A Disruptive Paradigm: The Systems Approach to Human Error

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What Do You Believe?

• Human Errors result from bad Choices
• Human Errors result from Mistakes
• Errors and Violations are the same
Session Objectives:

✓ Understanding the differences between at-risk behavior and normal human error

✓ Discuss the massive paradigm shift that is occurring

  ✓ Away from seeing worker behavior as the key problem
  ✓ Toward the understanding that behavior is systematically influenced, versus based on individual choice
  ✓ Recognizing the need for finding organizational and system influencers, and engaging workers in the process
Disrupting or “Shifting” the Paradigm

Thomas Kuhn - “The Structures of Scientific Revolution”
Popularized the term “Paradigm Shift”

“Scientific advancement is not evolution, but rather a series of peaceful interludes punctuated by intellectually violent revolutions” and in those revolution “one conceptual world view is replaced by another.”

Think how personal computers and the internet have impacted how both personal and business environments, acting as catalysts for a Disruptive Paradigm Shift.

A Disruptive Paradigm

William Corcoran, PhD. – Meaningful change comes from disruptive paradigms

“A disruptive paradigm is a paradigm that is life-threatening to the old ways of looking at things.”

“Often when a critical mass of people in an organization or in a society adopt the disruptive paradigm the days of the other are numbered.”
Systems Thinking about ‘Human Error’ is Disruptive

It Poses Threats to……

• Our set of beliefs that we and our organizations hold about worker behavior and safety.

• Our previous approaches to safety and impending obsolescence.

• The army of behavioral safety consultants and their promises of improvement and predictive analytics

Common Beliefs will be Disrupted

• “Free Will” – we control our destiny through personal choice…. In workplace settings as well?

• Errors are the outcome of poor choice and are voluntary actions…..blame, shame, retrain….

• Worker behavior is the root cause of most workplace injuries

• Workplace errors are deliberate acts of violation

• Disciplinary action is necessary in holding the violator accountable
What We Know About Human Error

• Human Error is Normal and Expected

• Errors are Mistakes - Not Active Choices

• Errors help us Learn
  • Can result in learning opportunities for others...

• Error likely situations can be Identified, are Predictable and can be Redesigned

Common Beliefs About Safety

• Zero Injuries = World Class Safety
  • The number of adverse outcomes is as low as possible

• Focusing on At-Risk Behaviors will improves safety
  • Observing and Changing behaviors will improve safety

• Human Error is the result of Unsafe Behavior

• Human Error can be eliminated through training, incentives, observation and discipline
Understanding “Context”

Human minds don’t see beyond the present

• What is about to happen is not anticipated nor even possible

• What they are doing in the present has no connection to what is about to happen

• The possibility of something going wrong and being hurt simply won’t happen

Review: Errors vs. Violations

Unsafe Acts

Errors

Decision Errors  Skill-Based Errors  Perceptual Errors

Violations

Routine Violations  Exceptional Violations
W. Edwards Deming

“There would be no problems in production or service if only our production workers would do their jobs in the way that we taught.

Pleasant Dreams!

The workers are handicapped by the system, and the system belongs to management.”

-- CLMI --

Our View of Error is Biased

• **Cognitive Bias**: a systematic error in thinking that affects the decisions and judgments that people make

  • How we are able to view and make sense of the world around us
  • Thinking Errors that humans make in processing information
Confirmation Bias

• The tendency to search for, interpret, focus on and remember information in a way that confirms our preconceptions.

• We look for evidence or reasons to confirm what we think already happened.
Fundamental Attribution Error

• We explain behavior by assigning attributes.

• We see error or mistakes as failures resulting from poor choice.

• This results in projecting ourselves as better than the person who made the mistake.
  • We would never have done that!

Hindsight Bias

• Those looking back on an event see all the causal consequences coming.

• But those involved and in the moment, armed only with limited foresight, see no such convergence.
Counterfactual Fallacy

• Confuses the real circumstances of an event and the mental alternatives that were likely to alter the outcome.

• What “should” have been.
  • “If she had looked before entering the intersection…”
  • “If he had not been driving so fast…”
  • “If the machine guard had been in place…”

• “Had things been different (which they weren’t) this would not have happened;
  • therefore, the person who committed the act is responsible for the outcome.”

“Just World” Hypothesis

• The view that bad things happen to bad people, and conversely.

• Comes directly from Newtonian thinking and usually thought when there is a bad outcome
Change Is Afoot In Safety!

- Away from the "Person Model"
- Focused on the work \textit{Systems and Context}
- Toward the "Organizational Model" ….

James Reason

Systems and Context Approach

- Systems Design & Organizational Control
- Focus on Climate/Culture
- Behavior Based Safety
Safe Work Design Can Make It
Poor System Design can “Provoke” Error

- Poor design – can put in motion latent conditions that can result in negative consequences
- Management decisions can potentially increase risk, and provoking error

Poor Management Systems increase the problem

- Measuring safety success through incident count and trailing indicators
- Expect compliance to rules and procedures
- Focusing on the worker as the problem
- Fixing the problem by focusing on changing the behavior of workers
- Identify unsustainable corrective actions: retraining, incentives, behavior observation, discipline, etc.
- Seldom identify organization or systems influences on behavior
The first interpretation of safety

Safety is the prevention of harm (unnecessary risks).

\[ \text{Safety} = \sum_{i=1}^{D} \text{Accident}_i \]

There is a presence of failures (things that go wrong) due to risks and hazards. The number of harmful events can be counted.

It is “easy” to count how much goes wrong, but does that measure safety?

HSE performance indicators
- Total recordable injury frequency
- Lost-time injury frequency
- Serious incident frequency
- Sickness absence
- Oil spills
- Other spills
Compliance (Level 1 and 2)

Reactive
- Wait for things to happen
  - Incidents
  - Citations
  - Goals
  - Objectives
  - Improvement initiatives
- Investigations focus on “who”
  - Blame individual employees
  - Counsel, retrain, discipline
- Accountability - without authority
- A safety department responsibility

Proactive
- Compliance Focus
  - Audit to test compliance
  - Inspect to stay in compliance
- Written programs (to check)
- Safety Training Programs
- Individual Accountability
- Resource fixes – safety priority
- Supervisor as Key Person
- Safety Committee
- Focused on “Zero” as the Goal

Performance Barriers
Common (Safety) Performance Barriers include:

1. Unclear strategies and values, and conflicting priorities
2. An ineffective/unsupportive senior leadership team
3. Leadership style is too top-down or too laissez faire
4. Poor horizontal coordination and communications
5. Inadequate leadership and management skills development processes in the organization
6. Poor or closed vertical communications
Managing Safety

• What are the key elements of a successful Safety Initiative?

• How does your organization manage safety? Is there a defined structure or process? How do you know if you have it?

• How do you track and measure safety performance?

• How is safety managed at each location or in each section/department of the organization?

Moving beyond compliance/rules-based safety?

Thoughts to consider:

1. Compliance is often the goal … and it probably needs to be!
2. When focused on compliance and rules we look for violators
3. When something goes wrong we look to see what rules were violated, or steps in the procedure skipped
4. Who messed up??!!
5. We then reprimand and take other actions to fix the worker
6. The culture of the organization remains immature (levels 1 & 2)
7. Safety success continues to be measured by the number of incidents, violations, at-risk behaviors, OSHA compliance, adherence to rules, etc.
Safety Management Systems (Level 3)

- Managed Approach: Plan - Do - Check - Act
  - Systematize, integrate and layer for each program

- Data collection
  - Incidents, action tracking

- Management and Department Accountability

- Risk-Based leading metrics
  - Moving away from just “Zero” incidents

- Employee Involvement and Recognition

- Goal = Injury Avoidance

ISO 45001 - ANSI Z10 - OHSAS 18001

- **ISO 45001 CD2**
  1) Scope
  2) Normative References (n/a)
  3) Terms and Definitions
  4) Context of the Organization
  5) Leadership & Worker Participation
  6) Planning
  7) Support
  8) Operation
  9) Performance Evaluation
  10) Improvement
  11) Annex

- **ANSI/AIHA/ASSE Z10 (2012)**
  - Management Leadership & Employee Participation
  - Planning
  - Implementation and Operation
  - Evaluation and Corrective Action
  - Management Review

- **OHSAS 18001 (2007)** *
  - OH&S Policy
  - Planning
  - Implementation & Operation
  - Checking
  - Management Review
ISO 45001 - draft

- ISO 45001 CD2
  - 1) Scope
  - 2) Normative References (n/a)
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  - 11) Annex

Safety-I – when nothing goes wrong

Safety is a condition where the number of adverse outcomes (accidents / incidents / near misses) is as low as possible.

Safety-I is defined by its opposite - by the lack of safety (accidents, incidents, risks).

The premise for Safety-I is the need to understand why accidents happen.

Accidents and incidents represent a lack of safety.

If we want something to increase, why do we use a measure that decreases?

How can we learn about safety by studying situations where it isn’t there?
Managing safety by snapshots

Safety management is based on analysing situations where something went wrong, hence on a set of snapshots of a system that has failed, described in terms of individual “parts” or system structures.

Acceptable outcomes are continuous

Unacceptable outcomes are discrete

How to feel safe

The belief in causality (Causality Credo)

1. Adverse outcomes happen because something has gone wrong (cause-effect thinking + value congruence between cause and effect).
2. Causes can be found and treated (rational deduction).
3. All accidents are therefore preventable (zero harm principle).

ZERO Mindset

We believe that all injuries and occupational illnesses are preventable. We are responsible for preventing and correcting unsafe behaviour and work conditions.

NO Repeats

All unsafe practices and incidents will be investigated to determine what happened and why. All necessary steps will be taken to prevent recurrence.

SIMPLE Non-negotiable standards

We will adopt a common, simple set of non-negotiable standards and rules throughout the Group. Divisional line management at all levels has the responsibility of implementing and maintaining the standards and rules.
The second interpretation of safety

Safety is the prevention of harm to patients

\[ \text{Safety} = \sum_{1}^{n} \text{Accident}_i \]

There is a presence of failures (things that go wrong) due to risks and hazards. The number of harmful events can be counted.

“Safety is a dynamic non-event”

\[ \text{Safety} = \sum_{1}^{n} \phi \text{Accident}_i \]

There is an absence of failures (things that go wrong), but as a result of active engagement. If safety is a non-event, it can neither be observed, nor measured.

Non-accidents

Is it possible to count the number of times something does not happen?

Why is it safe to drive or walk?

When we drive on the streets or move in a crowd, we continuously adjust our performance to what other people do.

Just as others continuously adjust to what we do – or will do.
Different ideas about why work is safe

Work is safe because ...

Why are there different ideas about why work is safe?

And how can they be reconciled?

Performance adjustments are necessary

Availability of resources (time, manpower, materials, information, etc.) may be limited and uncertain.

People adjust what they do to match the situation.
Performance variability is inevitable, ubiquitous, and necessary.

Because of resource limitations, performance adjustments will always be approximate.

Performance variability is the reason why everyday work is safe and effective.

Performance variability is the reason why things sometimes go wrong.
Same process

different outcomes

Function (work as imagined)

Everyday work (performance variability)

Malfunction, non-compliance, error

Success (no adverse events)
Acceptable outcomes

Failure (accidents, incidents)
Unacceptable outcomes

Increase safety by facilitating work

Understanding the variability of everyday performance is the basis for safety.

Function (work as imagined)

Everyday work (performance variability)

Malfunction, non-compliance, error

Failure (accidents, incidents)
Unacceptable outcomes

Constraining performance variability to remove failures will also remove successful everyday work.
Safety II – When everything goes right

Safety-II: Safety is a condition where the number of successful outcomes (meaning everyday work) is as high as possible. It is the ability to succeed under varying conditions.

Safety is defined by its presence.

The premise for Safety-II is the need to understand everyday performance.

If the level of safety increases, the proxy measure should also increase.

Safety can only be improved by studying situations where it is present!

Safety-II is achieved by trying to make sure that things go right, rather than by preventing them from going wrong.

The third interpretation of safety

Safety is the prevention of harm to patients

Safety is defined by its presence.

There is an absence of failures (things that go wrong) due to risks and hazards. The number of harmful events can be counted.

Safety = \sum_{1}^{n} \text{Accident}_i

“Safety is a dynamic non-event”

Safety = \sum_{1}^{n} \text{\phi Accident}_i

There is an absence of failures (things that go wrong), but as a result of active engagement. If safety is a non-event, it can neither be observed, nor measured.

Safety is a dynamic event

Safety = \sum_{1}^{n} (\text{acceptable outcome})_i

Safety is the presence of acceptable outcomes. The more there are, the safer the system is.
## The focus of resilience

Resilience is an expression of how systems cope with everyday situations by adjusting their performance to the conditions. A system's performance is resilient if it can function as required under expected and unexpected conditions alike (changes / disturbances / opportunities).

Resilience is not a system property, something it has, but a performance quality, something it does.

## Two types of Safety Management

### SAFETY-I
- **Zero accidents** – elimination of preventable harm
- **Counting adverse outcomes** – things that go wrong.
- **Linear thinking**: eliminate, prevent, protect
- **Work-as-imagined**: WAI-WAD compliance

### GOALS / TARGETS:
What is the goal or target?

### POSITION:
Where are we now?

### MEANS:
How can we improve?

### FOCUS:
What should be in focus?

### SAFETY-II
- **As much as possible goes well**
- **Measuring processes and functions** – things that go well.
- **Non-linear thinking**: improve, support, facilitate
- **Work-as-done**: Reconcile WAI-WAD

### Linear thinking:
- Eliminate, prevent, protect

### Measuring processes and functions:
- As much as possible goes well

### Non-linear thinking:
- Improve, support, facilitate

### Work-as-done:
- Reconcile WAI-WAD
Creating A Learning Culture: HOP

✓ To Improve Human and Organisation Performance

HOP: An Open and Involving Approach to Finding System Related Causes and Solutions

The GE Approach to HOP

“No Fault/No Blame” Criteria:

• People will make Unintentional Errors - Mistakes
• Error likely situations are Predictable
• Individual behaviors are Influenced
• Operational upsets can be Avoided
• Our Response to Failure Matters
HOP - Error Prevention Tools

- Self-checking
- Peer-checking
- Concurrent verification
- Independent verification
- Three-way communication
- STAR – stop, think, act, review
- “A real-time job pause”
- Pre-job briefing
- Post-job briefing
- Procedure use & adherence
- Problem-solving
- Questioning attitude
- Conservative decision making
- Stop & collaborate

Communicate – Learn - Adapt

Start Every Day:
- Talking About the Work/Tasks Ahead
- Expectations, Safety Concerns, Procedures
- Especially Critical Steps or Situations, and Controls

End Every Day with an L8MM:
- Discuss What Went According to Plan
- Discuss Variations and How Were They Handled
- Do We Have Any Continuing Concerns?
- Do You Have Any Suggestions for Tomorrow?
**HOP Learning Teams**

- Team brought together to learn – 4 to 6 workers
- First discuss the work of the day – “How did you start your day?”
- Discuss the “conditions” that existed and list
- No problem solving during the first meeting – just learning

**HOP Learning Team Questions**

About a week after an incident or discovery of operational drift the Learning Team starts to investigate…

1. What other task(s) do you do that are similar (or have you done) that could have lead to the same situation and outcome?

2. Do you feel you or others took, or have taken a shortcut because the “proper way” to do the task doesn’t make sense or is unnecessary? Explain.

3. What have you or others done differently in the past to avoid this same unwanted occurrence from happening? Explain.

What can we change to ensure this doesn’t happen again?
HOP Learning Team Questions

5. If you had a similar issue at your home, what would you do, or would you have done differently?

6. What ideas do you have to get others who do this same task to concentrate and focus so they do it the proper way?

7. What was different about this time that led to this situation and outcome?

8. If we gave you a blank check to fix this issue or situation, how would you do it?

HOP Investigative Approach

When an Event Happens:

1. Are the people OK? (not, why is the line down?)
2. Is the facility, equipment, process safe and stable?
3. Tell us the Story of what happened?
4. What else could have happened?
5. What Factors led Up to this event?
6. What worked well?
7. What didn’t work well or failed?
8. Where else has a problem like this happened before?
9. Where else could this problem happen?
10. What else should we know?
Final Thoughts About Safety 2.0

• Work is normally done **Efficiently and Safely**

• Look for what is “Right”

• Learn how work is actually Done, efficiently and safely

• Use this knowledge of how & why things usually go “Right” to explain how occasionally things “Go Wrong”

Safety 2.0 – Investigation Thoughts

• Variability is normal and most often is useful, and comes from positive, well-intentioned effort and resourcefulness

• Look at all workers as Key Resources, with the resilience necessary to adapt to variability within systems
  • Workers are Not a Liability or Hazard to themselves or others, but an important source of information and knowledge

• Begin to ask questions about the reality of work.
  • How is work actually done
  • What barriers exists that result in altered procedures and method?
  • Does variability introduce new hazards or risks?
  • Are procedures and controls adequate?
  • What should we ask that we won’t think to ask?
## Two types of Safety Management

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### GOALS / TARGETS:

- **What is the goal or target?**

### POSITION:

- **Where are we now?**

### MEANS:

- **How can we improve?**

### FOCUS:

- **What should be in focus?**

### SAFETY-II

- **As much as possible goes well**
- **Measuring processes and functions** – things that go well.
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A Disruptive Paradigm: Systems Approach to Human Error

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Disruptive Paradigms

Recently, I was reading an article from The Firebird Forum that was published by William Corcoran, PhD. The topic was about "disruptive paradigms" and was advocating for more transparency throughout organizations. It was a great article that I highly recommend you add to your reading list.

There were a number of thoughts conveyed in this article by Dr. Corcoran, the least of which had to do with the term "disruption". "Disruption can be adverse or beneficial. The value judgment of a disruption often depends on whether one has been helped or hurt by it and usually comes later than the disruption itself. When we use the word 'paradigm' we are referring to a way of thinking, a way of perceiving, and/or a way of performing."

Corcoran goes on to write that "A disruptive paradigm is a paradigm that is life-threatening to the old ways of looking at things (and provides an interesting list of examples). Often when a critical mass of people in an organization or in a society adopt the disruptive paradigm the days of the old paradigms are numbered. This is often a tipping point after which the old paradigm recedes and the disruptive paradigm gains momentum. But more often the disruptive paradigm exists side-by-side with the previously conventional paradigm for years, and this co-existence is antagonistic."

This article goes on to make its point about the need for greater transparency, but before it does it stresses that there is often great resistance to the disruptive paradigm. Advocates are labeled as heretics and seen as threats to stability, which they most certainly are.

Instead of continuing here to discuss disruptive paradigms and the need for greater transparency (which you can read for yourself in Dr. Corcoran's article) I want to put forward some thinking about another disruptive paradigm: Systems Thinking About Human Error.

Working In Context

Systems thinking isn't new to the safety world. In fact it has been around for a long time in aerospace and nuclear safety. But to most safety professionals or practitioners, focusing on risk factors that arise from the workers and their behavior has been more in-vogue than assessing risks from work related systems.

According to Nancy Leveson, PhD. and professor in aeronautics and engineering systems at MIT, systems thinking is an approach to problem solving that suggests the behavior of a system's components only can be understood by examining the context in which the behavior occurs. Viewing operator behavior (and human error) in isolation from the surrounding systems prevents full understanding of why an accident occurred; and thus the opportunity to learn from it.

Last month I spoke at the ASSE Professional Development Conference in Dallas on the topic of human error and how incident investigations often lead to erroneous conclusions. Titled "Human Error: Threats and Threatening External Forces."
is NO Root Cause", the presentation helped the attendees see how most incident investigations are biased from the start.

It is easy to see in hindsight what should have been done, but in the moment it is far more difficult for the employee to see what is about to happen. Workers are engaged in their work, trying to be efficient and get the job done. They probably have done the job successfully many times, and may have been praised for how quickly and effectively they performed the work. But then one time things didn’t turn out as planned and an incident occurred.

Almost instinctively, the supervisor and others look to see what the person did wrong as they begin to investigate. Often biased in their beliefs about the person’s role in the mishap, they embark down a road to find the root cause. Assuming that accidents have a root cause these investigations focus on the mistakes or behaviors involved (operator error) or technical failures, and ignore the plethora of organizational related issues that likely influenced the behavior (the context). Thus, the behavior of the worker is most often blamed for the mishap.

Focusing of the failure of the worker and their attendant behavior is easy to understand when you think about who gathers the initial information during investigations. Then consider how difficult it is for them to point out flawed management decision-making, safety culture problems, regulatory deficiencies, inadequate resources, and the pressure of time related issues, to name a few. In the October, 2014 issue of the ASSE Professional Safety Journal, Fred Manuele wrote about incident investigations and how our methods are flawed. He pointed out that much of our thinking about what and how to investigate, and who should conduct investigations is linked to the writings of H. W. Heinrich.

Heinrich believed that supervisors should be the ones to investigate, since they were closest to the work, and that it was their job to “identify the first proximate and easily prevented cause in the selection of remedies for the prevention of incidents.” Of course this led poorly trained supervisors and anyone else conducting an investigation to look at what the person did or did not do, and, as Heinrich suggested, “to consider psychology when results are not produced by simpler analysis.” After all, in Heinrich’s assessment 88% of all incidents were due to the unsafe acts of people. Thus, the remedies or corrective actions that followed were focused on what the person did and their lack of knowledge, situational awareness, motivation, or worse their disregard for the rules or need for protective equipment.

As continues to be the situation today, supervisors are poorly trained in the investigative process, and lack the time and motivation to dig deeper into any of the system related issues. As a result, most organizations find root causes that are really only symptoms without fixing the process that led to those symptoms. As Dr. Leveson sees it, "if we don’t begin to look at the big picture and understand the context in which the behavior occurred we will continue to have process flaws that will fail again."

So here is the disruptive paradigm shift: Human error is not the root cause of most incidents. All human behavior (and error) is affected by the context in which it occurs, and the context is the sum of all processes or organizational systems that influenced the situation.

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The "Systems Paradigm"

We've all heard speeches at conference or read books that reference the work of James Reason. A researcher and writer about the cultural and organizational influences that affect humans and their actions, Dr. Reason concluded "human error is only a symptom, not a cause -- A symptom of issues deeper inside the organization resulting from its systems (how the product is built, parts are sourced, contract deadlines are established, compensation is determined, performance is judged, etc.)."

From recent articles about the VPPPA conference last fall, we are learning about a new safety initiative at General Electric called Human and Organizational Performance (HOP). Based on the work of James Reason, and the desire to move beyond the results achieved from other initiatives, such as Six Sigma and Lean, GE has embraced HOP in an effort to wring out systems issues within the organization.

GE is shifting its paradigm and embracing the new Systems Paradigm. They have turned away from focusing on the employees' behaviors to accepting the fact that humans will make errors or mistakes. Though it is far easier to focus on people and their behaviors, HOP shifts the discussion to process design, methods, tooling, procedures, schedules, and such. They know this shift will take time, and will likely face strong resistance (like Dr. Corcoran suggests), but in the end will lead to a much stronger culture of performance.

James Leemann, PhD., wrote about HOP in one of his ISHN articles. To him, systems thinking is long over-due. Fixing the system and not trying to fix the people is the basic principle of the HOP philosophy. He wrote, "Think about if you were a safety professional working in a manufacturing plant with 2,000 employees producing more than 400 products from 100 different processes, and the safety performance is less than stellar. Would you rather fix the systems (i.e., 100 processes) or fix the behaviors of 2,000 employees? Of course, keep in mind that the systems tend to stay the same day in and day out; whereas the behaviors of the employees change constantly."

Summary

Systems thinking is a disruptive paradigm. Clearly it forces safety professionals and management to think differently about accident causation, but it also opens the door to many other possibilities. Initiatives like HOP hold great promise in making this shift away from behavioral causation. Leemann says it well, "consider the willingness and enthusiasm HOP-trained employees will have locating risks and impediments in their work area with the objective of reducing, eliminating, or employing defenses to prevent injury or loss, versus being watched and critiqued by someone else in the name of behavior based safety." Obviously Dr. Leemann is "a disruptor" and not a fan of BBS. Regardless of your position on BBS, I hope you see the value in looking beyond what the worker did or didn't do, the choice they made, or other identifiable failure and see the value in looking at the context they faced at the time.

It is an exciting time within the safety profession. We are hearing presentation after presentation, and reading numerous articles that are talking about human error and the systems approach to safety. This is part of our evolutionary journey as we move through the focus on behavior, to the importance of the influence of cultural, and now to initiatives directed at the organization and its systems. Whether we
call this new paradigm "Safety 2.0" or "Safety Different" doesn't matter. What does matter is that we all embrace this change of thinking and do our best to spread the word.

As organizations mature I see us embracing all methods, systems and behavioral. In upcoming blog posts I will write more about the HOP methods, and what other companies are doing to shift to systems thinking. I'd love to hear your thoughts on this topic and any ideas you might have that could help others. Thank you for reading and please share this post with others.