Safety Management Systems + Human Performance + Engagement + Performance Indicators = Safety Excellence

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History of Evolution of Safety Management Approaches

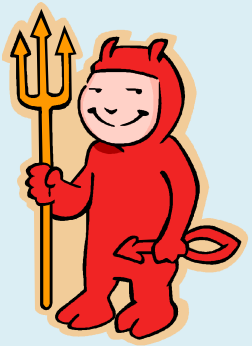
- 1930's to 1970's: Behavior-based and workers' compensation approaches
- 1970's: Regulatory compliance approach
- 1980's: Loss prevention/loss control approach (business case; cost benefit analyses)
- 1990's: Risk/quality management approach
- 2000's: Safety management systems approach
- 2010's: Human performance approach

Question

- Why do you think that this evolution of safety approaches occurred? Why was it needed?

Major Current Approaches to Managing Safety

- **Safety management system approaches**
- **Behavior-based safety approaches (including human performance)**
- **These two approaches are "either-or" propositions for many organizations: are these two approaches friends or foes?**



Safety Management System (SMS) Approaches

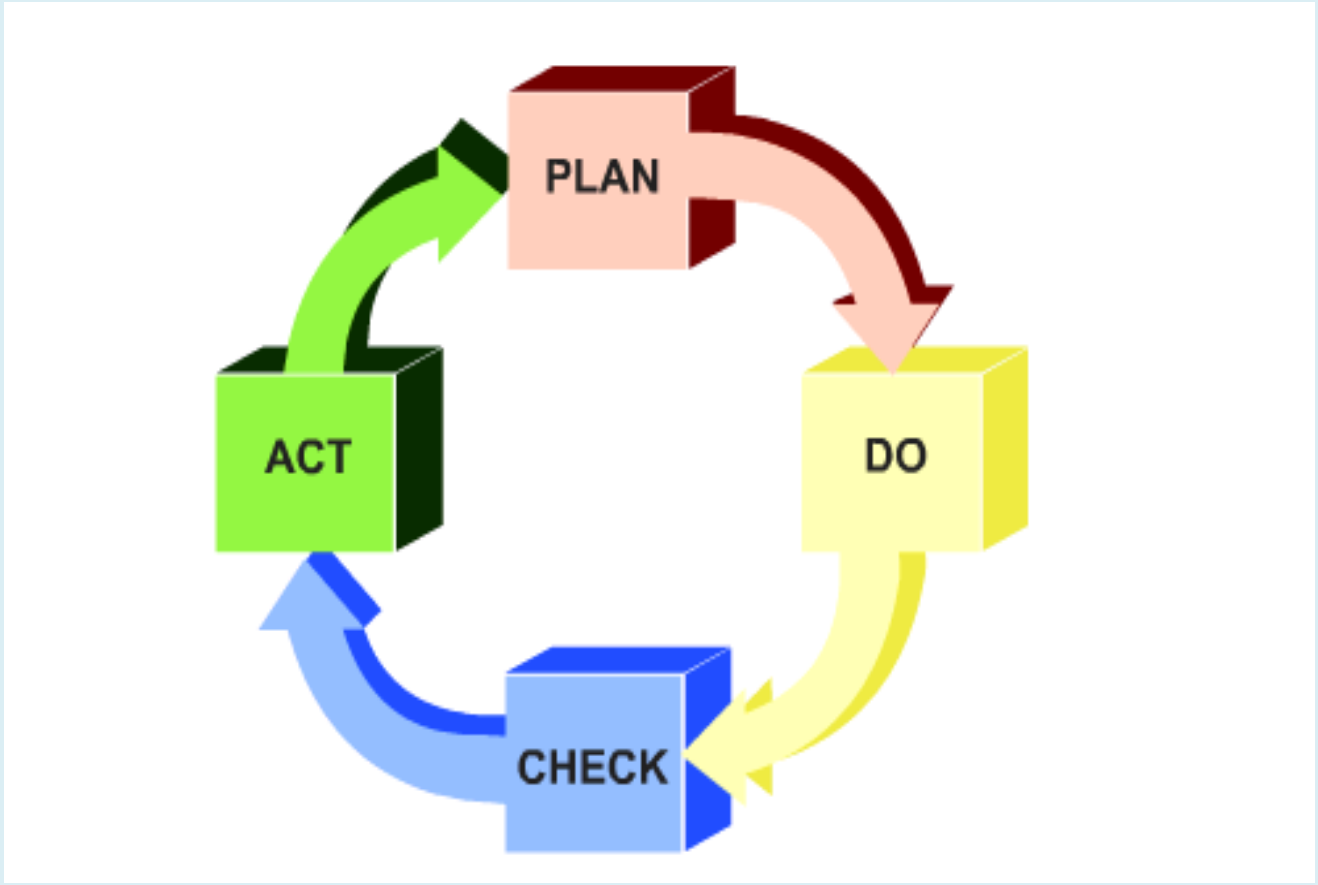
- **Consensus standards:**
  - **OHSAS 18001 (British / International)**
  - **ANSI/AIHA Z-10 (American) consensus standards**
  - Process based; combination of risk management and quality approaches
- **OSHA VPP (American)** (process / performance based)
- **ISO-45001 (International)** (to be released in 2016)
- Consensus standards based on:
  - ISO-9001 Quality Standard
  - ISO-14001 Environmental Management System Standard

Part 1: Safety Management Systems

Consensus Standards based on:

Plan – Do – Check – Act

Continuous Improvement" Cycle



Generic template for a safety management system under PDCA cycle

(1) Lead and commit (management) →

(2) Assess and establish risk/hazard baseline (PLAN) →

(3) Establish policy & set goals, objectives, strategies and tactics (PLAN) to reduce risk→

(4) Implement action plans to achieve/implement goals, objectives, and strategies (DO) to reduce risk →

(5) Review and adjust based on results (CHECK / ACT) →

(6) Lead and commit again in order to plan again in order to reduce more risk again

Sequential and Continual Improvement PROCESS that Reduces Risk

Safety Management System (SMS) Approaches

- **Features of these SMS approaches:**
  - **Mix of quality- and risk-based approaches**
    - **Planning**
    - **Risk identification, analysis, control and reduction**
    - **Operational control**
    - **Corporate directives and processes**
    - **Institutionalization/rigor of processes and systems**
    - **Continual improvement**
  - **You don't necessarily manage toward a bad "outcome" (number of incidents)**
    - **Manage to self-imposed objectives which are largely geared toward implementing a set of actions (e.g., leading indicators) that will (eventually) reduce risk**

First, what is a "quality-based" safety management system?

- **Work is accomplished through processes that are strictly developed, controlled and measured; establish permissible operating boundaries**
- **You keep on measuring your processes (audits, evaluations, assessments) to see if your processes are going "out of bounds" (six sigma); deviations and upsets are bad → perform corrective/preventive action as needed**
- **You get employee input to determine how to improve the processes in terms of quality, safety and efficiency**
- **But management is responsible for these processes; any incident that occurs is not due to the employee but rather this system which is deficient and is controlled by management**

THESE SYSTEM DEFICIENCIES (LATENT ORGANIZATIONAL WEAKNESSES) CAN BE PREDICTED AND DEALT WITH (PREVENTIVE) IF SMS EVALUATIONS ARE CONTINUALLY PERFORMED…AND NOT JUST WHEN A MAJOR INCIDENT HAS OCCURRED (REACTIVE)

What is a "quality-based" safety management system?

- **Quality = safety = productivity**
- **Lean manufacturing**
  - **Elimination of physical "waste" → could lead to environmental improvements/sustainability**
  - **Elimination of "time" waste → could lead to safety issues (increases in stress)**
- **Continual improvement of safety performance, risk reduction, and/or performance control**

What is a safety management system (using definitions in consensus standards)?

APPROACH 1 – Continual Improvement Process

Part of an organization's management system used to develop and implement its safety policy and manage its safety risks (OHSAS 18001)

- **A management system is a set of inter-related elements used to establish policy and objectives and to achieve those objectives**
- **A management system includes:**
  - **organizational structure**
  - **planning activities (including, for example, risk assessment and the setting of objectives)**
  - **responsibilities**
  - **practices, procedures, processes and resources**

What is a safety management system?

- **It is a systematic process that holds management accountable for managing safety through:**
  - **Goal / objective setting**
  - **Defining roles and responsibilities**
  - **Holding individuals accountable for executing their responsibilities within the management system**
  - **Developing proactive performance measures**

What is a safety management system?

APPROACH 2 – Functional Approach

- National Safety Council
- A safety management system is comprised of:
  - **Administrative and management elements**
  - **Operational and technical elements**
  - **Cultural and behavioral elements**

What Is an SMS in the Research Literature?

- **An SMS comprises a set of policies and practices aimed at positively impacting employees' attitudes and behaviors with regards to risk**

Implications of a Safety Management Systems Approach

- Safety is "owned" by all employees and "entrenched" throughout the organization, especially "the line" → safety is not just an organizational safety "staff" box (it can't be delegated to a certain group)
  - Employee involvement is important in defining and implementing the system
- But line management is ultimately responsible for safety performance since it controls the processes

What Are the "Logical" Roles for Safety Professionals under a Safety Management Systems Perspective?

- **Safety Professional is an "upfront" planning resource / consultant / advisor / technical person (not necessarily a "manager")**
  - **But what about crosscutting safety programs?**
    - **Hearing conservation, bloodborne pathogens, respiratory protection, hazard communication, fleet safety, etc.**

Some roles for safety professionals in a safety management system

- Assisting in identifying hazards and recommending hazard controls
- Participating in or leading safety design reviews
- Designing risk matrices for use in determining level of risks for activities
- Participating in incident investigations
- Training managers on SMS
- Reviewing procurements / purchases for risk
- Recommending corrective and preventive actions as a result of audits / evaluations / inspections

What Are the "Logical" Roles for Management under a Safety Management Systems Perspective?

- **Management is the safety program implementing resource → "doer"**
  - **Prevention**
  - **Mitigation**
  - **Decision-making**
- **Management is in the driver's seat; management controls work-related safety programs and processes; <u>decides on what is acceptable risk</u>**

Important Safety Program Practices (lists generated prior to emergence of SMSs)

- **NSC Research Studies in 1967 and 1992**
- **Top ranked safety program practices**
  - **Safety policy**
  - **Assignment of authority, responsibility, accountability**
  - **Development of safe job procedures**
  - **Safety training**
  - **Supervisory enforcement**
  - **Supervisor example**
  - **Management backing**
  - **Integration of safety into the entire process**

The Future Is:
Safety Management Systems!

- There's empirical research out there that suggests safety management systems work to reduce incidents and risk!
- My own research (that will be reported on later) suggests that the presence of a SMS and its components can predict / will reduce incident rates
- The passage of ISO-45001 in 2016 will "institutionalize" the SMS approach on the international stage for ~20 years
  - We are increasingly a global community and require international standards

Part 2: Performance Indicators

Performance Indicators

- Plan → Do → **Check** → Act
- Performance indicators / Performance measures / Performance metrics
- Safety managers often have to select the group of safety performance indicators for the organization
- Effectiveness of the safety manager and the safety program are judged by these indicators → is this right or wrong?

Lagging (Trailing or Reactive) Indicators

- These rates measure “bad things” that have already happened (e.g., injuries; severity of injuries).
- These “after-the fact” or “end-of-the-road” rates include those such as (in the US):
  - OSHA Total Recordable Case Rate (TRC Rate)
  - OSHA Lost Work Day Case Rate (LWC Rate)
  - OSHA Days Away, Restricted, or Transferred Case Rate (DART Case Rate)

Lagging Indicators (positive)

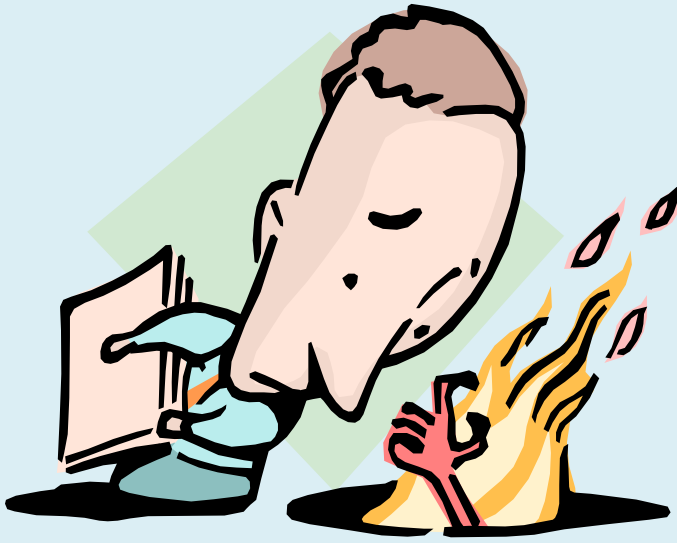
- Provide an overall estimate of the progress required to achieve a vision of “zero harm”
- Results oriented (proof is in the pudding)
- Lagging measures are required by OSHA in the USA
  - OSHA 300 and 300A Forms

Lagging Indicators (negative)

- Do not directly measure the effective implementation of safety programs, proactive action plans and preventative activities in place
- Individuals are not empowered to take control of safety and to develop an effective organizational safety climate → lagging indicators tend to be corporate measures
- **Are not predictive** → past performance does not predict future performance

Rewarding performance based on lagging indicators (e.g., a zillion hours without a safety incident)

- Creates pressure on employees not to report incidents, injuries, near misses or other incidents so as to keep the "record" intact (and get the reward)
- Creates pressure on Safety Manager to “manage” incidents so they would not be listed as recordable incidents
- Incidents could occur through no fault of an employee, so why penalize the employee or work team for such an incident?



Rewarding performance based on lagging indicators

- Failure to report incidents, even minor incidents and **near misses**, defeats the whole purpose of a proactive safety program, which is to generate as much information as possible on trends so that steps can be taken to curb future problems
  - Management has virtually no information on which to base future safety initiatives / decisions

Leading Indicators

- Metrics used to drive performance and are carried out to prevent and control injury, damage or loss → predictive of future performance
- Metrics used to reflect improvements in:
  - **Safety management systems**
  - **Employee behavior / actions**
- Leading indicators can be used to reflect achievement of objectives under a safety management system

Leading Indicators

- Slippages in leading indicators foretell disappointing results
- Provide a basis for early intervention to help ensure that improved performance will be realized

Leading Indicators

- What's the problem with leading indicators?
  - You have to weave a convincing tale linking the indicator with better safety performance
  - You have to tell a credible and non-convoluted story
- Let's discuss.

Good, Average, Bad Leading Indicators

GOOD ONES	AVERAGE ONES	BAD ONES
Corrective action implementation rates	Attendance rates at safety meetings	Number of inspections/evaluations conducted versus planned
Average time to implement corrective measures, etc.	Number of safety communications issued	Number of contacts made with the safety department
Percentage of incidents investigated and corrective action performed	Percentage of incidents investigated	Degree (?) of implementation of site safety action plans
Number of safety suggestions made by employees being implemented	Number of safety suggestions made by employees	Degree (?) of resolution of audit / evaluation / assessment findings
Number of positive rewards and recognition given for safety performance	Percentage of training completed	Percentage of behaviors observed which are "safe"
Number of (lack of) repeat incidents	Percentage of safety surveys completed	Number of near misses reported
Percentage of Job Safety Analyses (JSA) completed for critical jobs	Number volunteering for safety committees	Ratio of near misses to incidents reported

Rewarding performance based on leading indicators

- **Programs designed to reward employees for safety-related <u>behaviors actively evidenced</u> and <u>activities initiated/completed</u>, rather than for corporate <u>results</u>**
- Acts as a form of employee engagement
  - An engaged employee is a better employee
    - Safer employee
    - More productive employee

A REWARD SYSTEM BECOMES LESS IMPORTANT AS SMS CULTURE BECOMES MORE ENGRAINED IN THE ORGANIZATION AND ITS EMPLOYEES

Reality

- **It is probably important to use a mix of leading and lagging indicators to measure overall safety effectiveness and performance**
  - **Combination of programs where the leading indicator component is much more influential than the lagging indicator component**
  - **Can leading indicators be used to predict lagging indicators?**

Developing a Safety Reward and Recognition System (on Leading Indicators)

Need to develop "rules of the game" when developing a reward and recognition system:

Who/what behavior/actions gets rewarded? **How** (the process) does it get rewarded? **When** does the behavior/action get rewarded? **What** is the reward?

BE AS SPECIFIC AS POSSIBLE!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Developing a Safety Reward and Recognition System

WHAT DO YOU REWARD?

- **Reward safe work behaviors** (positive evidence)
- **Reward participation in safety initiatives**
- **Reward performance on leading indicators (or progress in attaining SMS objectives / goals / action plans)**

Developing a Safety Reward and Recognition System

- **RULES OF THE GAME:**
  - THE REWARD SYSTEM IS **FAIR**
    - **EVERYONE** CAN PARTICIPATE IN THE SYSTEM
    - **THE GREATEST DISSATISFIER IN A WORKPLACE IS THE PERCEPTION OF UNFAIRNESS OR INJUSTICE!**
  - THE REWARD SYSTEM IS **DESCRIBED**
  - THE REWARD AND RECOGNITION SYSTEM NARROWLY **FOCUSES** ON THE FEW BEHAVIORS/ACTIONS YOU WANT TO REWARD
  - BEHAVIORS/ACTIONS BEING REWARDED CAN **CHANGE** as needed (BUT NOT TOO MUCH)

Describing a Safety Reward and Recognition System

- Types of rewards / how much?:
  - Money / gift cards
  - Lunch celebration
  - Time off work
  - Recognition in meetings / bulletin boards
  - Combination of corporate-level and individual-level rewards

Developing a Safety Reward and Recognition System

QUESTION TO PONDER?

How does this reward and recognition system improve the safety management system?

Part 3: Traditional Behavior-Based Safety Programs

Why be concerned with behavioral aspects of safety?

NSC estimates that approximately 85% of incidents are related to unsafe acts (behaviors)

So key to reducing the a large percentage of incidents is to change behaviors so they are safe

The Traditional Behavior-Based Safety Approach (Psychology)

Identification / Management of Overt Behaviors

Employees themselves:

- Decide what critical behaviors to observe
- Conduct regular behavioral observations
- Deliver one-on-one feedback sessions with fellow employees
- Calculate daily percentages of safe behaviors in observed work areas
- Post the group data in conspicuous locations

Approach works via peer pressure + employee feedback (and feedback is a consequence)

ABC Model / Analysis

- **Designing Interventions: ABC model**
  - A for **Antecedent**
  - B for **Behavior**
  - C for **Consequence**
- **A powerful tool for:**
  - Understanding behavior
  - Getting to root causes (important)
  - Confirming effectiveness of improvement plan

ABC Analysis

- Antecedent (trigger)
- Behavior
- Consequence

- Telephone rings
- Answer phone
- Talk to caller

CONSEQUENCES
CONTROL BEHAVIOR

ANTECEDENTS
INFLUENCE BEHAVIOR TO THE EXTENT THEY ACCURATELY PREDICT CONSEQUENCES

Three factors that affect consequences

- **TIMING**
  - **SOONER / LATER**
- **CONSISTENCY**
  - **CERTAIN / UNCERTAIN**
- **OUTCOME**
  - **POSITIVE / NEGATIVE**

One powerful way of influencing behavior is feedback

- Feedback is information about performance in relation to a goal
- **Feedback is a consequence → this is why many believe that behavior-based programs work**

"Fixing" Mechanisms to Unsafe Behavior

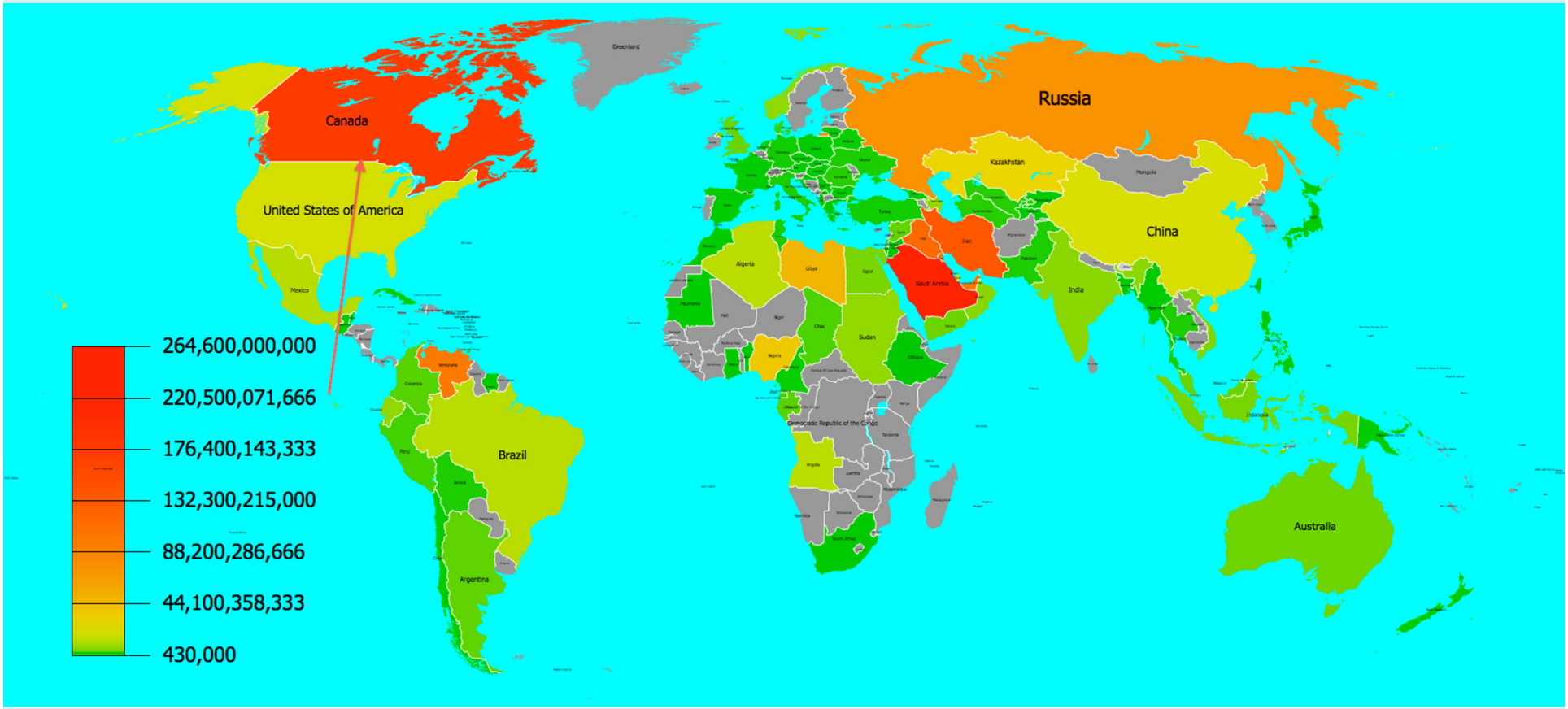
- Adding antecedents and positive consequences (for safe behaviors)
- Eliminating antecedents and positive consequences (for unsafe behaviors)
- **REMOVING BARRIERS (SYSTEM DEFICIENCIES) FOR SAFE BEHAVIOR**
  - Only way to IMPACT difficult behaviors
  - Used to modify, add and eliminate ANTECEDENTS and CONSEQUENCES

Keys to Removing Barriers

- *The staying power of behavior-based safety programs can be no greater than its effectiveness at removing the systems barriers to behaving safely*
- *Why do employees behave like they do in unsafe ways?*
  - ***Because almost always:***
    - ***Management behavior***
    - ***Flaws in management systems***
    - ***Presence of organizational barriers***
    - ***Presence of organizationally caused error precursors***

    are molding / influencing / directing employees' unsafe behavior

Part 4: Safety Management Systems: Different World Views → Human Performance Approach



System Optimization World View

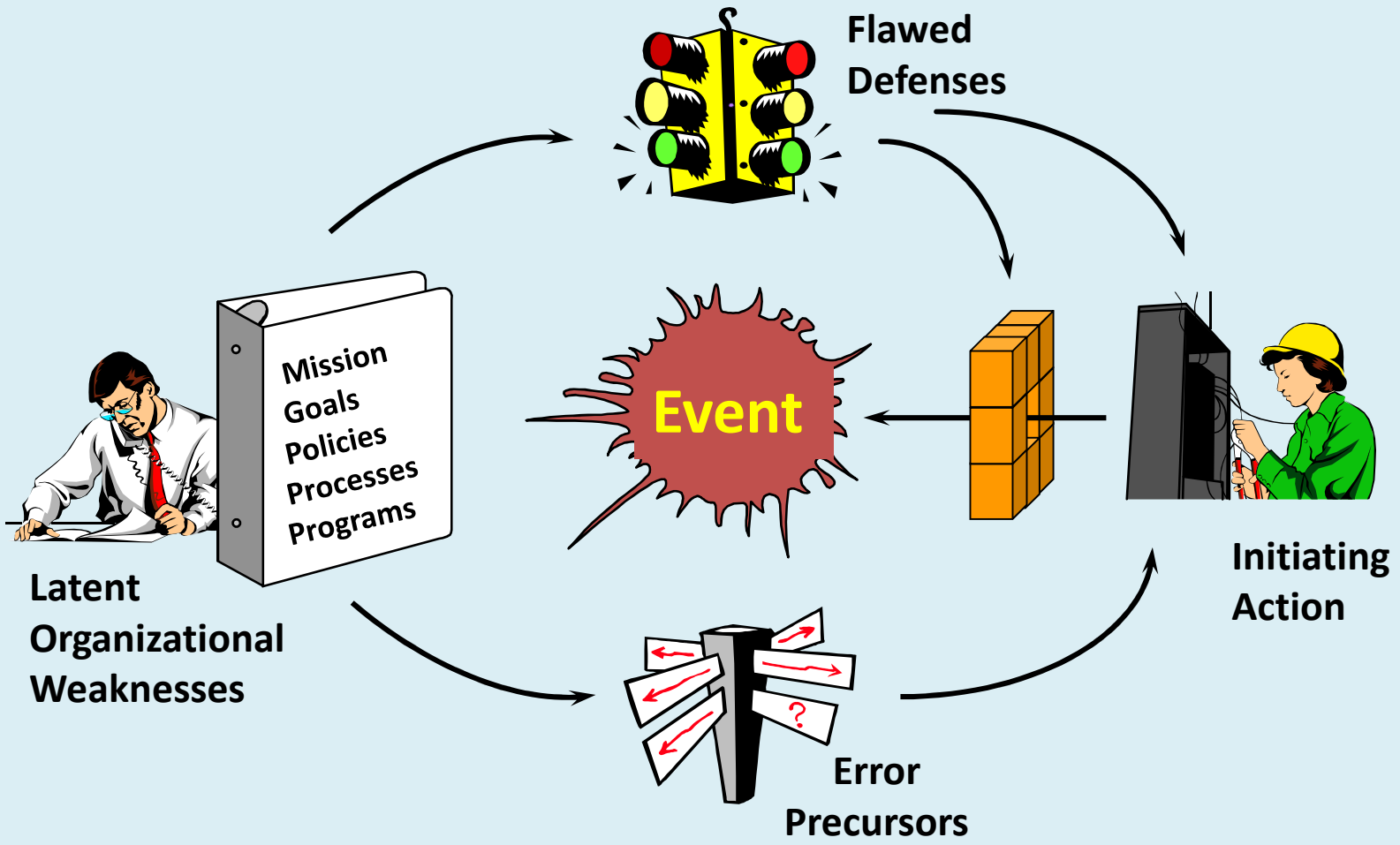
(Todd Conklin)

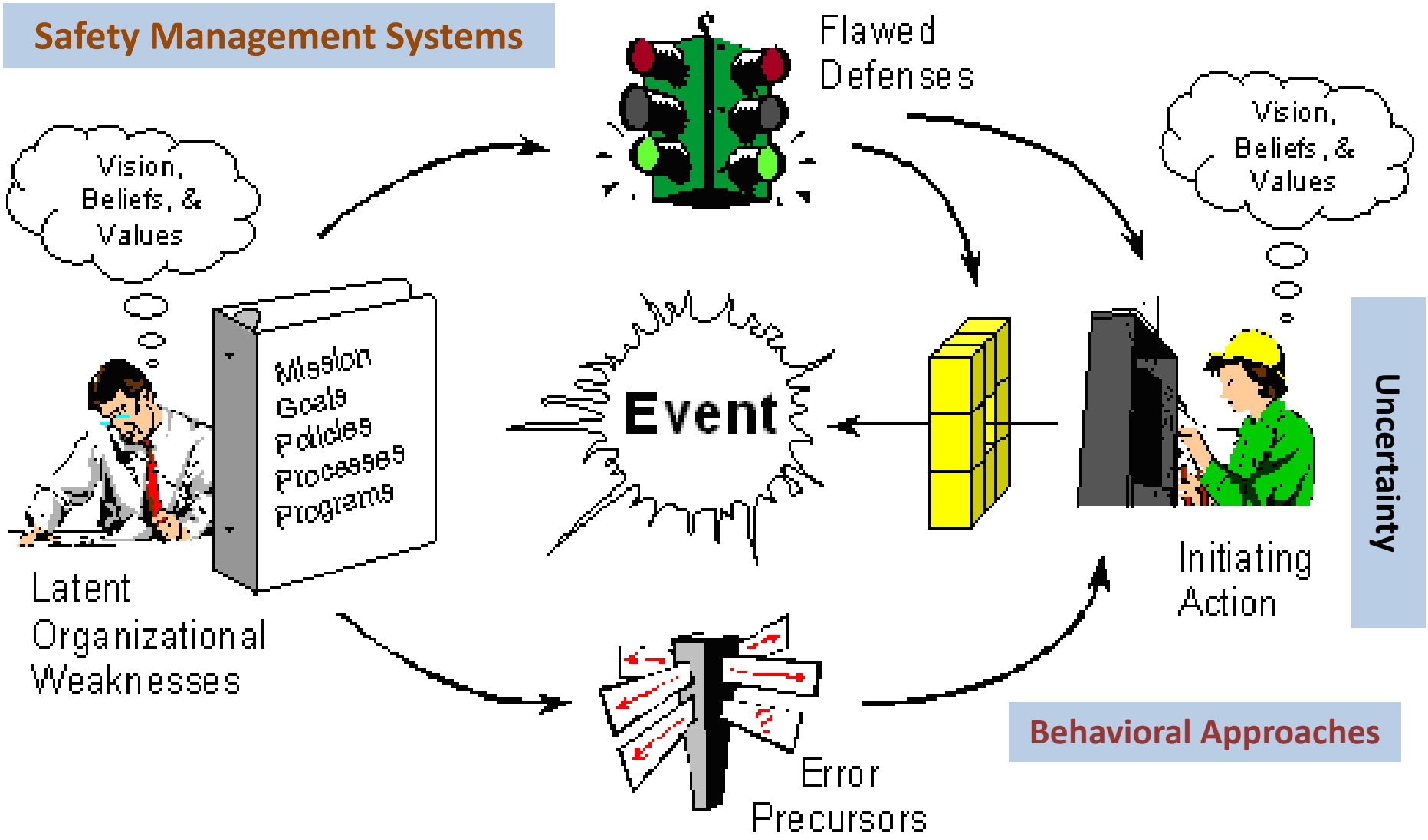
- **Things go right because:**
  - Safety management systems are well designed and maintained
  - Designers can foresee and anticipate contingency
  - Procedures are complete and correct
  - People behave as they are expected to — as they are taught
- **Therefore, humans are probably a liability and performance variability is a real threat.**
- **Legacy of the "quality" aspects of SMSs**

Problem?

- **Safety management systems will always be flawed**:
  - you can't plan and control to such a flawless degree that is practical / economical
  - these systems tend to be rather inflexible, while work is adaptive / uncertain
  - flawed people develop and implement these flawed systems

Anatomy of an Event





Anatomy of an Event from a Human Performance Perspective (adapted from U.S. Department of Energy)

System Realism World View

(Todd Conklin)

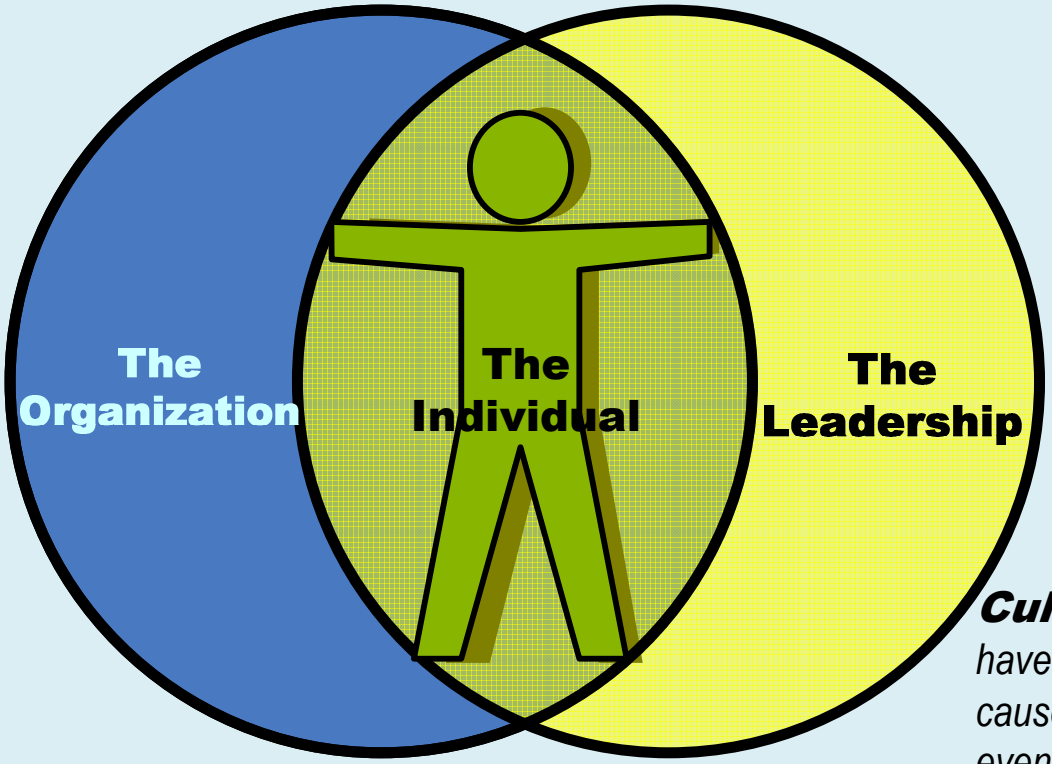
- **Things go right because employees:**
  - Learn to overcome design flaws and functional glitches.
  - Adapt their performance to meet demands.
  - Interpret and apply procedures to match conditions.
  - Can detect and correct when things go wrong.
  - Understand error prone situations and defend against them.
- **Therefore, humans are an asset without which the proper functioning of the systems would be impossible.**
- **System realism world view is synergistic with the human performance approach to safety management.**

Human Performance:
The Center of Any Safety Management System

Human Performance in a Nutshell

► *The Human Performance Perspective* ◄

The Organization: People will never perform better than what the organization "enables."



The Leadership: Sets the expectations (i.e., culture for human ***performance***)

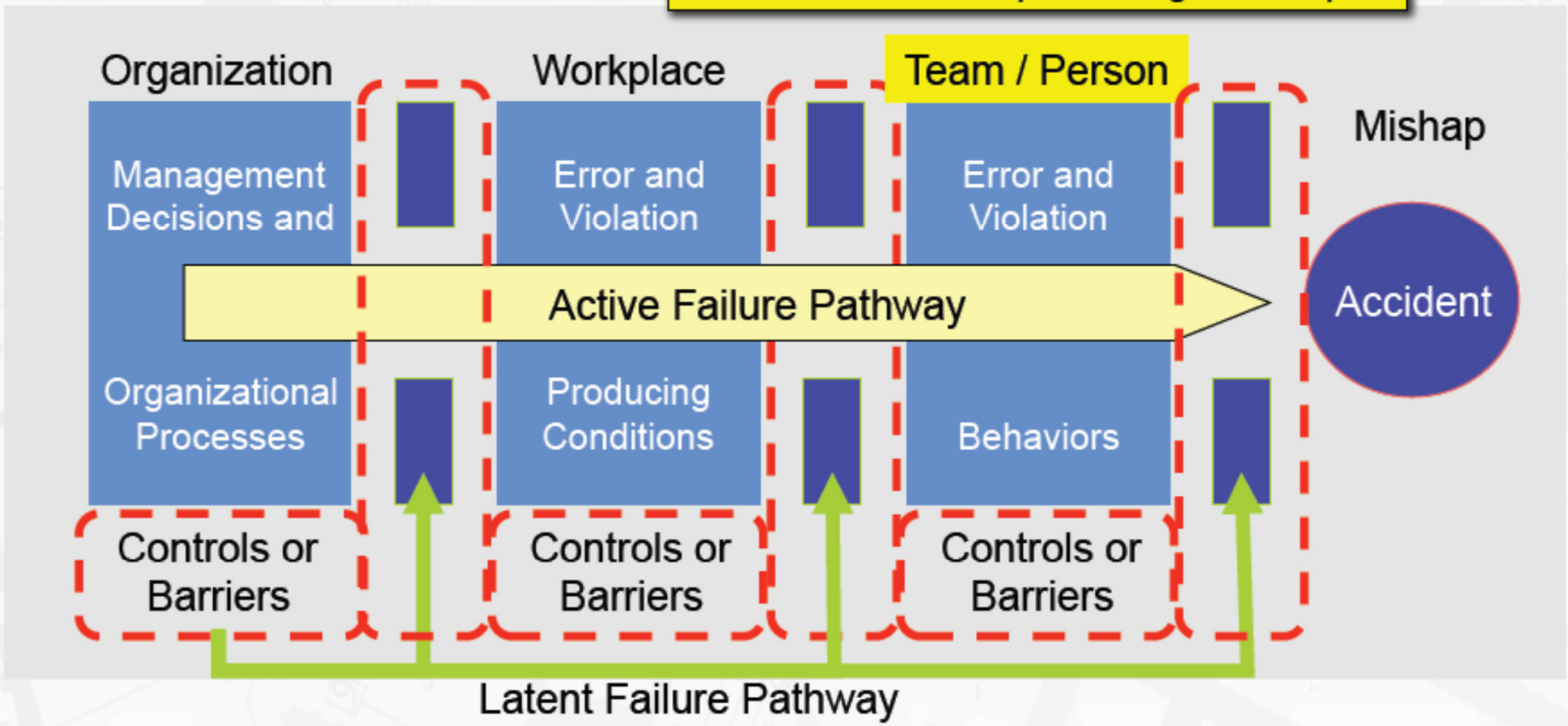
Culture & ***Leadership*** *have been identified as root causes in every catastrophic event over the past 25 years.*

Dr. Tom Krause, BST

The Individual: Stuck in the middle...
If a system relies on people doing the right thing every time, it will fail.

Part 5: Frameworks for Controlling Incidents from Safety Management System and Human Performance Perspectives

Human performance is often seen as the final barrier in preventing a mishap



Soft Defenses:	Procedural, e.g. regulation, surveillance, audit, procedures, licensing, drills, briefings, front-line operations monitoring
Hard Defenses:	Technical solutions and devices, such as barriers, lock-outs, alarms, NDT, PPE, and crumple zones

Source: J. Reason, A systems approach to organizational error, Ergonomics; the official publication of the Ergonomics Research Society, 1995

Strategic Approach to Hu

$$R_e + M_d \rightarrow \emptyset E$$

Reducing error ***and*** *Managing defenses* *leads to* **ZERO** *Events*

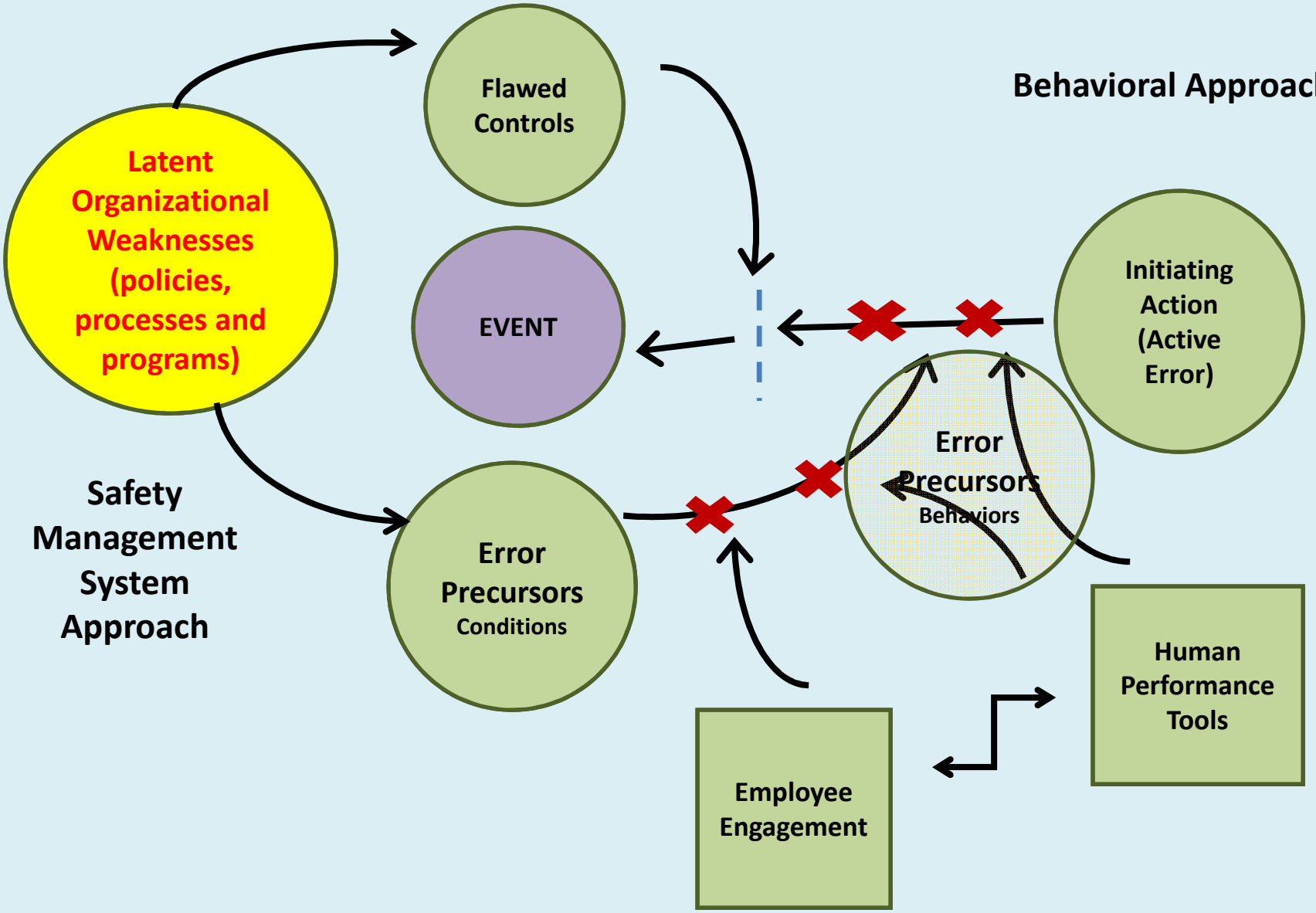
Identify
Analyze
Correct

INPO®

Two Approaches to Human Error

- **The Person Approach**
  - Focuses on ***errors*** of individuals, ***blaming*** them for forgetfulness, and poor attitude, and risk taking
  - Controls focus on reducing unwanted variability in ***behavior***
  - Errors are seen as ***human failures***
- **The Systems Approach**
  - Focuses on conditions under which individuals work and tries to build ***defenses*** to prevent errors or to moderate their effects
  - Controls focus on ***ensuring*** adequate ***barriers*** (i.e., lines of defense) are in place and removing error provoking factors
  - Errors are seen as an ***organizational / system based failures***

Framework for Controlling an Event from a Human Performance Perspective



Latent Organizational Weaknesses: Barriers

(Sam Gualardo, OSHA Consultation Office)

"Organizational Barriers"…*are not* typical *unsafe worker actions or unsafe workplace conditions…*

those are merely symptoms of organizational barriers

To achieve safety excellence, you *must look beyond the obvious and challenge the "organizational barriers"* that influence your safety culture or safety management system

Human Error…

found at the core of most incidents…

is a symptom of a much bigger problem

It is not a root cause…but merely the starting point of an investigation!

Presence of Barriers

All of the barriers that will be described are not found in any one organization...

but just one or two may cause a very significant negative impact on safety performance !

Some of the
"Organizational Barriers"

Production Output
Barriers

- Unregulated production output re:
  - *quantity of work…chocolate bars*
  - *pace of work…mattress delivery and coal trucks*
- Overselling the production capacity of the organization …*causing severe labor and facility constraints*
- Unrealistic production goals*…increases without added resources*
- Organizational incentives to entice risk taking

Customer Driven
Barriers

- A *"just say yes" customer* mindset
- Satisfying long accepted *customer expectations* e.g. *utilities, pizza delivery*
- At risk worker scenarios *…Black Friday*
- Unrealistic customer expectations*…causing*
  - Organizational *deadline pressures*
  - Unrealistic *work force expectations*
  - Unrealistic *product manufacturing, handling and delivery specifications*

Contractor Barriers

- A *"hands off"* mentality
  - *No minimum labor or safety standards set*
  - *No oversight…Apple's contract workers*
- *Creating incentives* to entice *worker* or *organizational* risk taking…
  - Low bid contracts
  - Heavy completion *delay penalties*
  - Large early completion *bonuses*

Fatigue
Barriers

- Overtaxing worker capabilities
  - *Inadequate work / rest regiments…bus drivers, pilots and young doctors*
  - *Excessive physical demands…migrant workers, hotel maids*
- *Excessive* or *uncontrolled* overtime
- Closely timed work … *package delivery*
- Erratic work schedules, e.g. *swing shifts… AT controllers*
- Secondary worker employment … *fatigue…Seniors w/ 3 jobs*
- Unrealistic policies *e.g. absenteeism…Buffalo Colgan crash*

Staffing
Barriers

- Hiring freezes…*short staffing*
- Increasing efficiency *…LEAN…resulting in less workers to do the work*
- Replacing experienced workers *w/less experienced*
- Assigning young workers to high risk tasks
- Pairing unfamiliar workers in *critical tasks…e.g. pilots*
- Job bidding and bumping *w/o proper training*
- Replacing leadership…*too often*
- Not replacing *"good ole boys"*
- Widening spans of control
- Excessive turnover causing a loss of institutional knowledge
- Failure to hire EHS professionals or… *slotting anyone into EHS position*

.

Financial Barriers

- *Underfunding* of budgets
- *Mindless* budget reductions… *firehouses*
  - *operating, PM, capital improvement and EHS*
- Exposing workers to inferior facilities, tools, equipment, work space, processes… *Massey Energy*
- Economic downturns causing… *cuts in safety, training*
- Obsessive focus… *on the bottom line…BP*
- Using Cost Benefit Analysis… *to (non) justify safety expenditures and decisions…Ford Pinto*

Role Alignment
Barriers

- Managers/supervisors *disengaged from EHS ownership*
- Managerial EHS roles
  - *undefined, unclear, unaccepted or poorly executed*
- Worker and workplace safety *is perceived* as the responsibility of the EHS staff
- EHS staff performing line management functions… *by default*

Other Barriers

- Accountability barriers
- Overconfidence barriers
- Political barriers
- Risk acceptance barriers
- Ethical barriers
- Psychological barriers
- Cultural barriers
- Communication barriers
- Goal conflict barriers
- Training barriers
- Performance measurement barriers
- Performance recognition barriers
- Cost ownership barriers
- Worker self-imposed barriers
- Focus barriers
- Management ignorance barriers

Overcoming
the
Organizational Barriers

Roles

What are the roles of safety professionals re: these barriers?

Two Options

1. Do nothing… *and ignore these issues exist*
2. Do your job…*and assure people, property and the environment are protected !*

The Path Forward

All roads lead to senior management… *most of these barriers cannot be overcome at other organizational levels !*

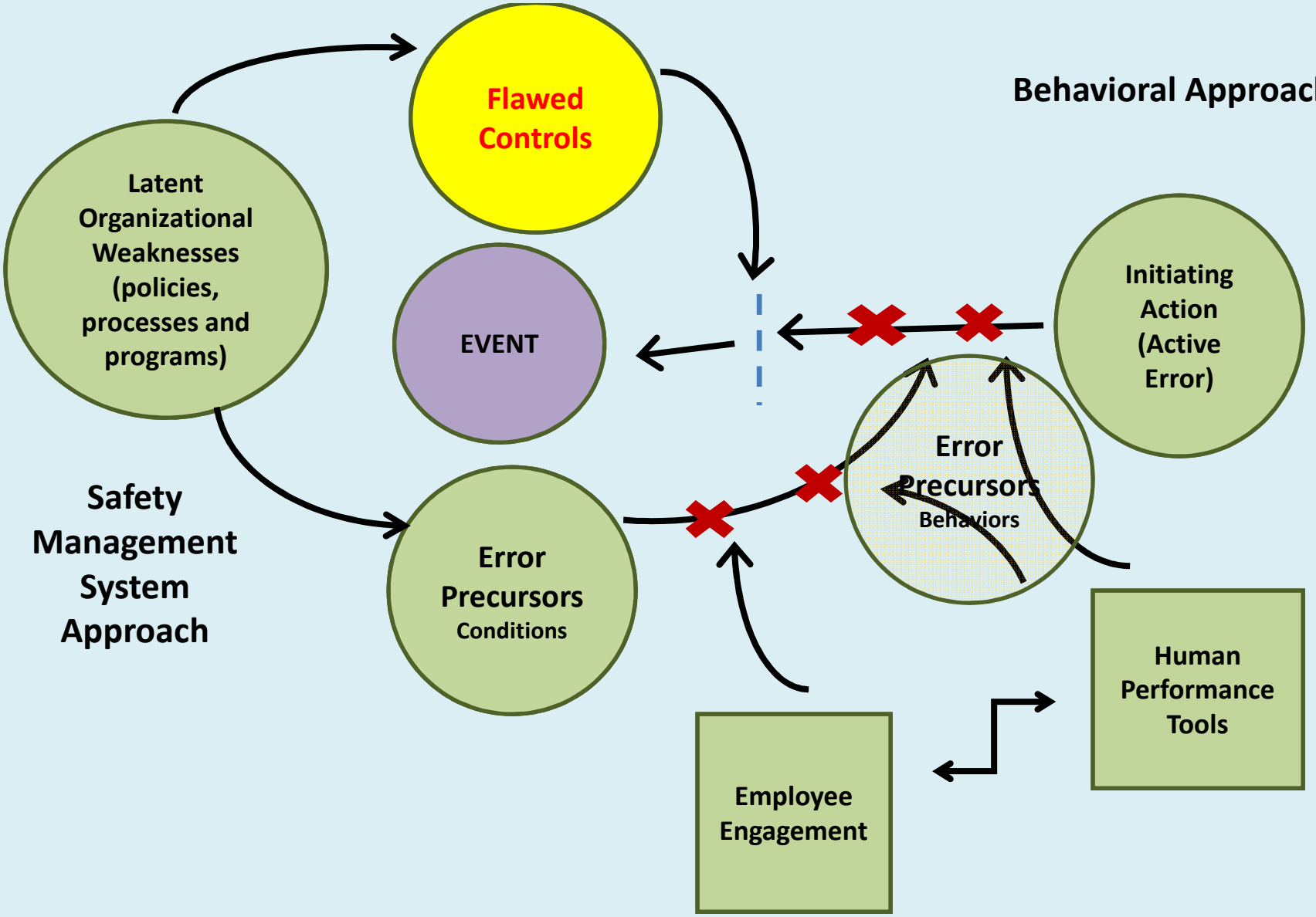
The Path Forward

It is critical for Safety Professionals to be aware of and raise these issues… to the decision makers…the senior leaders !

If you don't…nobody else will!

Safety Professionals: Information Disseminators (perhaps their most critical role)

Framework for Controlling an Event from a Human Performance Perspective



Layers of Protection Guidelines

Uncontrolled	Marginal	Controlled
0-1 Administrative LOP and no other LOP	1 Admin LOP + 1 Warning Device LOP	Marginal Risk + 1 Additional LOP + Routine Compliance Auditing
	or	**or**
	1 Admin LOP + 1 Safety Device LOP	5 Admin LOPs that involve "another set of eyes": a + b + c + d + f, or g + Routine Compliance Auditing
	or	
	1 Admin LOP + 1 Additional Admin LOP that involves "another set of eyes": b, or f, or g	**All controlled (acceptable) LOPs must be verified**

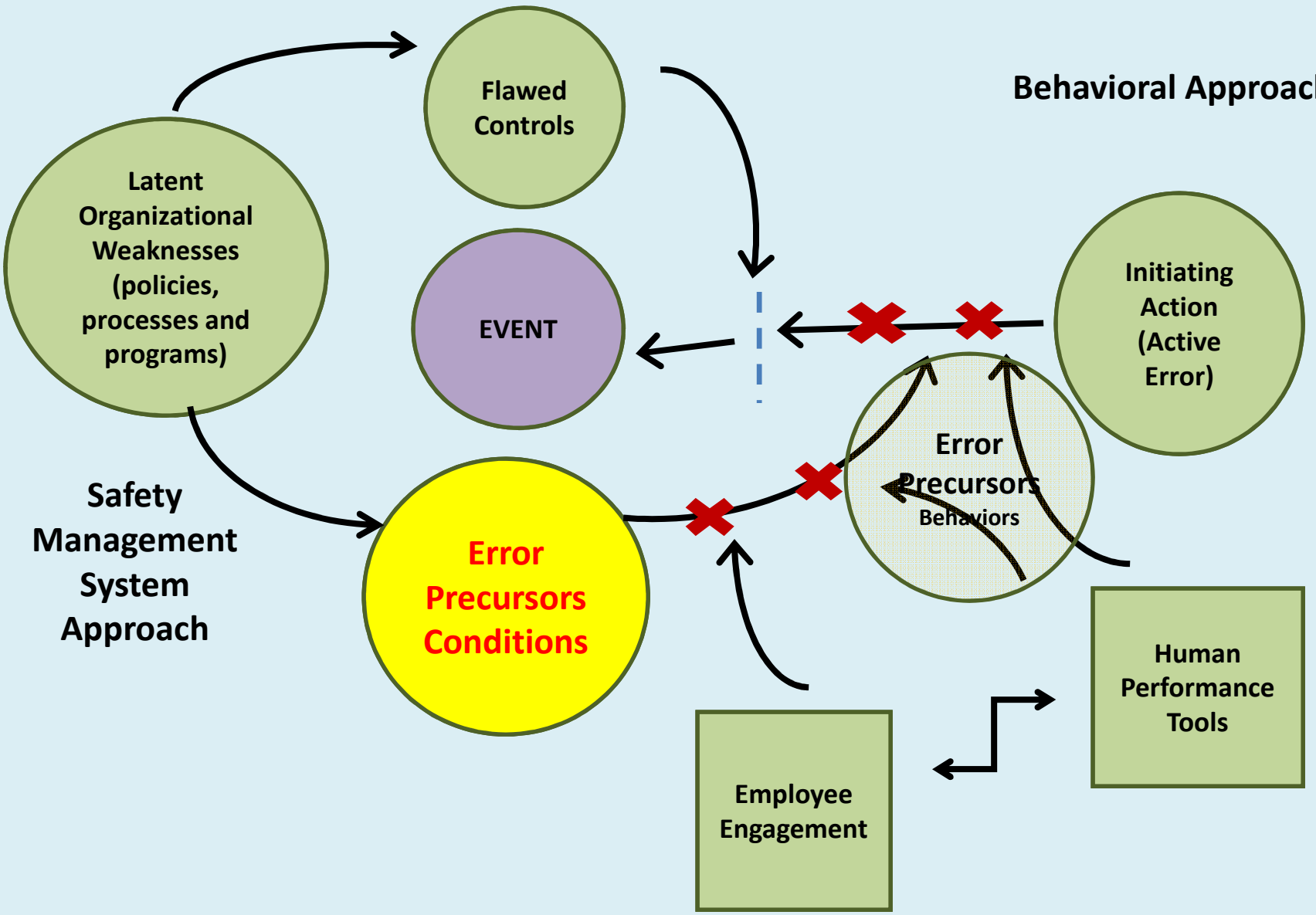
Administrative LOPs:
a) Written procedures,
b) Pre-job Assessment involving multiple people,
c) Training,
d) Task Specific Personal Protective Equipment,
e) Isolation/Distance - limit time of exposure or increase distance,
f) Inspection process/Observation/Auditing at time of task,
g) Dedicated Spotter for task: example Confined Space Observer (Observer for duration of job),
h) Emergency response equipment - showers/eyewash/DAP

Warning Devices LOPs:
Alarms,
Sensing devices,
Signs,
Barricade Tape,
Backup Camera

Safety Devices LOPs:
Physical barriers,
Machine guards,
Relief valves,
Interlocks,
Check valves

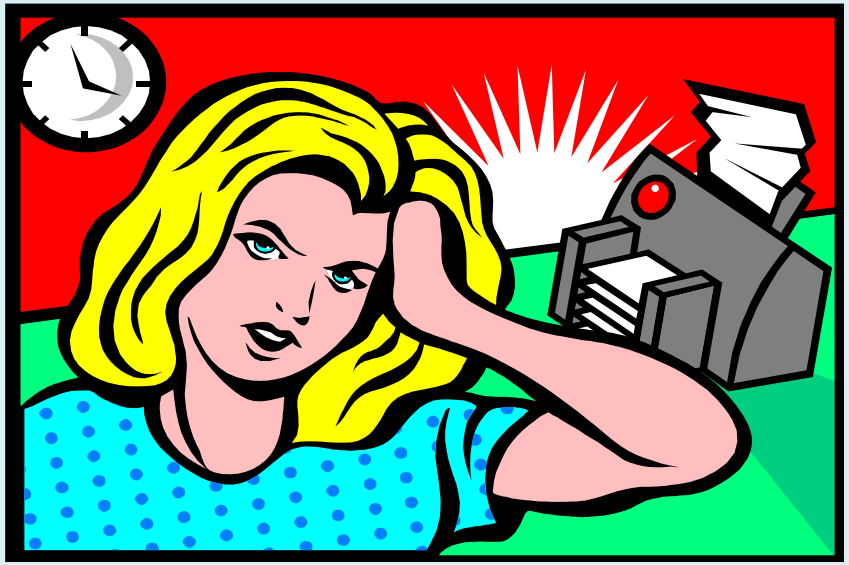
Design LOPs:
Engineering Solutions

Framework for Controlling an Event from a Human Performance Perspective



What Are Error Precursors?

An unfavorable condition that increases the *probability for error during a specific action*



Typical Error Precursors Found in the Workplace – (Unsafe) Conditions

Task Demands	*Environment*
Time pressure; high workload pressure; mental pressure	Distractions and interruptions
Simultaneous, multiple actions; multi-tasking	Changes and departures from routine
Requirements for interpreting information and procedures; vague procedures	Confusing controls and displays
Unclear goals, roles, or responsibilities; lack of clear standards; vague or imprecise work guidance; conflicting information	Unexpected equipment conditions or performance
Repetitive or monotonous actions	Environmental factors such as noise, temperature and lighting
End of shift work; last shift before holiday; first shift back from holiday	

Typical Error Precursors Found in the Workplace – (Unsafe) Behaviors

Individual Cognitive Characteristics (Employee Specific)	*Individual Capabilities and Skills (Employee Specific)*
Assumptions, dispositions and habits	Unfamiliarity with task / first time or non-routine or infrequent task
Overconfidence	New techniques not used before
Mental short cuts or biases	Lack of knowledge, proficiency or experience
Limited short-term memory	Poor communication or problem-solving skills
Inaccurate risk perception	Illness or fatigue; general poor health or injury
Unsafe attitudes	Inability to handle stress

Correlations between the Presence of Reported Error Precursors and Near Misses, First Aid Injuries and Injuries Beyond First Aid

Measure. At work….	Near Misses	First Aid Events	Beyond First Aid Events
there are **time pressures**. I feel rushed.	+	+	+
there are **mental pressures**. I find it difficult to concentrate.	+	+	+
I conduct many **non-routine tasks**.	+	+	+
I conduct many **new / unfamiliar tasks**.	+	+	+
I typically have a **high workload**.	+	+	+
I typically **multi-task** – doing many different things at the same time.	+	+	+
I receive work **guidance which is at times vague or imprecise.**	+	+	+
there are many **distractions** around me.	+	+	+
there is **low likelihood of detecting a violation of safety rules**.	+	+	+
safety requirements are **very inconvenient to comply with**.	+	+	+

Note: * p <.05: indicates of a strong correlation

Error Susceptibility: Modes of Performance / Errors

- **Skill-based performance**
  - Repetitive work; automatic work
  - Error rate: 1:1000
  - Skill-based errors: account for 25% of human errors
  - Error: Slip/lapse; inattention
- **Rule-based performance**
  - If/then work
  - Error rate: 1:100
  - Rule-based errors: account for 60% of human errors
  - Error: Misinterpretation; failure of expertise mistake
- **Knowledge-based performance**
  - Uncertain work in which few rules or innate skills address issues; pattern work
  - Error rate: 1:2 to 1:10
  - Knowledge-based errors: account for 15% of human errors
  - Error: Inaccurate mental picture; lack of expertise mistake

Employee Survey Results on Performance Modes Used by Employees in Error-Prone Situations

Number of employees responding to this inquiry was 2,262

Question: When I am confronted with really abnormal conditions or unusual situations, my strongest tendency is to do which of the following:	**Percent Response**
SKILL-BASED MODE: I stop work and seek guidance as to how to proceed.	**45%**
RULE-BASED MODE: I apply rules, procedures, and protocols and use them as guidance as to how to proceed.	**31%**
KNOWLEDGE-BASED MODE: I draw upon my own existing knowledge and use it as guidance as to how to proceed (e.g., thinking things through on the spot).	**24%**

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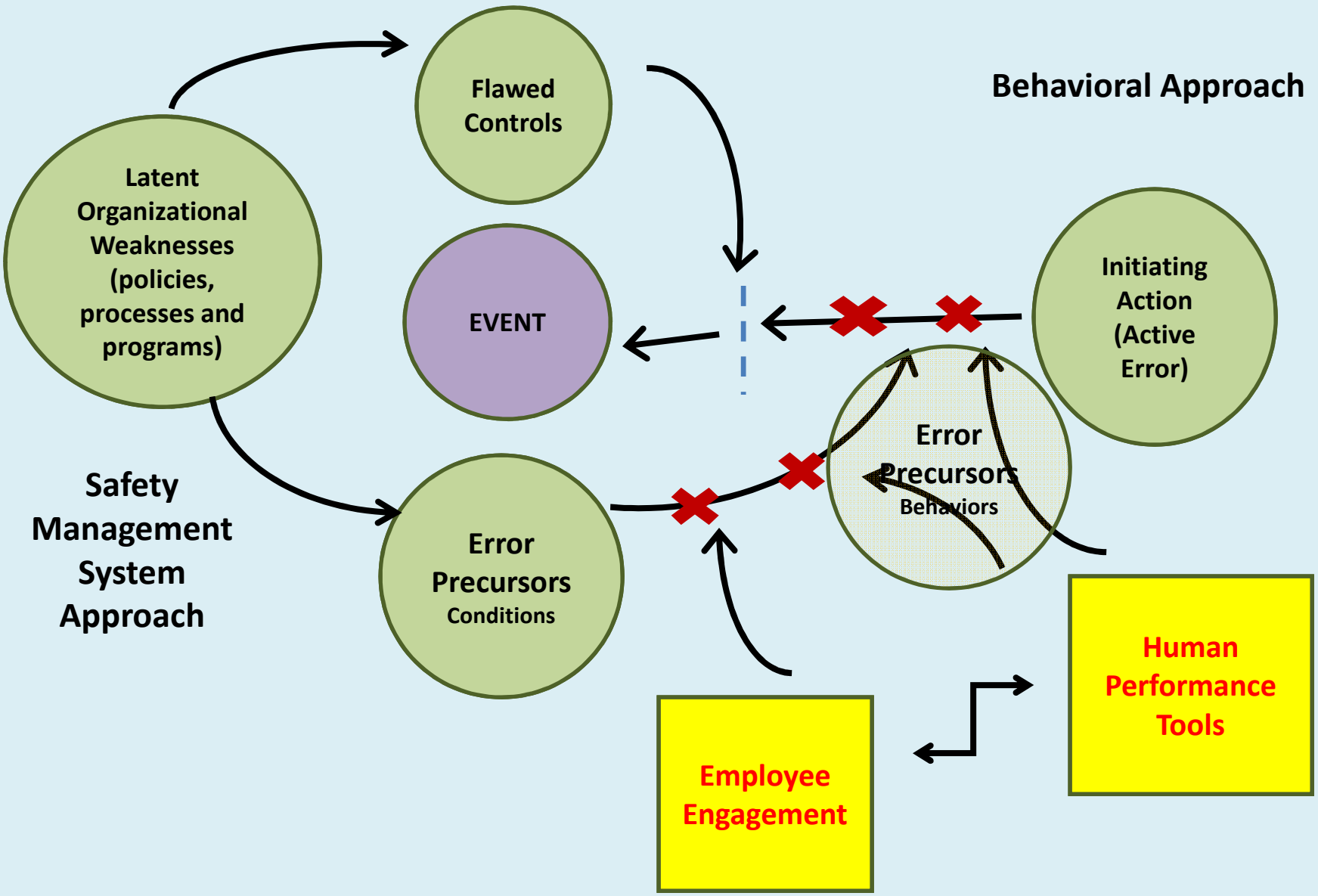


Part 5: Defensive Strategies to Preventing Human Error: Engaging Employees and Using Human Performance Tools

- Application of human performance tools
- Employee awareness and engagement

Interview Results:
Top 10 human performance improvement tools (from high performing organizations)

- ***Conducting Worker-Centric Pre-task and Post-task Briefings (e.g., Toolbox Meetings)***
- ***Self-Checking / STAR (Stop-Think-Act-Review)***
- ***Take-A-Minute / Job-Site Review***
- ***STOP and Seek / STOP When Unsure / Pause When Unsure***
- ***Questioning Attitude***
- ***Identifying Critical Steps***
- ***Coaching and Observation***
- *Three-Way (Repeat Back) Communications*
- *Concurrent Verification / Peer Checking*
- *Procedure Use, Adherence and Review*

Pre-Task Briefings

- **Ask what are the error traps present?**
- Ask what is the critical step or high risk task of the day?
- Ask what is the worst thing that can happen?
- Ask what mode (skill-, rule- or knowledge-based) will I be working in?
- Ask what are our roles and responsibilities?
- Ask if these tasks are new to the employee?

High Risk Task of the Day

Environmental Health & Safety

Dept	High Risk Task of the Day	Mode	Traps	Error Precursors	HP Tool(s)	Observer
S/ICR						
N. Ingot						
Hot Mill						
CCM						
Finishing						
CSO						

Dept	Lessons Learned - Yesterday's High Risk Task of the Day
S/ICR	
N. Ingot	
Hot Mill	
CCM	
Finishing	
CSO	

ERROR TRAPS	
Time Pressure	Knowledge based
Vague/ Poor work Guidance	Work Stress
Distraction	Mental Difficulty
Overconfidence	First Day Back
1st time/infrequent task	Last shift b4 holiday
Poor Communications	High Work Load
Non-normal Conditions	Fatigue

Critical Steps

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

Top Ten Reasons Why Human Performance Tools Work to Reduce Error

- **Heightened sense of situational awareness** concerning safety, presence of error precursors and traps, tasks to be performed, conditions and surroundings → **mindful uneasiness**
- **Increased deliberation, cautiousness and mindfulness in employees** as they approach and perform their tasks
- **More accurate estimates of risk** levels of activities
- **Higher levels of self-awareness**, including a more informed understanding of one's biases, vulnerabilities, deficiencies, and limitations
- **Communication and feedback promotion**, including facilitation of interactions with others

Top Ten Reasons Why Human Performance Tools Work to Reduce Error

- **Slowing down of activities**; gives employees more time to think about tasks
- **Identification of warning signals** that indicate that things are degrading or trouble is brewing
- **Recognition of assumptions** that need to be challenged
- **Continual improvement of procedures**
- **Higher levels of employee engagement**

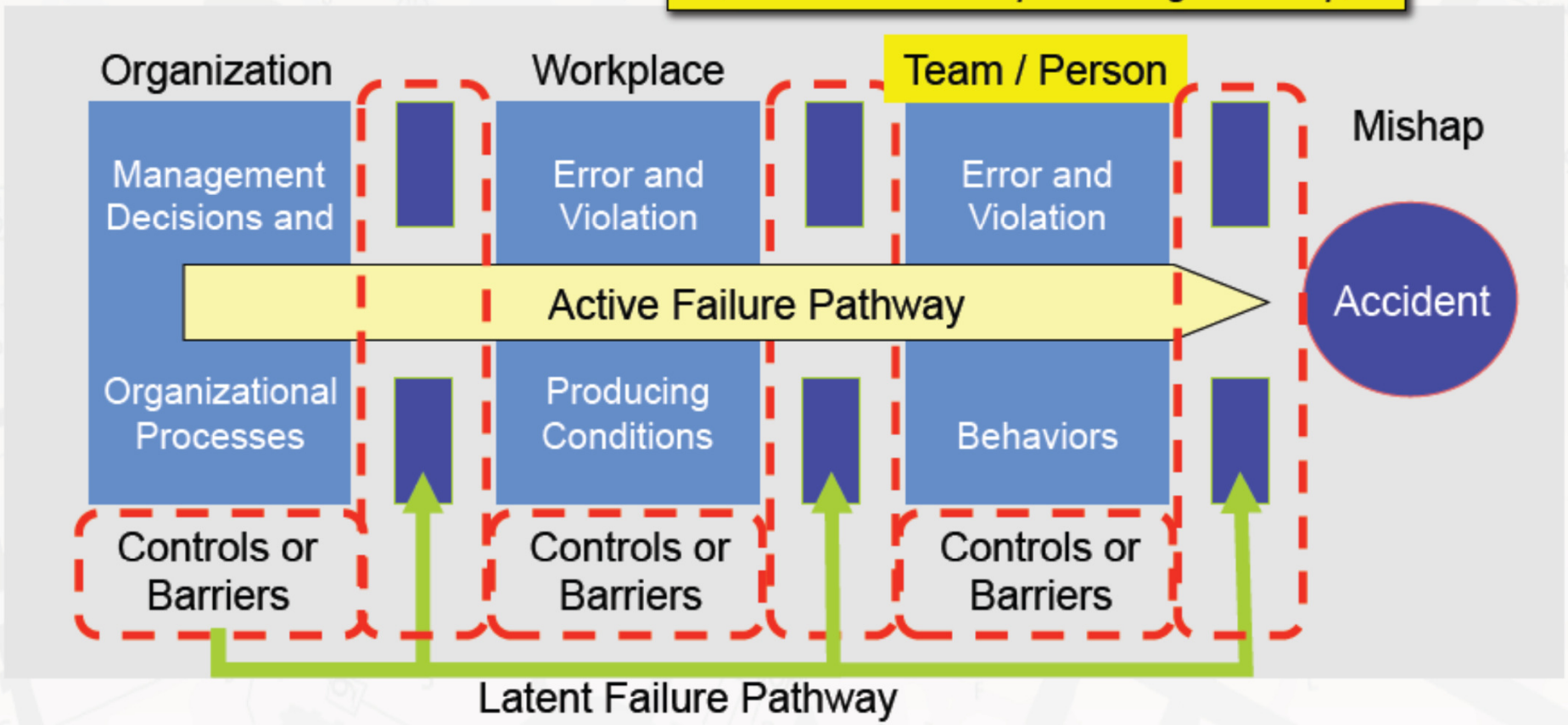
For more info on HP tools

- Wachter, J. K., & Yorio, P. L. (2013, February). Human performance tools: Engaging workers as the best defense against errors & error precursors. *Professional Safety*, 54-64.
- Can be retrieved from http://www.asse.org/professionalsafety/pastissues/058/02/F3Wach_0213.pdf

Why Do These Human Performance Tools Work?

- **ACTIVATES EMPLOYEE'S PERSONAL DEFENSES**
  - Protect against flaws (error precursors and failing defenses) in the safety management system?
  - Protect against flaws in themselves?
- **ACTIVELY ENGAGES (motivates) THE EMPLOYEE**
  - Cognitive
  - Emotional
  - Physical

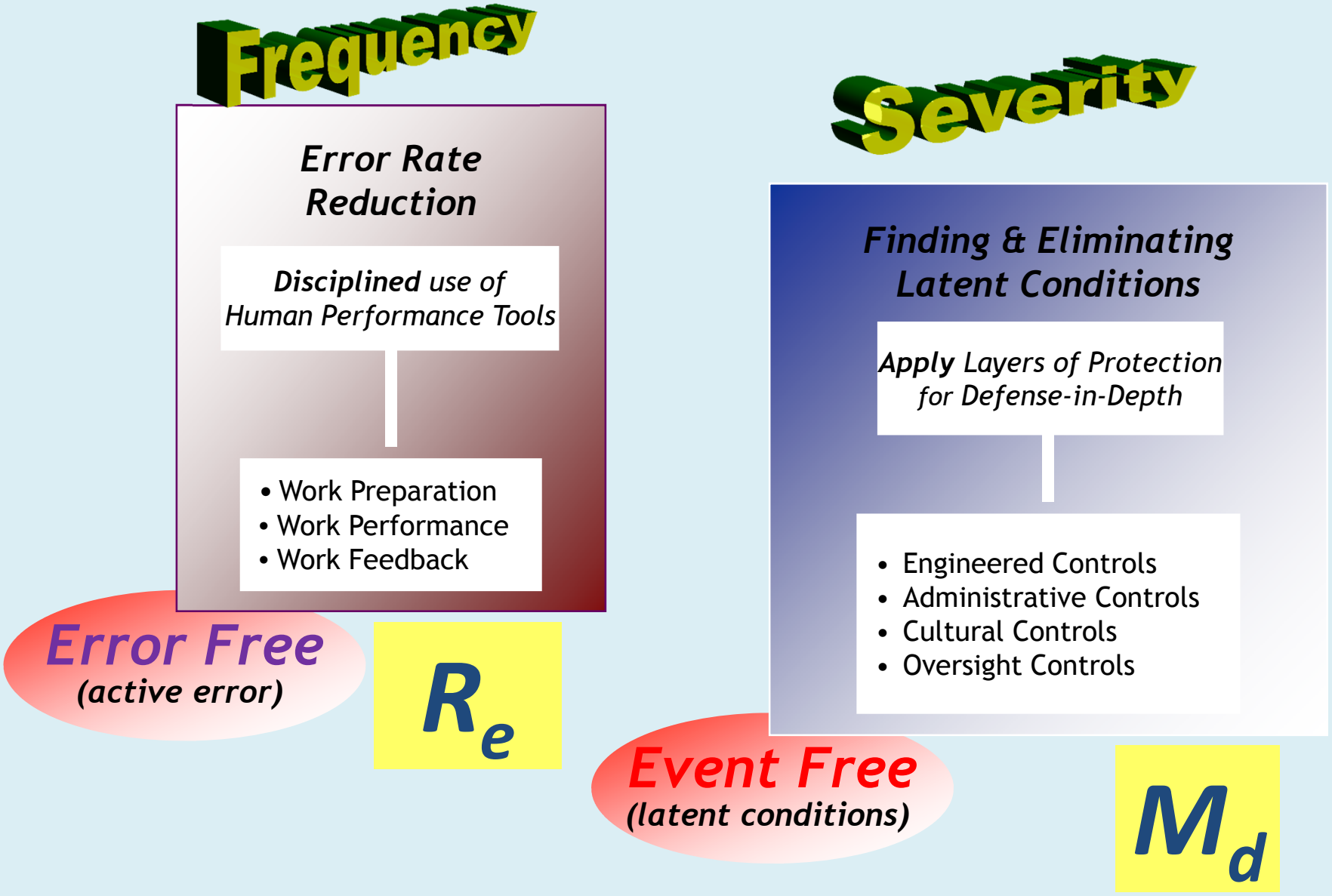
Human performance is often seen as the final barrier in preventing a mishap



Soft Defenses:	Procedural, e.g. regulation, surveillance, audit, procedures, licensing, drills, briefings, front-line operations monitoring
Hard Defenses:	Technical solutions and devices, such as barriers, lock-outs, alarms, NDT, PPE, and crumple zones

Source: J. Reason, A systems approach to organizational error, Ergonomics; the official publication of the Ergonomics Research Society, 1995

Approach Addresses Frequency and Severity



Strategic Approach to Hu

$$R_e + M_d \rightarrow \emptyset E$$

Reducing error **and** *Managing defenses* *leads to* **ZERO** *Events*

Identify
Analyze
Correct

Part 6: Mediation Studies: Safety Management Systems + Employee Behavior / Perceptions / Engagement → Reduced Incidents

- Safety manager surveys
- Supervisor surveys
- Employee surveys

Correlations for Safety Management Practices and Engagement Levels with Safety Outcomes (Safety Manager Survey)

	TRC Rate	DART Rate
1. TRC Rate		
2. DART Rate	.74	
3. Emotional Engagement	-.34	-.33
4. Cognitive Engagement	-.27	-.21
5. Engagement Composite	-.32	-.30
6. System of Safety Management Practices (Total)	-.29	-.27
7. Safe Work Procedures	-.22	-.21
8. Employee Involvement	-.30	-.29
9. Safe Task Assignment	-.15	-.13
10. Pre-/Post-Task Safety Reviews	-.27	-.30
11. Detection and Monitoring	-.16	-.13
12. Incident Investigation	-.13	-.16
13. Communication and Information Sharing	-.23	-.19
14. Safety Training	-.27	-.22
15. Cooperation Facilitation	-.22	-.16
16. Hiring for Safety	-.13	-.12

All correlations are significant at the p <.05 level.

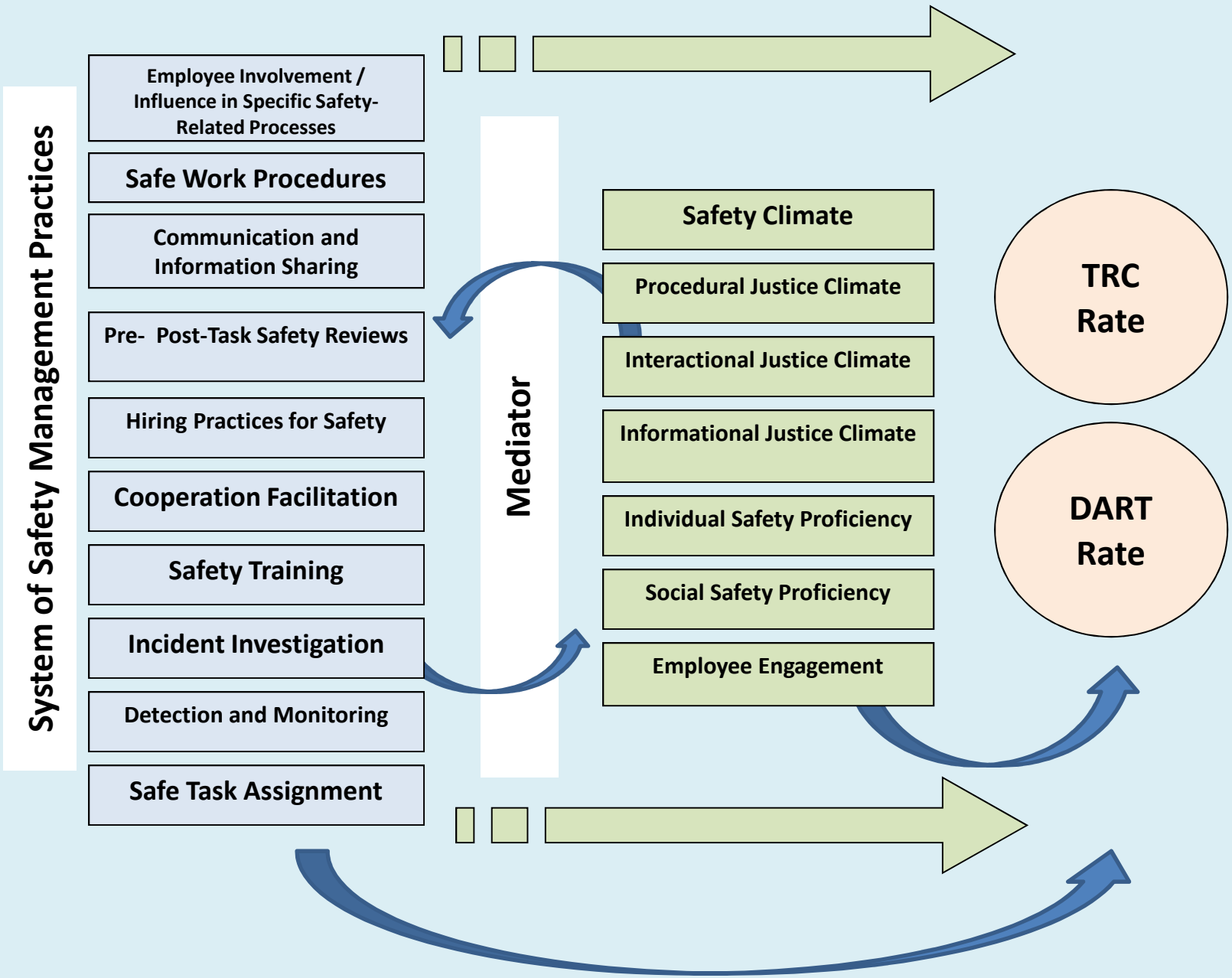
Correlations greater than or equal to .17 or less than or equal to -.17 are significant at the p <.001 level.

Safety Management Practice Composite Rankings across TRC and DART Rates

Note: Rankings based on squared correlation (R^2) from simple linear regression models.

SAFETY MANAGEMENT PRACTICES	TOTAL SAMPLE (ALL GROUPS) TRC RATE	TOTAL SAMPLE (ALL GROUPS) DART RATE	AVERAGE RANK ACROSS TRC AND DART RATES	GENERALIZED RANK (ALL GROUPS) TRC AND DART RATES
EMPLOYEE INVOLVEMENT / INFLUENCE	1	2	1.5	1
PRE- AND POST-TASK SAFETY REVIEWS	3	1	2.0	2
SAFETY TRAINING	2	3	2.5	3
COMMUNICATION AND INFORMATION SHARING	4	5	4.5	4
SAFE WORK PROCEDURES	6	4	5	5
COOPERATION FACILITATION	5	6	5.5	6
TASK-EMPLOYEE MATCHING	8	8	8.0	7
INCIDENT INVESTIGATION	9	7	8.0	7
DETECTION AND MONITORING	7	10	8.5	9
HIRING PRACTICES FOR SAFETY	10	9	9.5	10

MEDIATION


System of Safety Management Practices
Employee Involvement / Influence in Specific Safety-Related Processes
Safe Work Procedures
Communication and Information Sharing
Pre- Post-Task Safety Reviews
Hiring Practices for Safety
Cooperation Facilitation
Safety Training
Incident Investigation
Detection and Monitoring
Safe Task Assignment
Mediator
Safety Climate
Procedural Justice Climate
Interactional Justice Climate
Informational Justice Climate
Individual Safety Proficiency
Social Safety Proficiency
Employee Engagement
TRC Rate
DART Rate

Mediators / Behavioral Constructs

- **Supervisor and employee surveys (linked together)**
  - **Supervisor survey: management systems characteristics**
  - **Employee survey: employee perceptions**
- **Safety climate** → priority placed on safety.
- **Engagement** → harnessing full selves in active, complete work role performances by driving personal energy into cognitive and emotional labors.
- **Individual safety proficiency** → captures the degree to which an employee carries out his or her own work safely. It reflects the consistent and proper execution of the safe work behaviors required of the individual.
- **Social safety proficiency** → captures the interdependent nature of employee safety performance behaviors and is conceptualized to represent the minimum cooperative behavioral elements needed to ensure the safety of the collective.

Mediator: Justice

- **Procedural justice** → captures an employee's perception that practices are developed from accurate information, are unbiased and impartial, conform to an ethical standard, and the opportunity has been extended to employees to influence them.
- **Interactional justice** → captures an employee's perception that they are treated with dignity and respect.
- **Informational justice** → captures an employee's perception that information regarding practices is communicated by the organization in a timely, candid, and honest way.

Descriptive Statistics and Correlation Table

	Mean	1)	2)	3)	4)	5)	6)	7)	8)	9)
1) System of SMPs	46.46									
2) Individual Safety Proficiency	4.02	.42								
3) Social Safety Proficiency	3.97	.44	.70							
4) Safety Climate	4.01	.66	.63	.56						
5) Engagement	4.10	.65	.51	.49	.75					
6) Procedural Justice Climate	3.54	.60	.49	.30	.65	.65				
7) Interactional Justice Climate	4.00	.61	.56	.52	.74	.74	.70			
8) Informational Justice Climate	3.84	.59	.48	.37	.81	.81	.73	.74		
9) Recordable Incidents	1.13	**-.35**	**-.40**	**-.45**	**-.47**	**-.39**	**-.15**	**-.48**	**-.39**	
10) Lost Time Incidents	1.07	**-.31**	**-.39**	**-.47**	**-.41**	**-.33**	**-.10**	**-.42**	**-.29**	.83

All correlations above or below .25 / -.25 are significant at the p = .05 level.

All correlations above or below .33 / -.33 are significant at the p = .01 level.

SMPs are safety management practices.

Mediation Regression Results (Supervisor and Employee Surveys)

Predictors	Mediators			Outcomes					
	Engagement Composite	Emotional Engagement	Cognitive Engagement	Recordable Incidents			Lost Time Incidents		
Employee Engagement Composite	NA	NA	NA	-.54**	NA	NA	-.35**	NA	NA
Emotional Engagement	NA	NA	NA	NA	-.29*	NA	NA	-.01†	NA
Cognitive Engagement	NA	NA	NA	NA	NA	-.56**	NA	NA	-.37**
Safety Management System	.04**	.03**	.04**	-.01	-.02	-.00	-.01	-.17	-.00
Adjusted R^2	.38	.29	.38	.41	.29	.45	.32	.23	.36

Note: Unstandardized regression coefficients reported.

† p <.07	*p <.05	**p <.01

Above results show strong mediation through "engagement" of safety management system's effects on incident rates.

Additional Behavioral/Perceptional Characteristics that Act as Strong Mediators between SMSs and Reduction in Incidents

- Safety climate
- Interactional justice
- Social safety proficiency

Some Results/Conclusions

- **Each of the safety management practices identified in this study can be used to effectively decrease incident rates at the establishment level (safety manager survey).**
  - Employee involvement; pre- and post-task safety reviews
  - There are some effects of organizational size and sector; organizational size has more impact on the "strength" of these correlations than sector
- **Increased levels of perceived employee engagement can also effectively decrease incident rates at the establishment level.**
- **These safety management practices may work to decrease incident rates by engaging employees (mediation).**

Some Additional Conclusions

- Most of the employee perception / behavioral constructs investigated act as "mediators" through which a safety management system "works."
- The "behavioral part" of a safety management system (and its practices) is important in reducing incidents.
- A safety management system may be a necessary pre-existing condition in order to have a chance to be "safe," but it cannot guarantee it. You also need to have positive employee perceptions and engagement related to safety.
- **Thus, you need to have a combination of safety management systems and behavior-nurturing systems in the workplace to better ensure a higher probability of working safely → HAVE THESE APPROACHES BECOME FRIENDS (or maybe even get married)**
  - Should consensus safety management system standards have a stronger behavioral component in them?

Part 7: Summary

- **Safety management systems are necessary first steps in order to achieve safety excellence, but it cannot guarantee it!** Safety management systems are great (they are the future!) but they will always be flawed to some degree.
- **Leading performance measures** can be used to lead the path to improving safety management systems (and human behavior).
- To improve safety management systems and better guarantee safety excellence, **organizations need to address:**
  - **Latent organizational deficiencies (which lead to error precursors and failed defenses) and**
  - **Perform SMS assessments**

Part 7: Summary

- In order to address error precursors and the potential for human error, one of the best ways may be to **use human performance tools/employee engagement as "defensive mechanisms**"
- To address failing defenses, the best way may be to have **multiple layers of defenses**
- It appears that safety management systems may "work" through **employee engagement and perceptions → need to include these considerations in the design of safety management systems** (which currently are being overlooked in most SMS designs)
- **Need to use both SMS and human performance approaches in order to achieve safety excellence**

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