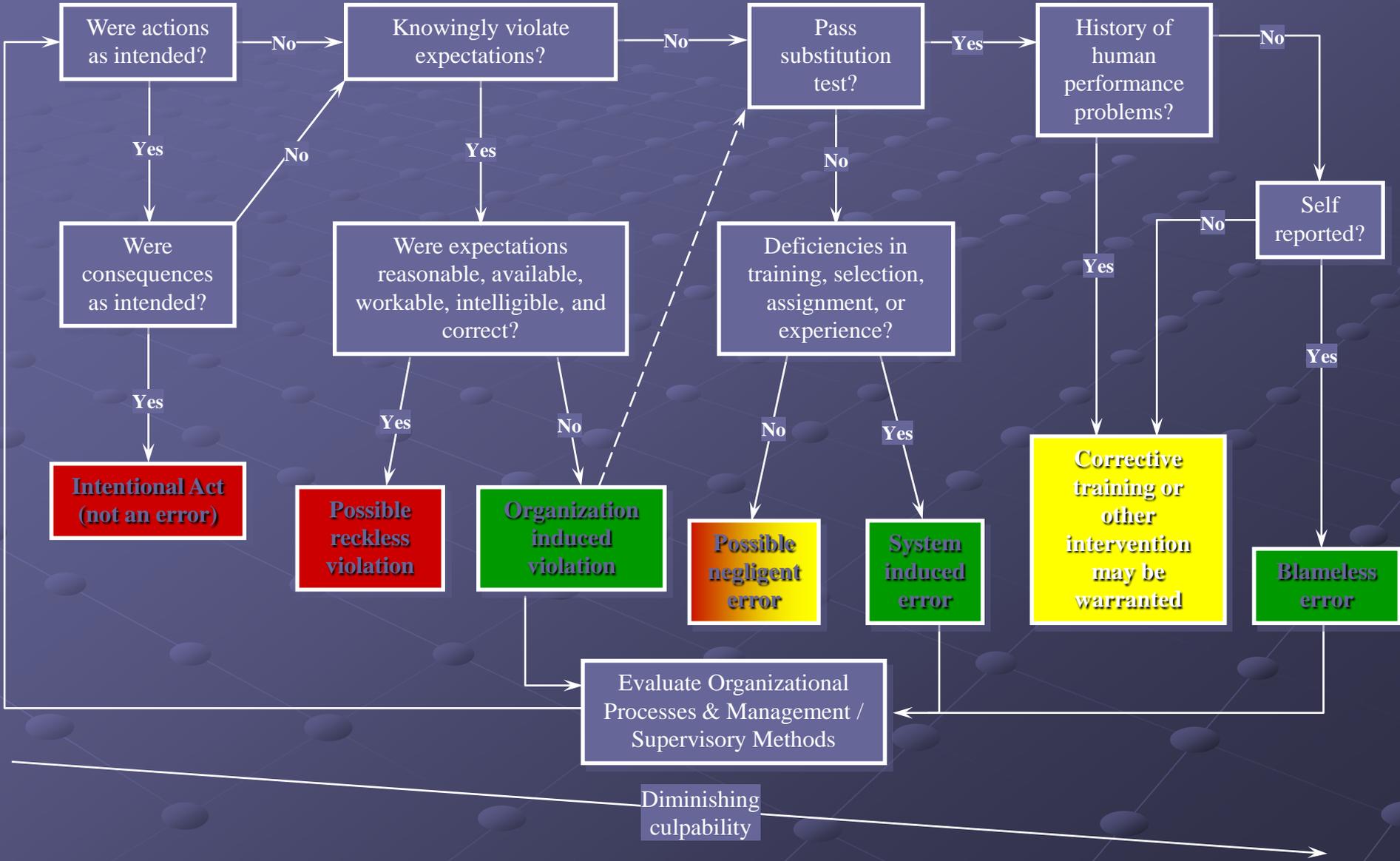
Less  
communication

Source: Reason, *Managing the Risks of  
Organizational Accidents*, pp.127-129.



# Culpability Evaluation Flowchart

- █ Discipline required
- █ Accountability PR&D
- █ Process Issue





*“The longest distance to travel in HPI is from the head to the heart.”*

-Tom Herrall, Mcguire plant manager

- Purposefulness
- Control
- Competence
- Progress



Tunnel Fire

HVCM  
Explosions/Fires

CMS Hydrogen  
Release(s)

Rad Posting  
Violations



Root  
Cause

Changes

Root  
Cause

Root  
Cause

Root  
Cause

Assumptions

Habit Patterns

Interpretation

Time Pressure

Unclear Goals

Stress

# Error Precursors

New Technique

Workarounds

Simultaneous

Hidden System Response

Hazardous Attitude

Complacency

Repetitive Actions

## Organizational Weaknesses

# Implementing a “Program”



1. Senior Management Commitment
2. Steering Committee
3. Self-assessment
4. Strategy
5. Communicate and Empower
6. Implement
7. Evaluate
8. Maintain

