



Nuclear Safety (Week 8 / Day 1)

Lecture #2: Human Performance Improvement (HPI) Overview

SAND2016-XXXX


Gulf Nuclear Energy Infrastructure Institute – 2016 Fundamentals Course

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*Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

Week 8 / Day 1 / Lecture #2 Outline



- Human Fallibility – the Basics
- The Role of the Individual in Human Performance
- System Design for Success
- The Role of Culture in Organizational Performance
- Be Careful How You Judge
- Putting it All Together

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The Basics



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To Err is Human

“... human fallibility is like gravity, weather, and terrain, just another foreseeable hazard. Error is pervasive ... What is not pervasive are well-developed skills to detect and contain these errors at their early stages.”

- Weick and Sutcliffe

Leading with Resilience in the Face of the Unexpected

Costa Concordia Cruise Ship, January 15, 2012



Source: <http://worldmaritimewar.com/archives/4479/italy-preliminary-indications-human-error-caused-cruise-ship-tragedy/>

Asiana Airlines Flight 214, July 6, 2013



Source: www.timesdaily.com/ & www.sgx.com/

Three Mile Island Accident, March 28, 1979



Source: www.en.wikipedia.org/wiki/Three_Mile_Island_accident/

Lockheed Martin Space Systems / NASA
Satellite damage, Sept. 6, 2003



Source: <http://www.freepublic.com/focus/news/1236400/pos>

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To Err is Human (Cont.)



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What is an Error?



An action that **unintentionally** departs from an expected behavior

- *Active Error*: immediate consequences; usually know 'who did it'
- *Latent Error*: latent consequences; usually do NOT know 'who did it'



"Errors are for the most part unintentional. It is very hard for management to control what people did not intend to do in the first place."

- Dr. James Reason
Human Error

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To Drift is Human



"It is a natural tendency to deviate from required behaviors as we develop confidence, and experience success in the tasks we perform – especially if we have not experienced any negative consequences associated with our deviation (or 'drift')."

"Sometimes the better we are at what we do ... the harder it is for us to recognize that we've drifted. We still think we're in a 'safe' place."

- Just Culture Community

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Case Study



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Sometimes People Choose to do Wrong



Violations: *Intentional* acts to deviate from a policy or procedure for personal advantage, usually adopted for fun, comfort, expedience, or convenience

- **At-Risk Behavior:** behavioral choice that increases risk where risk is not recognized, or is mistakenly believed to be justified
- **Reckless Behavior:** behavioral choice to consciously disregard a substantial and unjustifiable risk

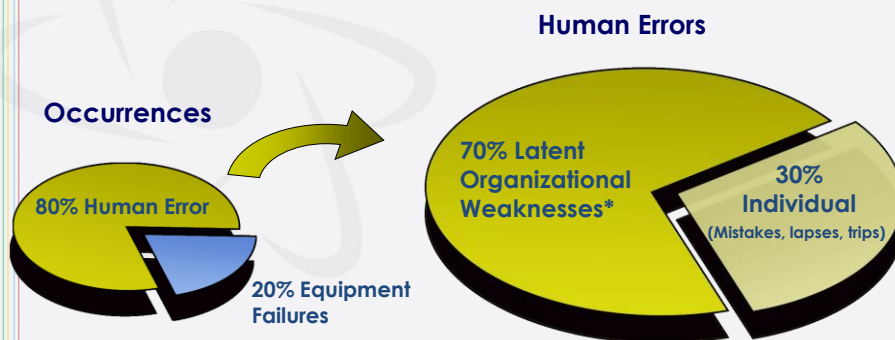


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Source: http://www.brianbehrend.com/archives/2004/12/barry_bomb_h.php

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What Causes Events?



* **Latent Organizational Weakness** = Hidden deficiencies in organizational structures, programs, processes or values, or equipment flaws that create workplace conditions that provoke error and/or degrade the integrity of defenses

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At-Risk Attitudes

... the scary side of human adaptability



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Common Traps of Human Nature



- Stress
- Mental Strain Avoidance
- Inaccurate Mental Models
- Limited Working Memory
- Limited Attention Resources
- Mind-Set
- Difficulty Seeing One's Own Error
- Limited Perspective
- Susceptibility to Emotional / Social Factors
- Motivated Toward Goal Accomplishment
- Fatigue



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Common Error Precursors



- Conditions that provoke error

Task Demands	Individual Capabilities
<input checked="" type="checkbox"/> Time pressure (in a hurry)	<input checked="" type="checkbox"/> Unfamiliarity with task/first time
<input checked="" type="checkbox"/> High workload (large memory requirements)	<input type="checkbox"/> Lack of knowledge (faulty mental model)
<input type="checkbox"/> Simultaneous, multiple actions	<input type="checkbox"/> New techniques not used before
<input type="checkbox"/> Repetitive actions/monotony	<input checked="" type="checkbox"/> Imprecise communication habits
<input type="checkbox"/> Irreversible actions	<input type="checkbox"/> Lack of proficiency/inexperience
<input checked="" type="checkbox"/> Interpretation requirements	<input type="checkbox"/> Indistinct problem-solving skills
<input type="checkbox"/> Unclear goals, roles, or responsibilities	<input type="checkbox"/> Unsafe attitudes
<input checked="" type="checkbox"/> Lack of or unclear standards	<input checked="" type="checkbox"/> Illness or fatigue; general poor health
Work Environment	Human Nature
<input checked="" type="checkbox"/> Distractions/interruptions	<input checked="" type="checkbox"/> Stress
<input type="checkbox"/> Changes/departure from routine	<input type="checkbox"/> Habit patterns
<input type="checkbox"/> Confusing displays or controls	<input type="checkbox"/> Assumptions
<input type="checkbox"/> Work-arounds/out of service instruments	<input checked="" type="checkbox"/> Complacency/overconfidence
<input type="checkbox"/> Hidden system/equipment response	<input type="checkbox"/> Mind-set (intentions)
<input type="checkbox"/> Unexpected conditions	<input type="checkbox"/> Inaccurate risk perception
<input type="checkbox"/> Lack of alternative indication	<input type="checkbox"/> Mental shortcuts or biases
<input type="checkbox"/> Personality conflict	<input type="checkbox"/> Limited short-term memory

See Handout

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System Design for Success - Defenses, Barriers & Controls -



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“System” Design for Error Reduction



Key Question #1:

- *Did we design a robust “system,” knowing that it will be comprised of fallible humans and sometimes faulty equipment?*
 - We would like to believe that everyday systems are infallible ... yet the reality is we can only do so much – knowing that a perfect system is **beyond our control**
 - We must design systems under the belief that even the best of systems will have some risks of adverse outcomes



Source: <https://www.jasculham.org/>

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“System” Design for Error Reduction (Cont.)



Key Question #2:

- *Did we design the “system” to give our employees the best chance of getting their job done right, every time?*
 - Consider the design of the overall system itself, and its impact the reliability of humans in the system
 - *“Human performance”* strategies to improve the reliability of the human
 - *“Engineering”* strategies required for reliable systems



Source: <https://www.jasculham.org/>

“All organizations are perfectly aligned to get the results they get.”

- Arthur W. Jones
Organizational Design Expert

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Design for Human Reliability

... knowing that humans will never be perfect



Perception of Risk:

- Relies on individual's ability to recognize that they are in a high-risk situation, and to limit **at-risk behaviors**
- Fosters focus on the specific task being worked
- Examples:
 - Attitude: healthy uneasiness for what could go wrong; a "**Questioning Attitude**"
 - Effective "risk recognition" coaching by manager



Source: <https://www.justculture.org>

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Design for System Reliability

... knowing that systems will never be perfect



- **Work Environment** - Consider structural elements within the organization and their influence (motivation and ability) on error rates, choices, behaviors, attitudes, etc.
- **Barriers** - Designing errors out the system is much more effective than simply telling people not to make mistakes
- **Redundancy** - Creation of multiple paths to allow success through a second path if the first path does not work
- **Recovery** - Ability to catch an upstream error before it can lead to an adverse outcome



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Flawed Defenses



D1 - Engineered Controls:			
A	Lack of human factors design (e.g., equipment ergonomics) to reduce the rate of human error; Lack of error-tolerant design	J	Lack of redundancy in critical system components
B	Lack of <i>Mistake-Proofing</i> in the design and configuration/layout of processes	K	Failed or bypassed safety or security interlocks

D2 - Administrative Controls:			
A	Unclear or undefined roles, responsibilities, authorities, accountabilities, and performance expectations	O	Insufficient staffing - leading to excessive overtime, workload, and fatigue
B	Vague standards of performance in work procedures and instructions	P	Routine authorization to exceed overtime limits (leading to chronic fatigue)

D3 - Cultural Controls:			
A	Having inconsistencies between what managers say they want and what they reward or pay attention to	M	Presence of a culture that does not value the prevention of errors or mishaps
B	Providing awards, bonuses, and kudos based solely on productivity measures (e.g., ends justifies the means, no harm – no foul)	N	Adverse cultural norms within the organization

D4 - Oversight Controls:			
A	Management & independent oversight of facility or organizational performance is inadequate	G	Self-assessments are superficial, are not focused on important attributes, or are not formally performed or tracked
B	Senior management oversight of human performance is inadequate	H	The measurement tracking/trending of risk-important processes are insufficient or are not performed



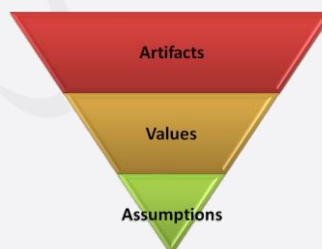
See Handout

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The Role of Culture in Organizational Performance

As the Culture of an Organization Goes ...



"When it comes to leadership and management, one thing always holds true: you will either manage the culture of your organization, or it will manage you."

- Tim Autrey, CEO
Practicing Perfection Institute



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Key Components of a Safety Culture*



- A **flexible** culture
- A **learning** culture
- A **reporting** culture
- A **just** culture



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* Ref.: *Managing the Risks of Organizational Accidents*, James Reason, 1997.

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A Flexible Culture



Characterized by the ability to reconfigure in the face of high tempo operations or certain kinds of danger

- Intelligent awareness; proactive mental mindset
- Challenges “*the way we’ve always done things*”
- Free-flow of information and ideas
- Deals constructively with failure and mistakes
- Highly skilled staff - flexibility to quickly reorganize, adjust, and move the right skill sets to deal with events
- Decision-making migrates down and around



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A Reporting Culture



An organizational climate in which people are willing to report their errors and near-misses, as well as identified system weaknesses affecting their performance

- Basis: Valid feedback on local and organizational factors promoting errors and events is far more important than assigning blame to individuals
 - Essential for the organization to learn and continuously improve



"In order to learn from the small stuff so we can prevent really bad things from happening, we have to develop a self-reporting culture."

- Tim Autrey, CEO
Practicing Perfection Institute

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A Reporting Culture (Cont.)



- Success depends upon how the organization handles bad news, blame, punishment, etc.
 - **Reactions** of manager/leader, peers, and subordinates directly influence employee willingness to report
- Challenges:
 - Frank confession ≠ human strength
 - Disincentives are strong (extra work, fear of reprisal, skepticism, lack of trust)



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Source: <http://www.afix.com/blog/apply-reporting-culture-to-work/>

A Reporting Culture (Cont.)



Key Elements:

- Clearly communicated reporting expectations
- Self-reporting process that is fast, simple and easy
- Perceived and understood benefit/value
- Rapid, useful, accessible and intelligible feedback
- Respectful and non-punitive work environment
- An environment of **trust** throughout the organization



Source: <http://www.amarshah.com/2010/06/make-mistakes-stay-awake-again-2010/>

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A Just Culture



*Atmosphere of **trust** in which employees feel safe to admit their mistakes, where employees are encouraged to provide essential information about the organization (processes, practices, etc.), and in which they are clear about where the line is drawn between acceptable and unacceptable behavior*

Tenets:

- It is unacceptable to punish all errors and 'unsafe' acts regardless of origins and circumstances;
- It is equally unacceptable to give blanket immunity from sanctions to all actions that contribute to organizational accidents

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A Just Culture (Cont.)



- Method to evaluate human performance (individual **behaviors**) that deviate from that which was expected, and those that do not match the organization's values
- Aids in determining the right course of action (*with regards to consequences*) when an employee has:
 - *made an error*
 - *drifted into an at-risk behavior*
 - *engaged in reckless behavior*
 - *not met his or her obligations (duties) to the organization*



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Be Careful How You Judge

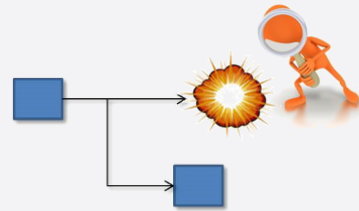
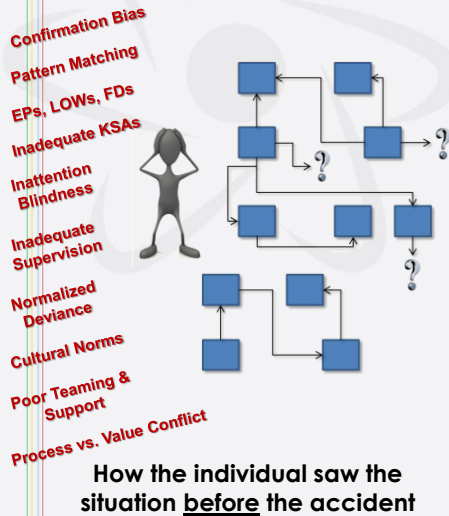
- Just Culture in Action -



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Differing Perceptions about Accidents



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Judging Human Behavior in a Just Culture

- **Assume** people come to work ... wanting and planning on doing a "good job"
- **Assume** people do what makes sense to them in the moment
- Human error is not random, but rather a **symptom** of trouble deeper within the "system" (or organization)



Source: <https://www.justculture.org/>

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Judging Human Behavior in a Just Culture (Cont.)



- Find how people's assessments, priorities, decisions, and actions made sense at the time
 - See the world from the point of view of people *inside* the situation
➔ **CONTEXT**
 - Does not justify behavior – it explains it
- Evaluate the organization as the event unfolded - from the perspective of the people involved in the event

Task Demands	Individual Capabilities
☐ Time pressure or a hurry	☐ Unfamiliarity with each other
☐ High workload (large memory requirements)	☐ Lack of knowledge (lack of mental model)
☐ Simultaneous, multiple actions	☐ New techniques not used before
☐ Repetitive actions/memory	☐ Ineffective communication skills
☐ Inevitable actions	☐ Lack of proficiency/experience
☐ Integration requirements	☐ Ineffective problem-solving skills
☐ Inconsistent rules or responsibilities	☐ Unstable attitudes
☐ Lack of or unclear standards	☐ Illness or fatigue, general poor health
Work Environment	Human Nature
☐ Inconsistent requirements	☐ Errors
☐ Changes/departure from routine	☐ Habit patterns
☐ Confusing displays or controls	☐ Assumptions
☐ Work uncharacteristic of previous instruments	☐ Complacency/overconfidence
☐ Hidden system/equipment responses	☐ Mind-set (intentions)
☐ Unexpected conditions	☐ Inaccurate risk perception
☐ Lack of attention/relaxation	☐ Mental shortcuts or biases
☐ Personality conflict	☐ Limited short-term memory

"To explain failure, do not try to find where people went wrong. Instead, find how people's assessments and actions made sense at the time, given the circumstances that surrounded them."

- Sidney Dekker

The Field Guide to Human Error Investigations

Judging Human Behavior in a Just Culture (Cont.)



- Review organizational processes, programs, structures, tools, equipment, training, etc., for the presence of impactful **Latent Organizational Weaknesses**
 - Undetected deficiencies in organizational processes, programs, structures, equipment, or values that create job-site conditions that either provoke error or degrade the integrity of defenses/controls



Source: <http://2tu.com/haqamian/102378>Name-the-Game-questions>

"Your world is perfectly organized to create the behavior(s) you're currently experiencing."

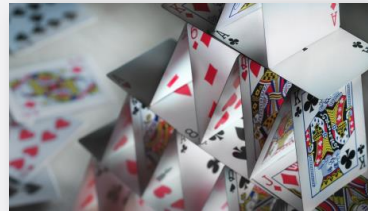
- Kerry Patterson, et al
Influencer: The Power to Change Anything

Judging Human Behavior in a Just Culture (Cont.)



- Review **defenses/barriers/controls** – *relied upon by the organization and the individual* – to determine if they were:
 - *flawed*
 - *non-existent*
 - *bypassed*

or in some way failed to prevent, catch, or mitigate the consequences of the event (accident)



Source: <http://www.designboom.com/tag/playing-cards/>

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Judging Human Behavior in a Just Culture (Cont.)



- Consider the organizational culture and its influence
 - *Condoned vs. condemned poor practices/behaviors, and normalized deviations*
 - *Treatment of personnel relative to human error, at-risk behavior, or reckless behavior*
- Understand the cultural “norms” within the organization, as well as the social influences on error rates, choices, behaviors, attitudes, etc.



“The significance (or severity) of an event depends upon the consequences suffered, and not on the error that initiates it. The error that triggers a serious accident ... and the error that is one of hundreds with no consequences ... can be the same error.”

- Institute of Nuclear Power Operations

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"I Can't Believe That Happened!"



"...the ability to deal with a crisis situation is largely dependent on the structures that have been developed before chaos arrives. The event can in some ways be considered as an abrupt and brutal audit: at a moment's notice, everything that was left unprepared becomes a complex problem, and every weakness comes rushing to the forefront."

- Patrick Lagadec and Jocelyn M. Phelps
Preventing Chaos in a Crisis: Strategies for Prevention, Control and Damage Limitation



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Source: <http://www.qualitycarandtruckrepair.com/services/automotive-maintenance/>

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Judging Human Behavior in a Just Culture (Cont.)



Circumstances/Conditions (e.g., Error Precursors)

Organization (e.g., Leadership, Culture, LOWs, Flawed Defenses)

individual (e.g., Training vs. Qualification, appropriate KSAs and experience)

Tasks & duties

Environment (e.g., Policies, procedures, tools, equipment, training content)

eXchange (e.g., Substitution test)

Teaming atmosphere (e.g., Mission vs. Team vs. Individual)

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Putting it All Together



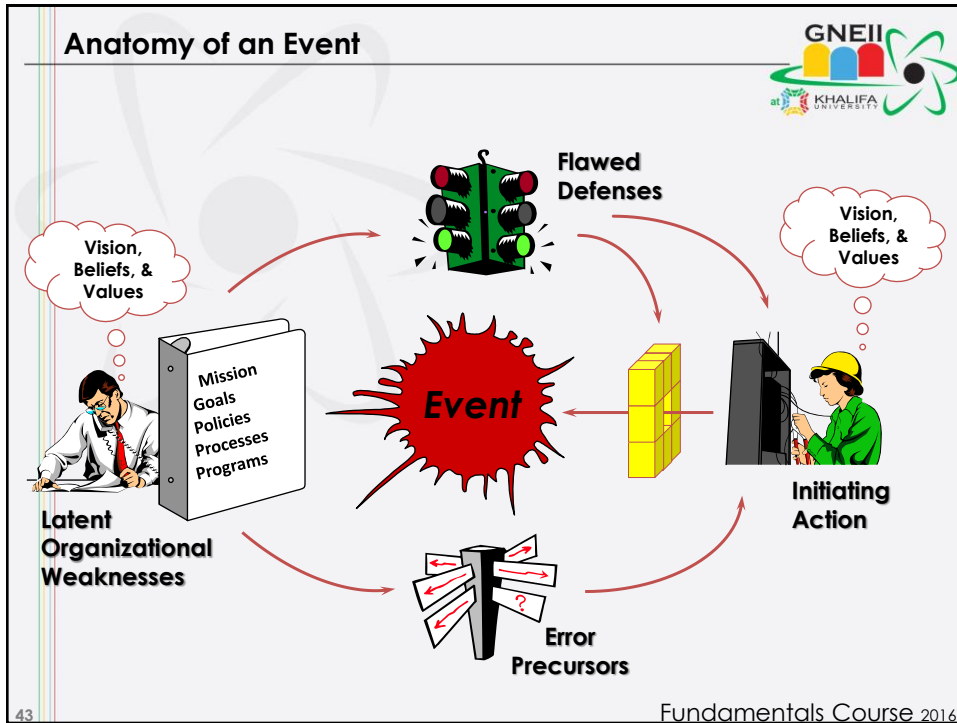
"There are four kinds of people: people who make it happen; people who watch it happen; people who wonder what happened; and people who never knew anything happened."

- Conners, Smith & Hickman

The Oz Principle: Getting Results Through Individual and Organizational Accountability

Principles of Human Performance Improvement

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



What Individuals can do ...

Understanding human fallibility encourages a proactive perspective toward work:

- Personnel should possess a keen - and healthy - sense of **uneasiness** toward any activity
 - prompts the mindset: "*expect success but anticipate failure;*" "*what could go horribly wrong?*"
 - fosters **intolerance** for error traps / precursors

"If error-free performance (avoiding active errors) is not held up as an important value or is not expected for daily work, then people may adopt unsafe practices to get their work done, possibly placing themselves, others, or the facility at risk of an event."

Human Performance Reference Manual, INPO 06-003

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What Individuals can do ...



- Understand error-provoking factors and human fallibility & vulnerabilities
- Be watchful and do not proceed in the face of uncertainty (*Stop when Unsure*)
- Be *proactively accountable* (responsible) for their results
- Use equipment, tools and procedures/work instructions as intended

Error Precursors	
Task Demands	Individual Capabilities
<ul style="list-style-type: none"> • Time pressure (time hurry) • High workload (memory requirements) • Simultaneous, multiple tasks • Repetitive actions (monotonous) • Incomprehensible tasks • Inadequate requirements • Unclear goals, roles, & responsibilities • Lack of or unclear standards 	<ul style="list-style-type: none"> • Unreliability without self-time evaluation • Lack of knowledge (mental models) • Poor technique not constructive • Imprecise communication habits • Lack of proficiency / inexperience • Inadequate problem-solving skills • "I'm sure" attitude for critical tasks • Stress / fatigue
Work Environment	Human Nature
<ul style="list-style-type: none"> • Distractions / interruptions • Changes / deviations from routine • Confusing displays or controls • Hierarchical / OOS instructions • Hidden system responses • Unspecified conditions • Lack of alternative resolution • Personality conflicts 	<ul style="list-style-type: none"> • Sloppiness • Habit patterns • Assumptions • Complacency / Overconfidence • Mind-set • Inaccurate risk perception • Tunnel vision (tunnel) • Limited short-term memory

OOS = Out of Service

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What Individuals can do ...



- Regularly critique processes and procedures ... to **continuously** seek out *Error-Likely Situations, Latent Organizational Weakness, and Flawed Defenses*
- Bring forward suggested improvement
- Report deficiencies promptly
 - "See something? Say Something!"



Source: <http://fremppublic.com/forums/showthread.php?p=2>

"The people doing the work are the ones who have the answers. They know where the set-ups and workarounds are, where procedures are confusing, which processes don't work, and constraints are placed upon them by poor organizational infrastructure, policy, and tradition."

- Tim Autrey, CEO
Practicing Perfection Institute

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What Individuals can do ...



- Acknowledge your errors/mistakes, and then learn from them
- Engage in open, honest and constructive communication – *talk about what needs to be talked about*
- Constructively challenge each other (thoughts, actions, etc.)
 - *Questioning attitude helps prevent team errors*



"With every problem, someone somewhere sees it coming. But those people tend to be low rank, invisible, unauthorized, reluctant to speak up, and may not even know they know something that is consequential."

- Weick & Sutcliffe
Managing the Unexpected

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What Leaders can do ...



- **Respond** (vs. react) to errors, bad news, and events of consequences
 - Do so thoughtfully and mindfully, from a position of caring
 - Seek first to understand
 - Determine the context
 - Ask: "*Why would a well-intentioned person do (or say) _____?*"
 - Ask: "*What risk did the person see (or not see) when they decided/chose to _____?*"
 - Establish a "**Just Culture**" within the organization

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Questions?

References

- *Human Error*, James Reason
- *The Human Contribution*, James Reason
- *Managing the Risks of Organizational Accidents*, James Reason
- *Managing Maintenance Error*, James Reason
- *The Field Guide to Understanding Human Error*, Sidney Dekker
- *The Field Guide to Human Error Investigations*, Sidney Dekker
- *Just Culture*, Sidney Dekker
- *Whack-a-Mole*, David Marx
- *Organizational Culture and Leadership*, Edgar Schein

*"The more you read, the more things you will know.
The more that you learn, the more places you'll go."*

- Dr. Seuss