Resilience Engineering: creating system capability to manage the unexpected

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7 December 2015
830a – 400p
Session Objectives

- Identify and be able to apply methods of Safety I – safety culture, cause analysis, process improvement, and principles of Safety II - High Reliability Organizations and Resilience Engineering.

- Identify sources of Resilience in existing systems to retain through change.

- Develop a strategy for safety improvement using Resilience Engineering based on demonstration projects in healthcare.
SAFETY I AND II: WHAT ARE THEY? AND HOW DO THEY FIT TOGETHER?
Safety 1

- Safety defined by the lack of safety (accidents, incidents, risks)
- Focus on events where safety is absent, rather on those where safety is present.

Why is a HIGHER level of safety measured by a LOWER number of adverse outcomes?

Safety II

- Safety defined by as many things as possible go right.
- Focus on everyday actions and outcomes – risk as well as opportunities.

System is measured by the number of safe outcomes and the number of unsafe outcomes.

Dominant Safety Thinking

Modeled after Hale and Hovden (1998) and Hollnagel (2014)
Dominant Accident Model

- Complex Non-linear
- Complex Linear
- Sequential

Modeled after Hale and Hovden (1998) and Hollnagel (2014)
Safety Science

Rules & devices
Process reliability
Behavior-based safety

High Reliability Organizations
Resilience Engineering

Safety I

Safety II

Usability Testing

Usability testing is systematic and performed by human factors specialists – more thorough than asking users what they think.

- Before you purchase device or equipment
- After purchase when device or equipment is sub-standard. (You can at least train users on error prone acts – the tricky parts.)
- When cause solving
What Can Leaders Do?

**Hot Causes:**
1) Harm is not zero
2) Best care is not 100%
3) Patients are not always treated with compassion

**Cool Solutions:**
1) Improve processes: Lean, Six Sigma, TQM, PDSA, etc.
2) Fix proximate causes: cause analysis
3) Fix proximate causes: human factors
4) Prevent proximate causes: usability testing
Anatomy of a Safety Event

**Multiple Barriers** - technology, processes, and people - designed to stop active errors (our “defense in depth”)

**Active Errors** by individuals result in initiating action(s)

**Latent Weaknesses** in barriers

**EVENTS of HARM**

**PREVENT**

- The Errors

**DETECT & CORRECT**

- The System Weaknesses

Influencing Behaviors at the Sharp End

“You have to manage a system. The system doesn't manage itself.”

W. Edwards Deming

"A bad system will DEFEAT a good person every time."

W. Edwards Deming

Adapted from R. Cook and D. Woods, Operating at the Sharp End: The Complexity of Human Error (1994)

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"At the sharp end, there is almost always a discretionary space into which no system improvement can completely reach. Systems cannot substitute the responsibility borne by individuals within that space."

Sidney Dekker

Just Culture: Balancing Safety & Accountability (2007)
Non-technical skills describe how people interact with technology, environment, and other people. These skills are similar across a wide range of job functions. These skills include attention, information processing, and cognition.

Generic non-technical skills:

- Situational awareness
- Attention
- Communication
  - repeat backs
  - call outs
  - phonetic & numeric clarification
  - clarifying questions
  - inquiry, advocacy, assertion
- Critical thinking
- Protocol use
- Decision-making

Flin, O'Connor, and Crichton, Safety at the Sharp End, 2008
What Can Leaders Do?

**Hot Causes:**
1) Harm is not zero
2) Best care is not 100%
3) Patients are not always treated with compassion

**Cool Solutions:**
1) Prevent error: non-technical skills as safety culture
2) Improve reliability: operational leadership as leader skills
   - Safety Message
   - Daily Check-In or Daily Safety Brief
   - Safety Huddle
   - Lead local learning systems
Optimizing Reliability

- **Reliability Culture**
  - Safety as the core value
  - Behavior expectations for error prevention
  - Collaborative Interactive Teams
  - Leadership behaviors for reliability

- **Behavior Accountability**
  - Human Factors
  - Process, Protocol & Technology
- **Process, Protocol & Technology**
  - Resource allocation
  - Evidence-based practice (e.g. bundles)
  - Technology enablers

**Design to Optimize Human Performance at the point of people interface:**
- Easy to do the right thing – impossible to do the wrong thing
- Intuitive design
- Mistake proofing by design (i.e. poka yoke)

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Human Factors Integration

- Human Factors described relationships among people and the rest of the socio-technical system.
- When you solve one relationship you are applying Human Factors.
- When you solve all of the relationships – you are applying Human Factors Integration.
High reliability organizations (HROs)
“operate under very trying conditions all the time and yet manage to have fewer than their fair share of accidents.”
*Managing the Unexpected* (Weick & Sutcliffe)

**Risk** is a function of *probability* and *consequence*.
By decreasing the probability of an accident, HRO’s recast a high-risk enterprise as merely a high-consequence enterprise.

HROs operate as to make systems ultra-safe.
Reliability Culture - Genius of the AND

Safety Focus + performed as intended consistently over time = No Harm

Evidence-Based Process Bundles + performed as intended consistently over time = Clinical Excellence

Patient Centered + performed as intended consistently over time = “Satisfaction”

Financial Focus + performed as intended consistently over time = Margin

RELIABILITY CULTURE
“Failure Prevention”
### A Survey of HRO Theory

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<th>Scientists</th>
<th>Craftsmen</th>
<th>Field Engineers</th>
<th>Integrators</th>
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<td>Ron Westrum, Patrick Hudson, et al</td>
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<td>Charles Perrow</td>
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Weick & Sutcliffe 2007

Anticipation has three elements:

1. **Preoccupation with failure**: to avoid failure - look for early signs
2. **Reluctance to simplify interpretations**: critical thinking and looking past easy explanations provides situational awareness
3. **Sensitivity to operations**: systems are dynamic and non-linear – provide direct oversight to adjust to unpredicted interactions

Containment has two elements:

4. **Commitment to resilience**: the organization maintains function(s) during high demands. Resilience has three components:
   - Absorb demands and preserve functions
   - Maintain the ability to return to service after untoward events
   - Learn and grow from untoward events
5. **Deference to expertise**: decision-making seeks those with knowledge and experience regardless of rank or status
Bounces Back

resilience

riˈzilyəns/
noun
noun: resilience; plural noun: resiliences

1. the ability of a substance or object to spring back into shape; elasticity. "nylon is excellent in wearability and resilience"

2. the capacity to recover quickly from difficulties; toughness. "the often remarkable resilience of so many British institutions"
Stress, $\sigma$

Brittle

Ductile

Area under curve = absorbed energy

Strain, $\varepsilon$
Brittlenessness

Resilience = \frac{1}{\text{Brittlenessness}}
Boundary of Economic Failure
(management pressure toward efficiency)

Boundary of Acceptable Workload

Acceptable Performance Boundary

Dynamic Safety Model  (Rasmussen 1997)
Resilience Engineering

- Resilience Engineering conserves and sometimes increases the resiliency of socio-technical systems.

- Resilience means “bounces back” – the system adjusts to a demand or upset.

- Resiliency in socio-technical systems emerges from people perceiving change and making adjustments.
What Can Leaders Do?

Hot Causes:
1) Harm is not zero
2) Best care is not 100%
3) Patients are not always treated with compassion

Cool Solutions:
1) Collegial care teams (teams that think together)
2) Human Factors Integration by in-situ simulation
3) Harm Early Warning Systems (HEWS)
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<td>Definition of safety</td>
<td>As few things as possible should go wrong.</td>
<td>As many things as possible should go right.</td>
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<td>Safety management principle</td>
<td>Reactive, respond when something happens, or is categorized an unacceptable risk.</td>
<td>Proactive, continuously trying to anticipate developments and events.</td>
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<td>Explanation of accidents</td>
<td>Accidents are caused by failures and malfunctions. The purpose of investigation is to identify causes and contributing factors.</td>
<td>Things basically happen in the same way regardless of outcome. The purpose of an investigation is to understand how things usually go right as a basis for explaining how things occasionally go wrong.</td>
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<td>Attitude to the human factor</td>
<td>Humans are predominately seen as a liability or a hazard.</td>
<td>Humans are seen as a resource necessary for system flexibility and resilience.</td>
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<td>Role of performance variability</td>
<td>Harmful – should be prevented as far as possible.</td>
<td>Inevitable but also useful. Should be monitored and managed.</td>
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Two Types of Reliability

Managing the expected

- Standardization
- Standard work
- Automation

*Process reliability*

Managing the unexpected

- Thinking
- Thinking in teams
- Information systems + adjustments

*System resilience*
Shared Thinking Exercise

1. Form a “system” in pattern of the Rasmussen Dynamic Safety Model

2. Evaluate changes to boundary and operating point.

3. Reflect: how we know our “distance” to a boundary? What adjustments do we have to make?