

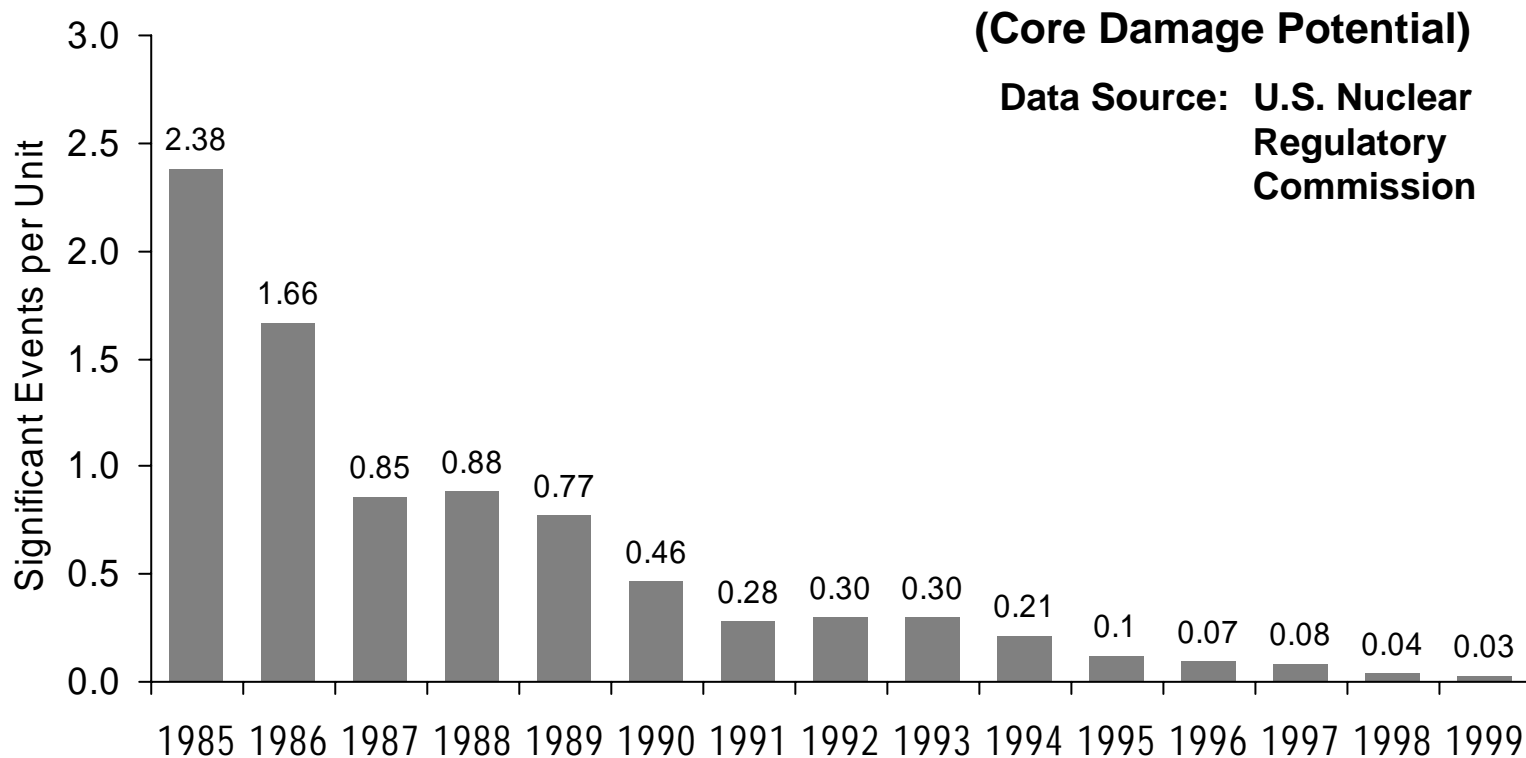
Human Performance

T. Shane Bush
INEEL

Human Performance Management

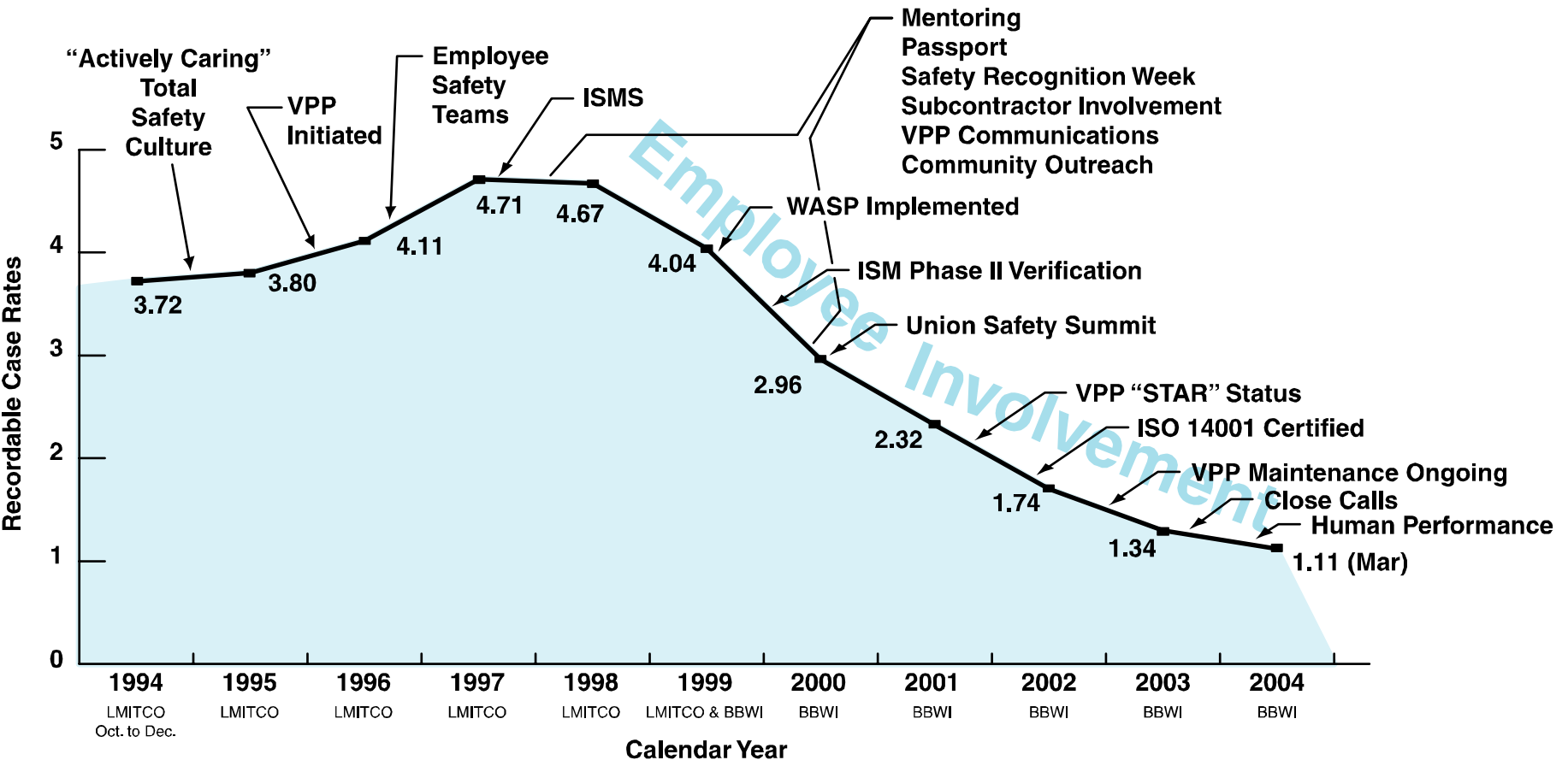
- 90% of all incidents are triggered by Human Errors (70% Org issues).
- Commercial Nuclear Power Industry has reduced significant events from 238 to 3 per year.
- Quality, Efficiency, & Safety are driven by Human Performance.

Significant Events Annual Industry Averages



Our Road to Zero . . .

Employee Involvement and Excellent Safety Systems Result in Injury Reduction



Note: Includes construction subcontractor performance.

Human Performance Management

Principles

- People are fallible, and even the best people make mistakes
- Error-likely situations are predictable, manageable, & preventable
- Individual behavior is influenced by organizational processes and values
- People achieve high levels of performance largely because of the encouragement and reinforcement received from leaders, peers, and subordinates
- Events can be avoided through an understanding of the reasons mistakes occur and application of the lessons learned from past events (or errors)

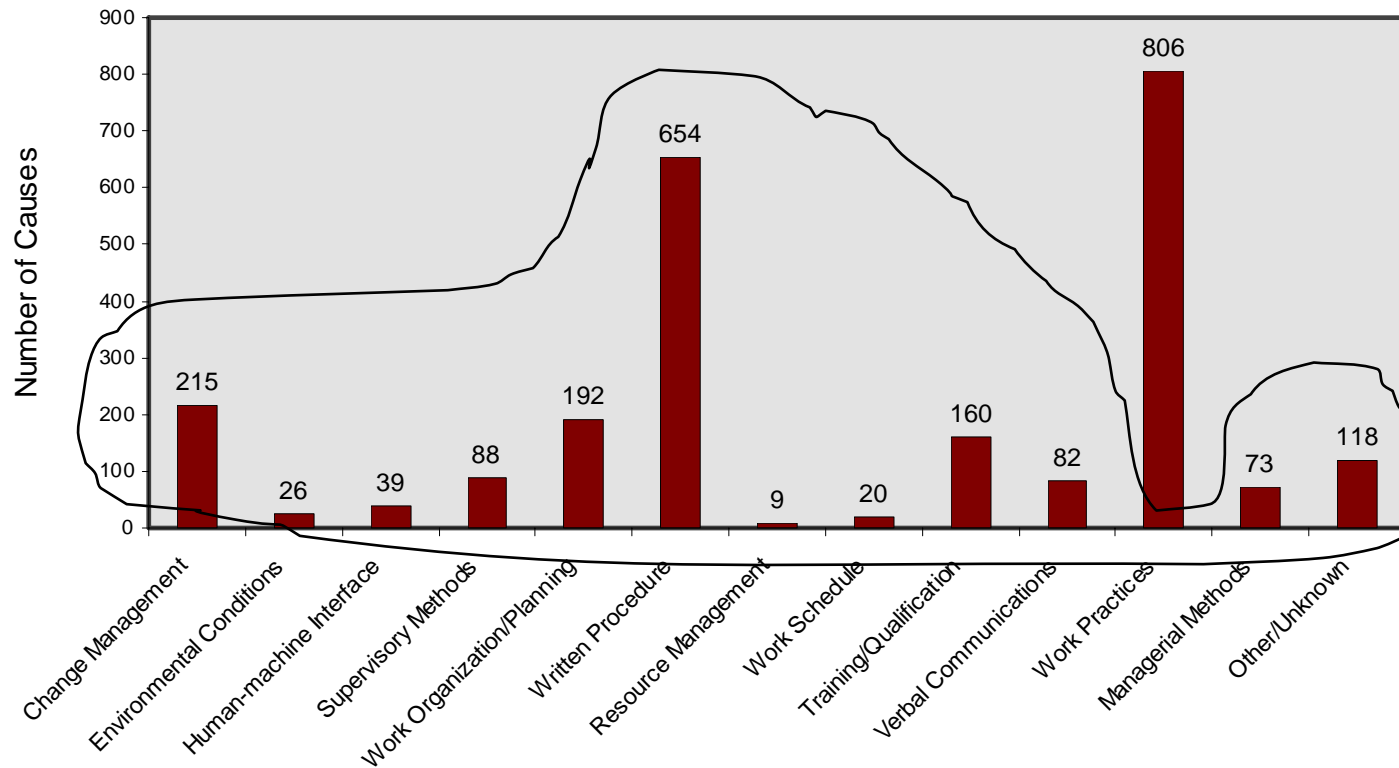
Human Performance

Types of Errors

	Active Errors	Latent Errors
Who?	Workers	Managers, Engineers, Workers
What?	Equipment	Paper, values, and beliefs
When?	Immediate	Later or delayed
Visible?	Yes	No

Industry Event Causes *due to human performance*

1,676 = Org behavior (68%) **806 = Individual behavior (32%)**



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

“Events are not so much the result of error-prone workers as they are the outcome of error-prone tasks and error-prone work environments, which are controlled by the organization”

“No matter how well work is organized, how good procedures are, how well equipment is designed, how good the teamwork, people will never perform better than what the organization will allow.”

Maurino, Reason, Johnston, & Lee. Beyond Aviation Human Factors. 1995

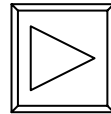
New Paradigm

$$\mathbf{Re} + \mathbf{Md} \rightarrow \mathbf{\emptyset E}$$

[reducing error AND managing defenses leads to zero events]

Individual + organization & processes >>>> Performance Improvement

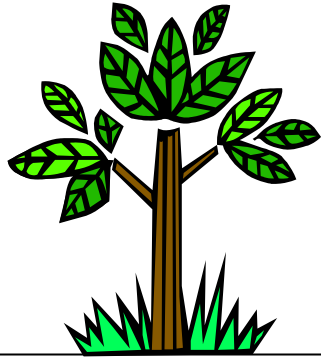
Reducing Errors



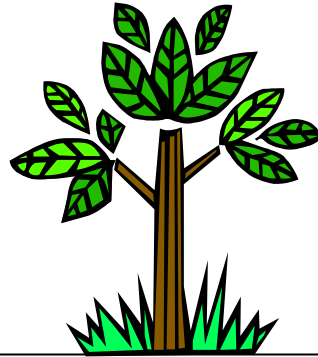
Managing Defenses

Zero Accidents

Drill
into conduit



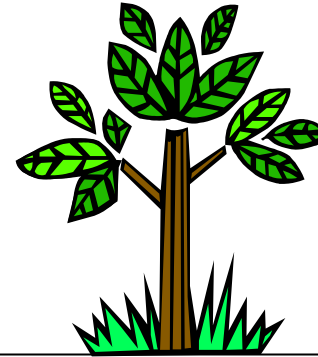
Fire
Hydrant



Electrical
Panel



Back Into
Power Pole



Root
Cause

Changes

Root
Cause

Root
Cause

Root
Cause

Assumptions

Habit Patterns

Interpretation

Time Pressure

Unclear Goals

Stress

Error Precursors

Workarounds

New Technique

Simultaneous

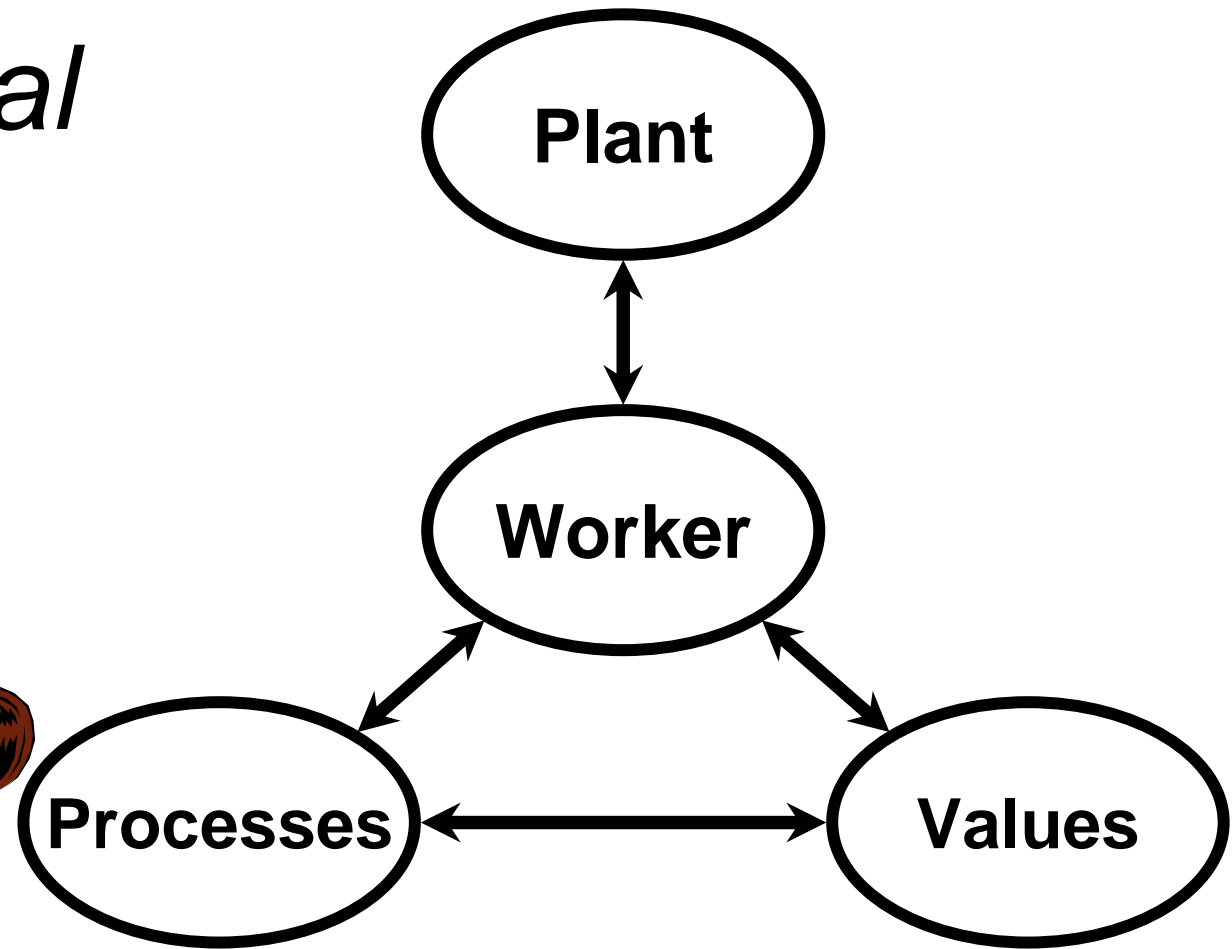
Hidden System Response

Complacency

Repetitive Actions

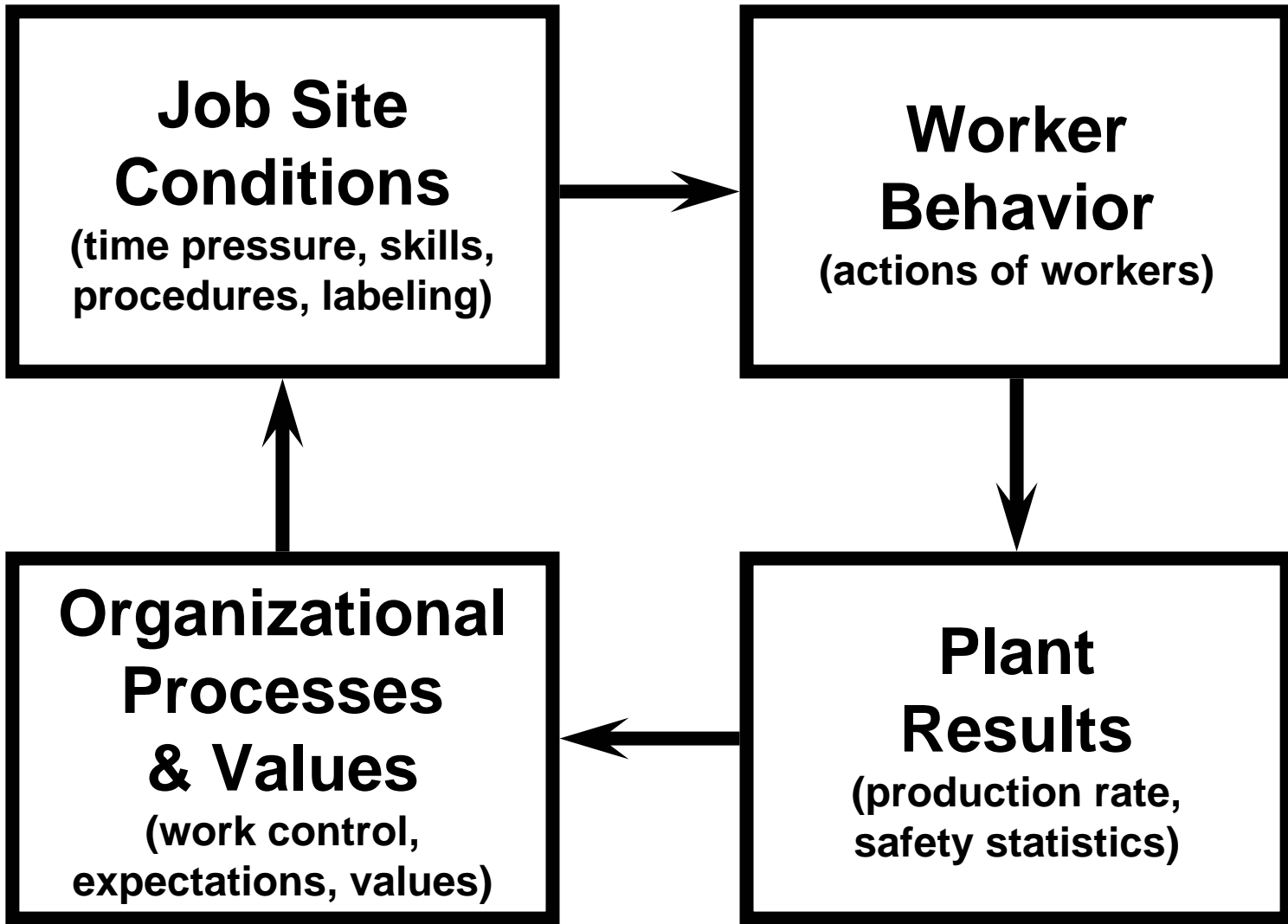
Hazardous Attitude

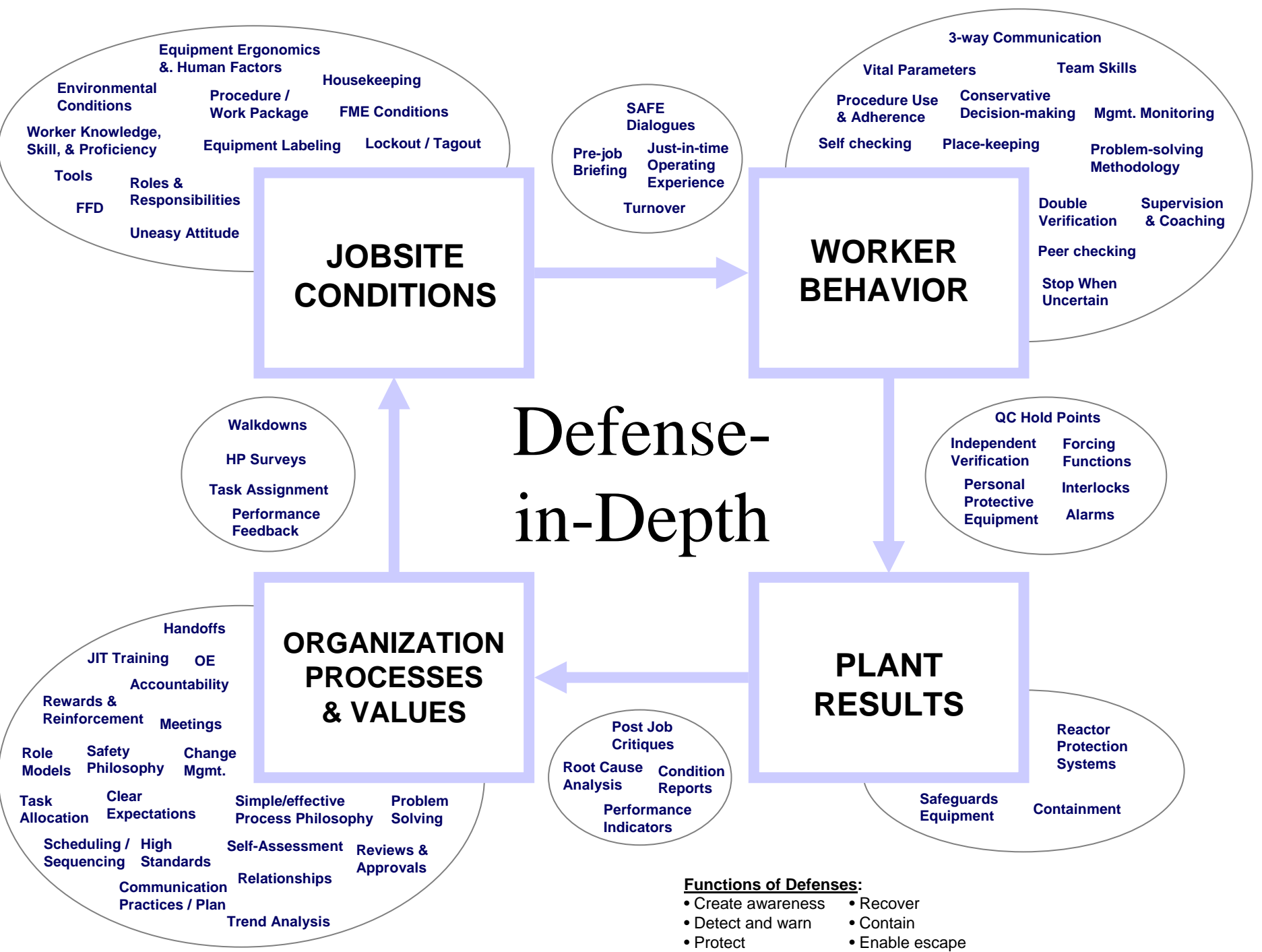
Individual



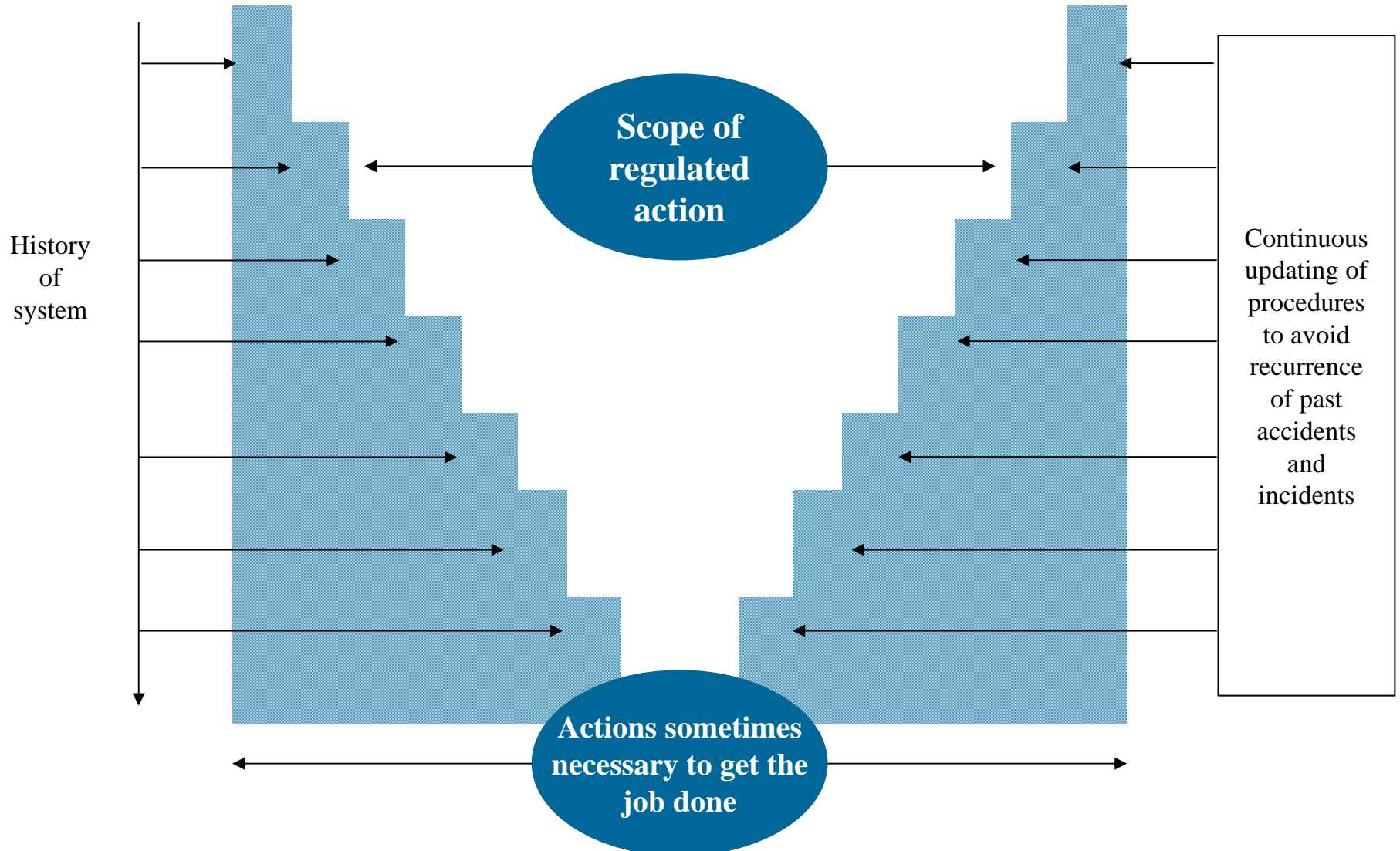
Strategic Framework
for Human Performance

The Performance Model



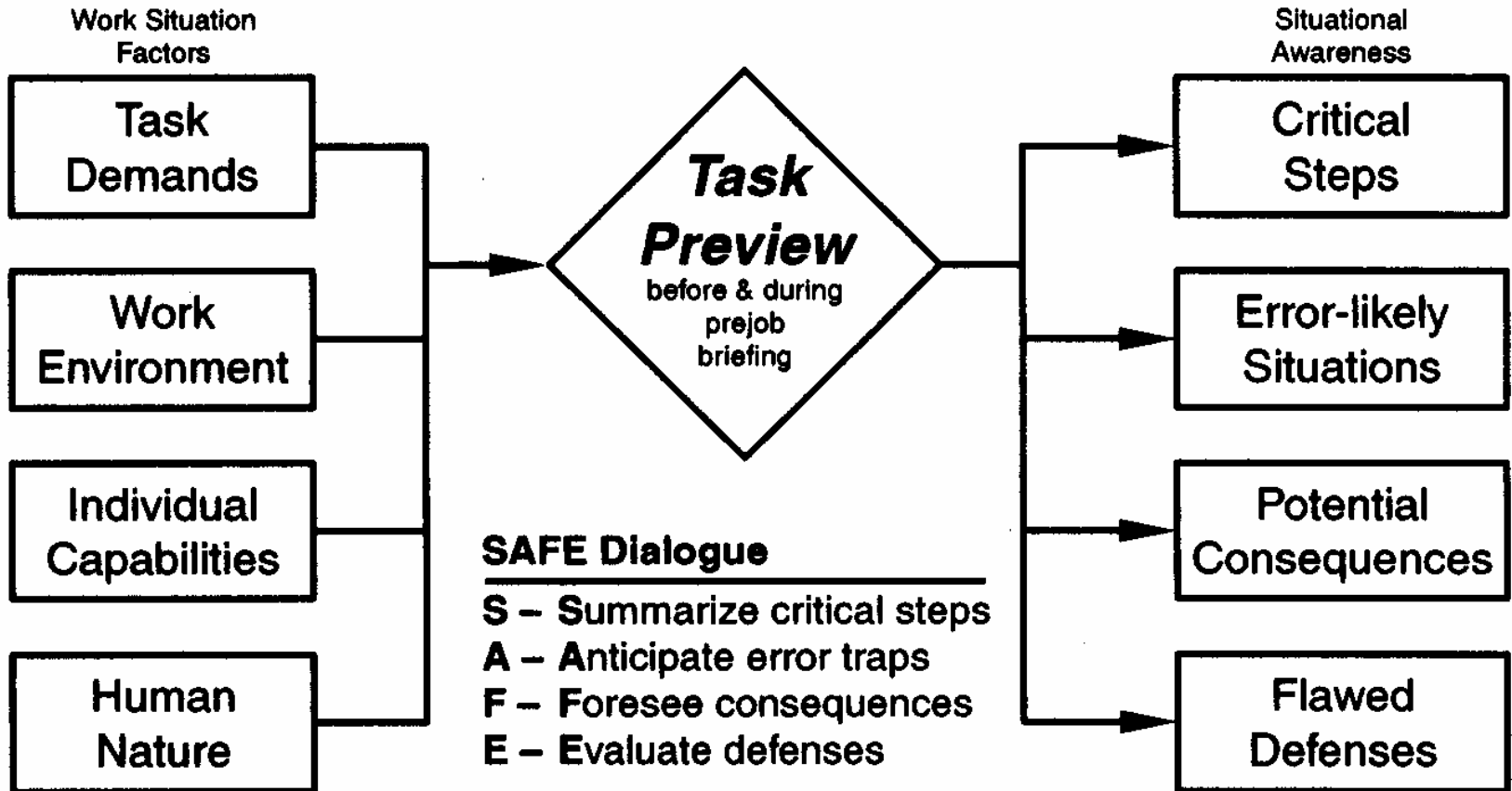


How necessary additional safety procedures reduce the scope of action required to perform tasks effectively

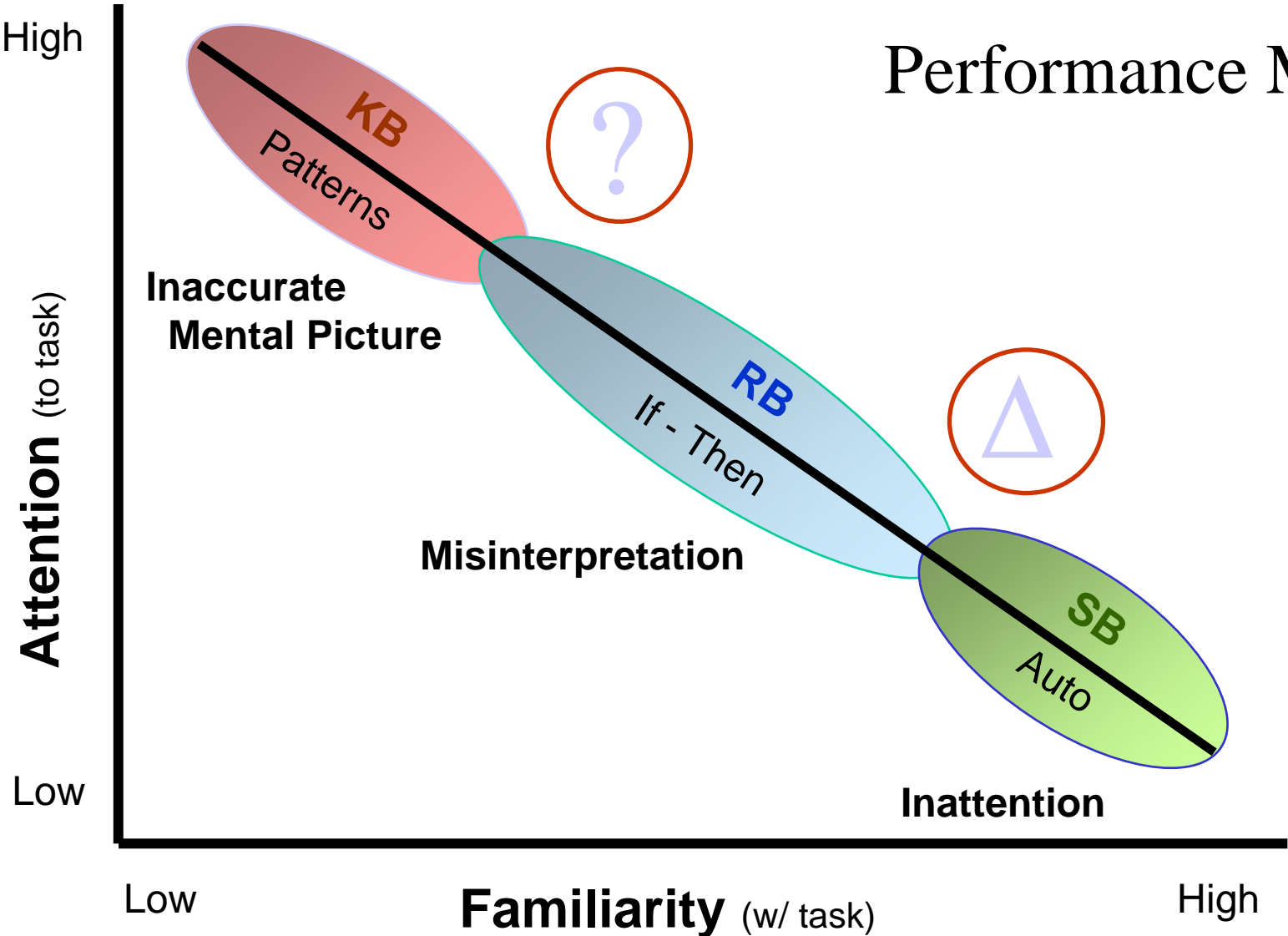


Task Preview

INPO

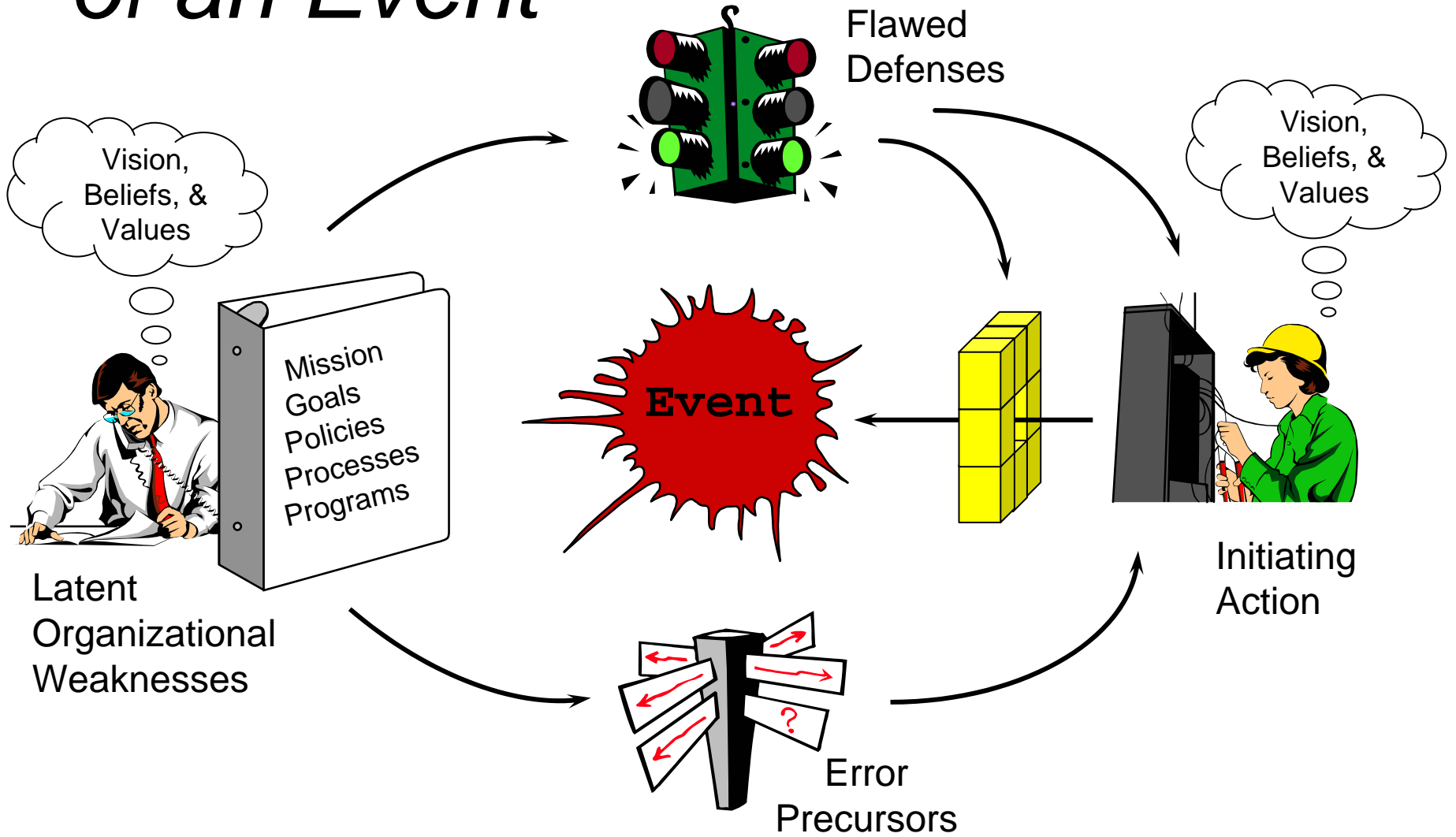


Performance Modes



Source: James Reason. *Managing the Risks of Organizational Accidents*, 1998.

Anatomy of an Event



Error Precursors

short list

Task Demands	Individual Capabilities
• Time pressure (in a hurry)	• Unfamiliarity w/ task / First time
• High Workload (memory requirements)	• Lack of knowledge (mental model)
• Simultaneous, multiple tasks	• New technique not used before
• Repetitive actions, monotonous	• Imprecise communication habits
• Irrecoverable acts	• Lack of proficiency / Inexperience
• Interpretation requirements	• Indistinct problem-solving skills
• Unclear goals, roles, & responsibilities	• “Hazardous” attitude for critical task
• Lack of or unclear standards	• Illness / Fatigue
Work Environment	Human Nature
• Distractions / Interruptions	• Stress (limits attention)
• Changes / Departures from routine	• Habit patterns
• Confusing displays or controls	• Assumptions (inaccurate mental picture)
• Workarounds / OOS instruments	• Complacency / Overconfidence
• Hidden system response	• Mindset (“tuned” to see)
• Unexpected equipment conditions	• Inaccurate risk perception (Pollyanna)
• Lack of alternative indication	• Mental shortcuts (biases)
• Personality conflicts	• Limited short-term memory

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

HU Improvement Plan

Specific Process Improvements

- HU Tools
 - Error Precursors
 - Task Preview
 - Anatomy of Events
 - Defense in Depth
 - Observation/Coaching/Counseling

HU Improvement Plan

Specific Process Improvements

- Work Processes (Proactive)
 - Work Planning
 - Project Planning
 - Pre-job Briefs
 - Work Observation

HU Improvement Plan

Specific Process Improvements

- Event Analysis (Reactive)
 - Critiques
 - Accident Investigations
 - Causal Analyses

Common Indicators at TRA

Task Demands	Individual Capabilities
Time pressure (in a hurry)	Unfamiliar with task/ First time
High workload	Lack of knowledge
Simultaneous, multiple tasks	New technique not used before
Repetitive Actions, monotonous	Imprecise communication habits
Irrecoverable acts	Lack of proficiency/ Inexperience
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Hidden system response	Mindset
Unexpected equipment conditions	Inaccurate risk perception
Lack of alternative indications	Mental shortcuts
Personality conflicts	Limited short-term memory

Event Trend

- Depressurize loop hanging a LO/TO
- Shipped waste box with lead plug to RWMC
- Power not removed from panel accepted to work
- NR-3 Cask Work Control
- GE-2000 Cask Contamination Event
- Overflowed Resin tank
- Troubleshooting LOCS DCS without procedure
- Failure to follow RadCon posting/survey requirements
- Error in CSAP for cycle 130 start-up
- Operated ATRC with wrong Nuclear Instrument

TRA Operational Improvements via Human Performance



- *Primary Mission is Fuels and Material Testing for the Naval Nuclear Propulsion Program.*

- *TRA had approximately **12 occurrence reports in 2002** that had human error as the root cause (ie: Inattention to detail, Not following procedures, Worker error).*
- *TRA Management formed a group to review the general error precursors related to these events and identify the contributing organizational weaknesses.*
- *Utilizing human performance principles, TRA experienced **only 2 events in 2003** where human error was identified as the root cause.*