The Joint Application of RCA, HPI & Resilience Engineering Principles

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After This Presentation You Will Be Able to:

► Describe what “Struck by” incidents are

► Distinguish between the PROACT Root Cause Analysis (RCA) Approach and the Lewis Tree Service (LTS) HPI and Resilience Engineering approaches

► Evaluate the findings from the joint analysis

► Compare notes on what we learned as a result of working together
What are “Struck by” incidents?
The #1 Most Dangerous Job in America
(Tree Work Including Logging Workers)

There are ____ fatalities per year in the logging industry.

A) 50  
B) 75  
C) 100  
D) 500
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Logging fatal injury rate was slightly more than 132 per 100,000 people, making logging by far the most dangerous industry in the U.S.

Electrical power-line installer and repairer The fatal injury rate for power-line workers was approximately 21 per 100,000.
What are ‘Struck By’ Incidents?

- Being struck by a piece of tree
- Most common accident: worker being struck by tree or falling branch
- TCIA*: Typical struck-by victim remained in the Drop Zone (DZ)

*The Tree Care Industry Association (TCIA) is a trade association of 2300 tree care firms and affiliates worldwide whose mission is to advance tree care
What is a ‘Drop Zone’ (DZ)?

Drop Zone Establishment Diagram for Sectional Removal Operations – Roadside Example

- A minimum of FOUR Drop Zone markers in place – two optional shown
- Drop Zone markers placed at a minimum TWENTY feet outside of drip edge of tree to be removed in a controlled manner

Traditional DZ Approach:
- Do not cross this line while work is being performed aloft.
- Do not enter w/o permission from worker aloft using 3-way communication.

These examples are guidelines and do not represent all instances. Diagrams are not to scale.
‘Struck By’ Incidents: The Shape of SURPRISE

- Tree falls in unexpected direction due to
  - Cutting Techniques
  - Rigging Techniques

- Hidden decay or damage

- Part of adjacent tree

“Boundary areas are discovered only through experience of surprise.” - David Woods
Compare PROACT RCA Approach and the LTS HPI & Resilience Engineering Approaches
Compare Use of ‘Initial’ Event Timelines

Sample RCA Event Time (will generally span over a longer time period):

HPI & RE: What is happening with the person (spans the day of event)?

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Timeline of events

Normal Day

Incident Day/s
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“It happens fast!”

You can show the information map and pictures/drawings to the focus group in the next stage to help them understand the event and conditions that supported decisions and actions.
The PROACT RCA Approach
RCA as a System, Not a Task

**Preserve**
- Retain Incident Information
- “First-Pass” Data Collection
- Gather Additional Data

**Order**
- Determine RCA Is Required
- Select Team Members
- Establish Functional Guidelines
- Review Available Data
- Build Logic Tree
- Develop and Verify Hypothesis
- Determine Verification Data Needs

**Analyze**
- Select Team Members
- Establish Functional Guidelines
- Review Available Data
- Build Logic Tree
- Develop and Verify Hypothesis
- Determine Verification Data Needs

**Communicate**
- Report Team Findings
- Present Team Recommendations

**Track**
- Implement Recommendations
- Measure Effectiveness

"First-Pass" Data Collection
Investigation
Analysis
Corrective Action
What Do You Think About the Term ‘RCA’?

"One honest question: First I thought that I agree that the concept of root causes is not adequate. Then I reflected it from my perspective of being a Forest Ecosystem Manager. I came to the conclusion that it is actually very adequate. Roots change over time, they are literally countless in numbers, adopt to changing conditions, alter their environment and even make trees walk (Mangroves can walk because roots adjust to changing salinity levels). The roots of trees communicate with each other, creating an intricate web/parallel universe. Thus my question: what is it exactly that “does not work well” with the image/approach of root causes?"

- Christoph H. Hinske
HPI
- What happened, starting from beginning of day?
- What did you think was happening?
- How common is this?
- What would have helped?
- What good practices have you seen?
- How can you tell things are getting tricky? (weak signals)
- When do you need to go into drop zone with work overhead?

Incident

RCA
- What happened, starting from undesirable outcome and moving backwards in short increments of time. Consistent with confirmed timeline chronology.
- Questioning guided by logic tree reconstruction of incident & evidence, starting with ‘How Could’ questioning about the physics of what happened?
- When a decision point is reached, the questions shift to ‘Why did you feel the decision you made at the time was appropriate?’
- Drilling down will uncover system’s flaws, cultural norms and socio-technical factors.
## Compare Evidence Collection Strategies

<table>
<thead>
<tr>
<th>PROACT RCA</th>
<th>HPI / RE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts</td>
<td>Systems</td>
</tr>
<tr>
<td>Position</td>
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<tr>
<td>People</td>
<td>People</td>
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<td>Paper</td>
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<tr>
<td>Paradigms</td>
<td>Stories</td>
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</tbody>
</table>
Why Do Event Physics Matter? Comparing Cut Dynamics

- Pop-Cut
- Conventional Wedge-Cut
- Humboldt Wedge-Cut
Pop-Cut Dynamics
Proper Cut/Full Overlap

- Direction of force to “pop”
- Cross-Sectional View
- Profile View
- Cut
- Opposing Cut
- Overlap
- Offset
- Fiber Split (“pop”)
- Area of Fiber Split
  (Offset X Diameter)
Pop-Cut Dynamics
Improper Cut/Partial Overlap

Cut
Opposing Cut
Overlap
Fiber Shear
Holding Wood

Cross-Sectional View

Profile View

No overlap

Push
The Impact of ‘Holding Wood’ on Fall Direction
Rotational Dynamics (Forensics)

Expected drop direction

Push

Actual drop direction

Rope Pull

Rotation

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Germination of an Undesirable Outcome

Undesirable Outcome

Physical Root Causes

How one labels causes/contributing factors, doesn’t matter!

Human Root Causes

Latent Root Causes

Policies & Procedures

Human Factors/ HPI

Communication Systems

Technology Systems

Training Systems

Management Oversight

Deficient Organizational Systems
Reconstructing the Event Using a Logic Tree

1. Describe the Event
2. Describe the Modes
3. Hypothesize
4. Verify the Hypotheses
5. Determine Physical Roots and verify
6. Determine Human Roots and verify
7. Determine Latent Roots and verify

7 Step Process (Abbreviated Structure Only)
Logic Tree Sample - Defining the Event and Mode(s)

Operational Work Stand Down

High Risk, Close Call During Class 30+ Hazard Tree Removal Operation
Employee had to:
1) be in the Drop Zone,
2) something then had to impact him and
3) he was not able to escape.
Evaluate the findings from the joint analysis
### Sample Latent Root Causes

<table>
<thead>
<tr>
<th>Sample Latent Root Causes</th>
<th>Sample HPI Approach Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of depth and breadth in cutting and rigging skills</td>
<td>Develop skills</td>
</tr>
<tr>
<td>Inadequate oversight to capture situations of inappropriate cutting techniques</td>
<td>Perform “forensics” as part of normal observations</td>
</tr>
<tr>
<td>“Work Stop” policy exists but not followed</td>
<td>Social factors: inviting, “speaking in”, leader response, identifying specific situations</td>
</tr>
<tr>
<td>Worker had overconfidence in ability and knowledge</td>
<td>Improve calibration: matching capabilities to difficulties</td>
</tr>
</tbody>
</table>

### Sample of Identified Contributing Factors

### Actionable Corrective Actions
Actual Learning Team Findings
Drop Zone Safety

**Traditional approach:**
- Do not cross this line while work is being performed aloft.
- Do not enter w/o permission from worker aloft using 3-way communication.

**Learning Team, we asked:**
- How well is DZ policy working?
- How can we get people to comply?

**We learned:**
- All but one person had “run like hell to escape a piece of falling wood”
- Procedural cover vs. functional DZ
- DZ too small or too large adds risk
- Situations where DZ boundary per policy not possible
- Close calls with falling limbs (esp. smaller pieces) not seen as a big deal.
Excerpts:

“...tree violently shifted... I ran as fast as I could downhill, looking for something to protect me.”

“tree slowly falling on toward power lines ...weight of tree was too much”

“noticed climber was not tied in properly... prevented a fall”
What did we learn as a result of working together?
### PROACT RCA

1. Questions based on FACTS!
2. Key: Data Preservation/Data Analytics (Physics)
3. Proper Stating of Investigation Objectives
4. Reliance on Evidence vs Hearsay
5. The Potential Impact of the ‘Truth’ as Received by Those Who Review Findings and Recommendations
6. Acceptance of the Truth

### HPI / RE

1. Questions based on learning from surprise and work as done
2. Key: what’s going on with person
3. Objective: learning and forward facing actions.
4. Story is more important than truth.

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**We have common goals:**
- Avoid blaming worker
- Identify deeper system issues.
What’s Next for Lewis Tree Service?

A Better Question May Be: What is critical for successful work?

Something happens
Absence of Safety

Nothing happens
Presence of Safety

Opportunities:
• Gain “Outside Insider” insights from unbiased Ohio State Safety Researcher
• Identify “Struck-by” risk factors
• Learn when to slow or stop. “too dangerous to take down” “large piece stuck” (escalation policy)
• Develop team situational awareness.

“…2nd most variable, dynamic work environment – only one worse was special forces …little have control over contrasted with factory safety (machines, lighting etc.). Level of variability is extraordinary.”
Thank You!

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