CII Research Team 293
Strategies for Hazard Recognition

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Essential Research Question

"Which practices, techniques, and processes are effective for establishing and improving hazard recognition in the construction industry?"

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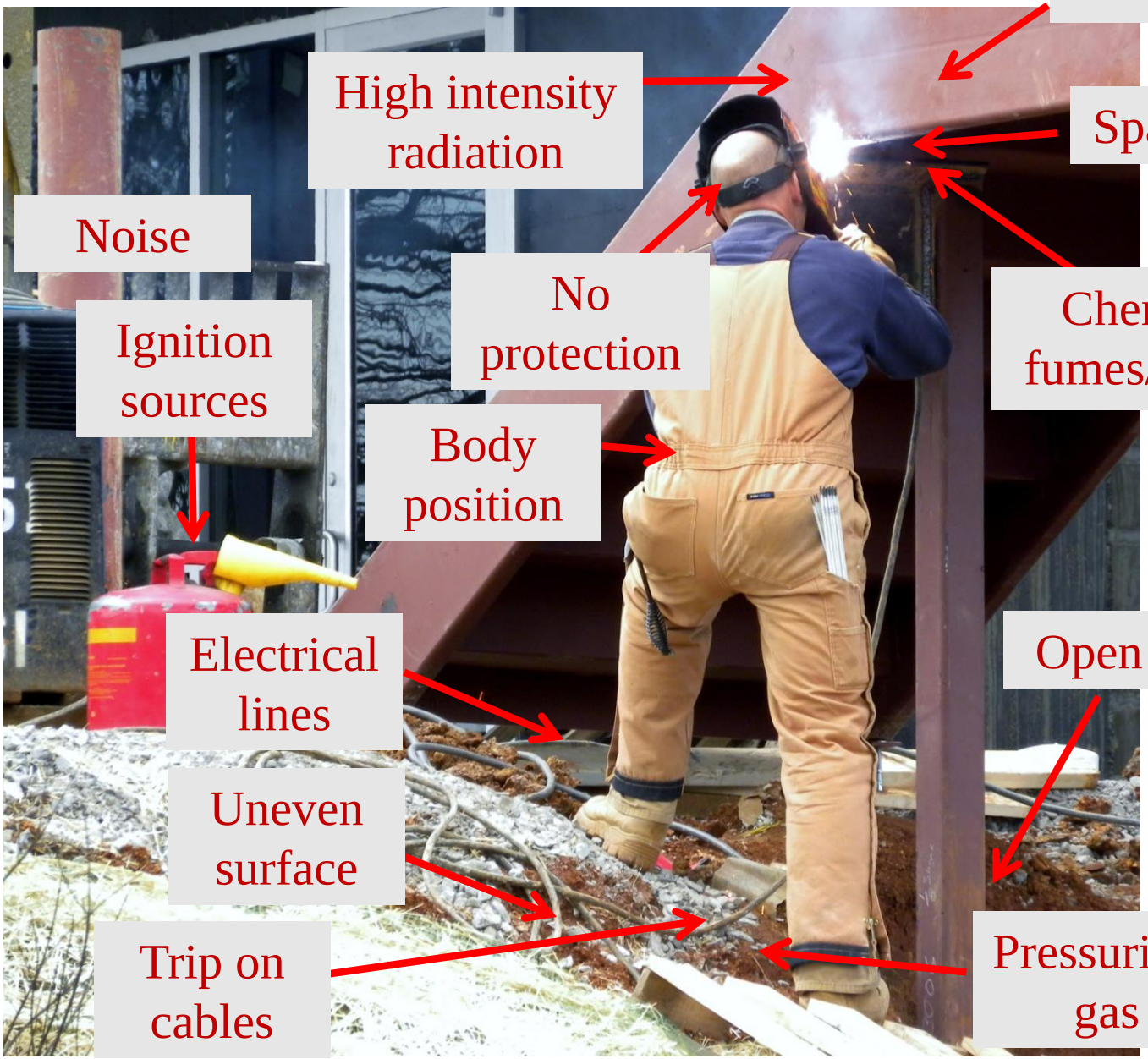
Hazard Recognition Test



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Why is hazard recognition important..?

High injury rates in the construction industry are partly due to worker's inability to recognize hazards.

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We Struggle with Hazard Recognition

- On average workers are only able to identify **45%** of hazards that they will encounter during a work-day.

- Why?
  - Lack of training
  - Lack of experience
  - Lack of communication
  - Changes in task/conditions
  - Inattention
  - Cognitive limitations
  - Others?

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Overview of research method

Identify innovative and effective hazard recognition strategies

Experimental field testing of developed strategy on active work crew

Develop strategy and field testing protocol

Analysis of field data and reporting of field testing experience

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Prioritizing Hazard Recognition strategies

- Goal: Identify the three most promising strategies that may transform construction hazard recognition
- Criteria
  - Active
  - Testable
  - Minimizes disruption
  - Easily implemented
  - Easy of workforce training
  - Scalable and adaptable
  - Promotes scenario building
  - Worker participation
  - Transformative potential

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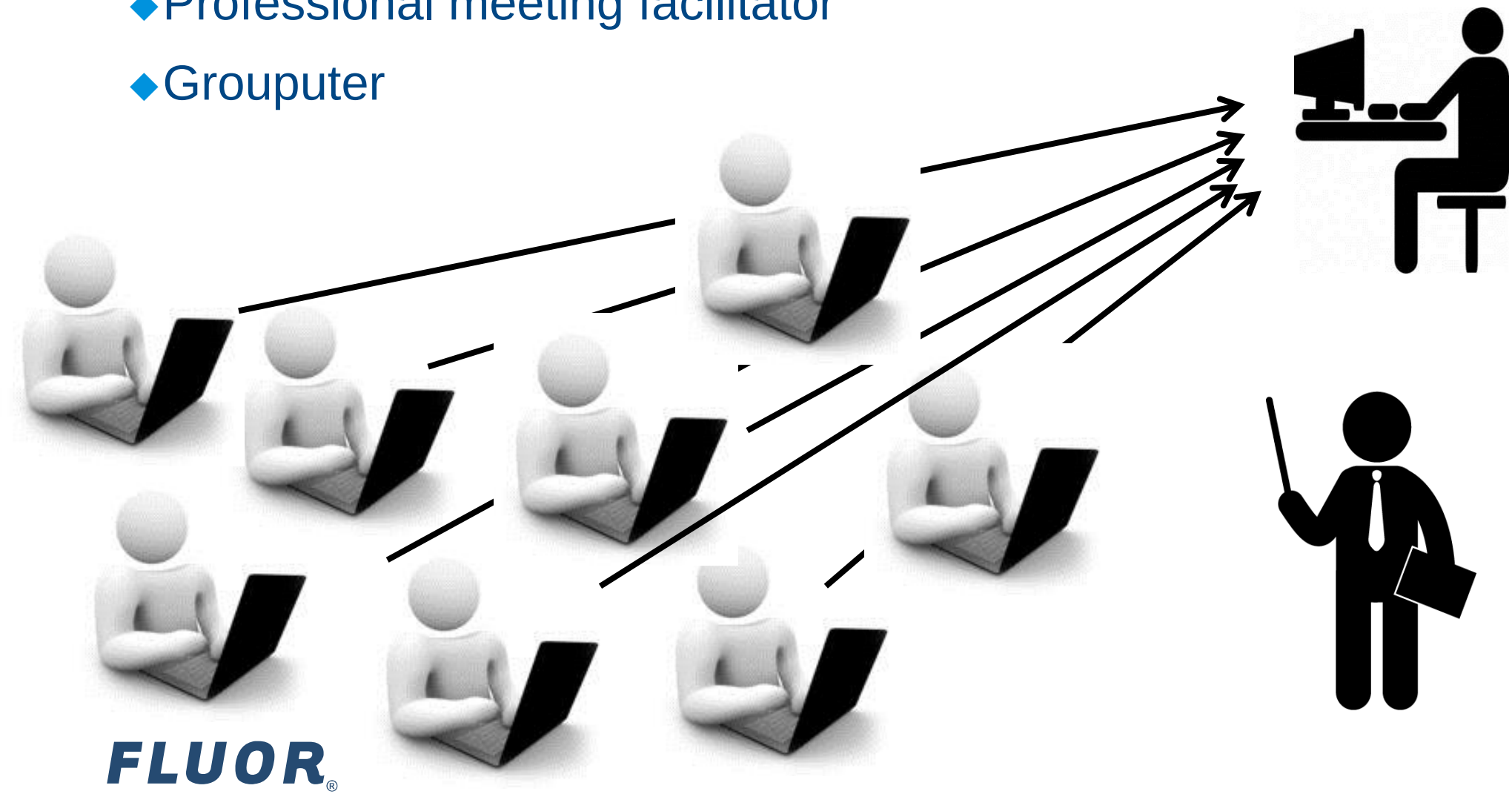
Prioritizing using Nominal Group Technique

- Each strategy was rated on 1-10 scale after 3 rounds of discussion
- Professional meeting facilitator
- Grouputer



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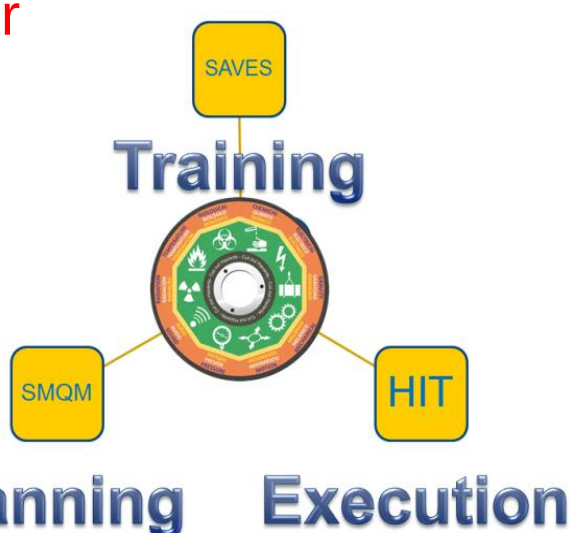
Subcommittee Development of 3 Strategies

1. Training: System for Augmented Virtuality Environment Safety (SAVES)
   - BIM model, >500 photographs, identified hazards
2. Planning: Safety Meeting Quality Measurement (SMQM)
   - Rubric content developed w/group brainstorming
3. Execution at worksite: Hazard Identification and Transmission Board (HIT Board)
   - Full-scale prototype built by team and vendor



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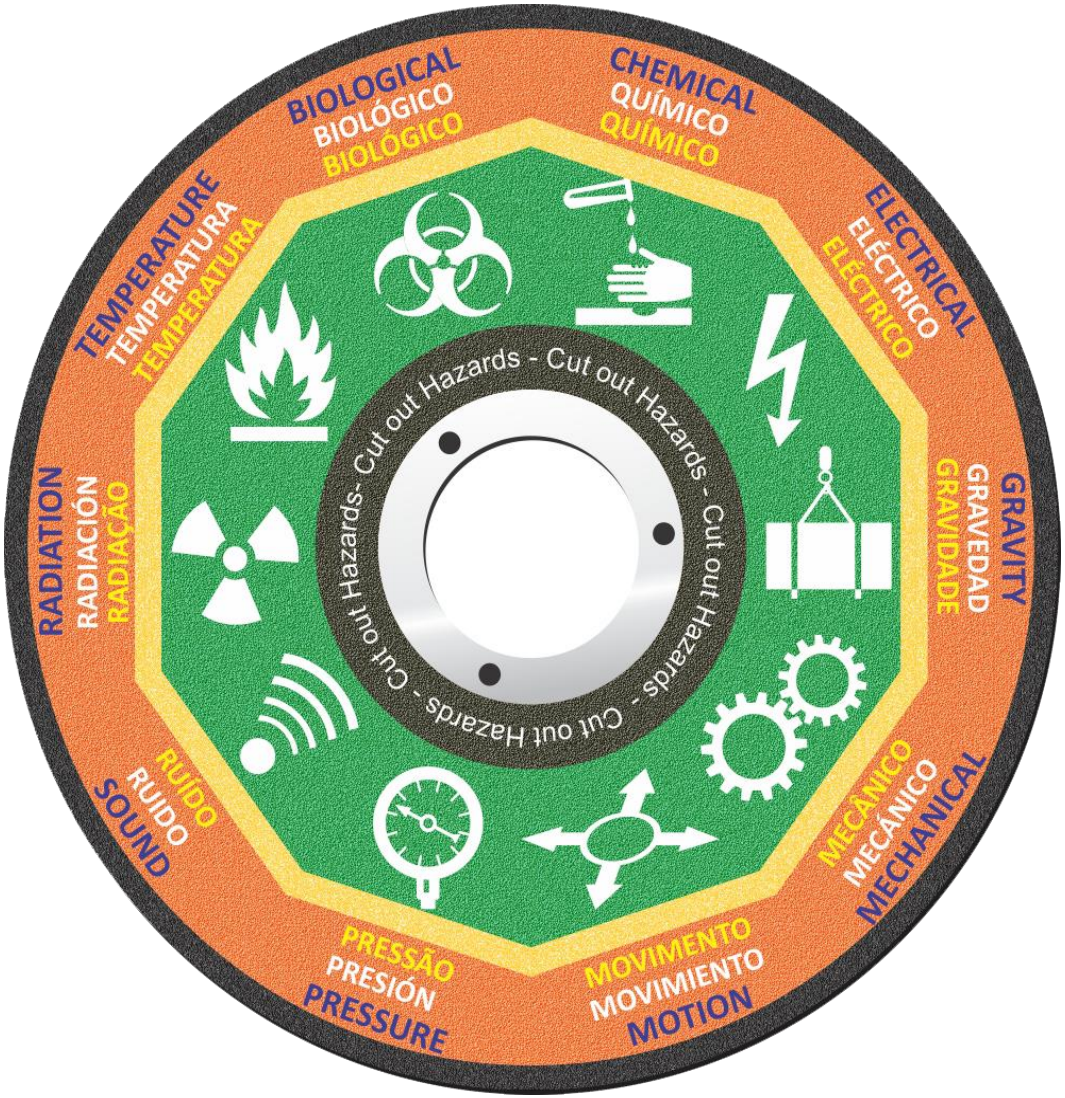
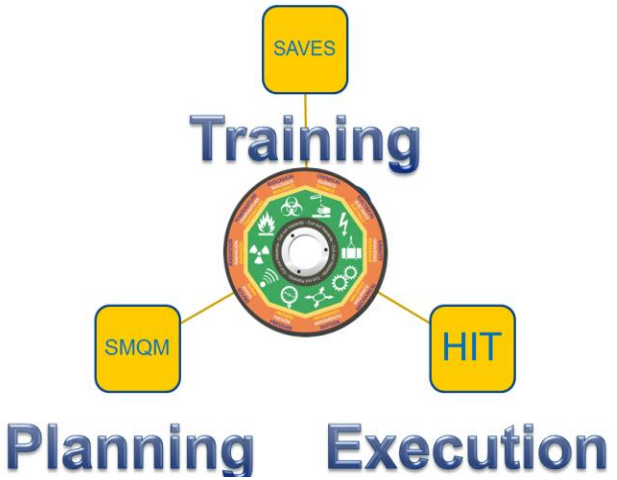
Energy Mnemonics for "Situational Awareness" within the Environment



<u>Hazard</u> - A condition or action that has the potential for an **unplanned release** of, or **unwanted contact** with, an energy source that may result in harm or injury to people, property, or the environment.



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Adapted from Fleming, 2008

System for Augmented Virtuality Environment Safety (SAVES)

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What is SAVES?

SAVES is a team training game that makes learning to identify potential hazards in construction fun, while being in a safe environment.

“I have not come across many other training programs that could engage workers for more than an hour like this tool does.”

- Company Safety Trainer

“After the training, the site evaluation process during permit release were more detailed and specific. ”

- Safety Representative

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A New Way of Communicating Safety Training

- Departure from typical stand-and-deliver training
- The students (crew) are in charge
- Learning through discovery and teaching one another
- Knowledge is gained through discussion with peers
- Exploring in a safe virtual environment

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Safety Meeting
Quality Measurement Tool (SMQM Tool)

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Pre-Job Safety Meetings

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Safety Meeting Quality Measurement Tool

Level	Plan			Do				Assess & Adjust		Score
	Identify the Job	Basic Steps	Hazard Identification & Mitigation	Discussion Location	Supervisor Leadership	Crew Participation	Documentation	Job Changes	Evaluate	
MATURE (3) To meet the criteria for an overall score at the Mature (3) Level, the score must total be 23 - 27. However, if any component scores at the Least Mature (1) Level, reduce the overall score to the Less Mature (2) Level.	The job as discussed is detailed and specific, adequately identifying the job to be conducted the tools that may be used and the environmental conditions at the jobsite. If multiple jobs are being conducted, separate pre-job meetings are conducted for each job.	The basic steps of the job are discussed and explained in sequential order. The integration of steps is discussed in enough detail to accurately describe the entire process of completing the job. The relationship between the worker, the task, the tools, and the work environment are detailed.	Relevant energy sources and specific hazards are addressed and discussed for the job; subsequent plans to mitigate the hazards are fully addressed (e.g. permits, tools, equipment, training, procedures). Evaluate activities for task demand (task difficulty) and suggest safety measures that may reduce task difficulty. Compare alternate 'means and methods' to accomplish specific tasks with safety as the focus, and implement the best (less hazardous) alternative. In addition, potential hazards in surrounding work areas, or associated with adjacent work, are discussed and properly mitigated. STOP Work Authority is discussed and both the specific work area conditions (e.g. wrong tool or equipment, not enough or the right people, lack of clear understanding) and general work area conditions (weather, adjacent work, emergencies, major weather event, plant alarms) that will stop work are addressed.	The pre-job discussion takes place where the job is to be conducted. This includes final Supervisor review and verbal approval to proceed with the work. Pre-inspect condition of tools, plants and equipment for the task to be accomplished. A pre-job preliminary discussion may take place away from the site of the job (e.g. construction trailer, gang box, conex, office) but the pre-job discussion is finalized where the job will take place.	Supervisor or Crew Lead facilitates the pre-job and asks specific questions of multiple workers to obtain their input regarding planning and conducting the work safely. Supervisor solicits active participation of all crew members and encourages members to lead various pre-job discussion components. Supervisor upholds and empowers workers to use STOP Work Authority. Supervisor evaluates awareness and competency of the crew in accomplishing the job.	Each crew member offers input, asks questions, and actively listens during the pre-job discussion. Crew members are given the opportunity to communicate to the supervisor any additional resources (e.g. PPE) they may need to perform the task safely. Crew members may lead various pre-job discussion components.	All components of the pre-job meeting are accurately documented on the appropriate project pre-job form. The pre-job form is reviewed and signed by each crew member, and signature approval is provided by the Supervisor or Crew Lead. Following any STOP Work Authority or changes to the job, the changes are documented on the pre-job form. Changes are noted as an update.	After lunch or breaks, the Supervisor revisits the job site(s) and assesses and identifies any changes or potential changes for the job (e.g. work or equipment change, change in crew members, visitors). The Supervisors regroups the crew and discusses the remaining steps for the job and its associated hazards, including additional mitigation measures for any changes or potential changes that may occur. If anything unexpected is encountered, work shall be stopped. Implications and corresponding changes shall be discussed and agreed prior to restarting work.	At the end of the day, areas of concern (components of the tool not utilized) are pointed out by the Supervisor. Feedback and changes to improve performance levels are discussed. Hazards that may have gone unidentified are recognized and recorded as lessons learned.	27 26 25 24 23
LESS MATURE (2) To meet the criteria for an overall score at the Less Mature (2) Level, the score must total be 14 - 22.	The job as discussed is specific (i.e. work tasks are appropriately identified); however, it is not detailed (associated tools and work methods are not thoroughly detailed) and therefore does not identify all of the work to be completed. Tools required to complete the job and environmental conditions are ignored.	The basic steps of the job are discussed and explained in sequential order. However, the integration of steps is discussed only in general terms. The relationship between workers tasks and tools are not considered.	Relevant energy sources and specific hazards are addressed and discussed; subsequent plans to mitigate the hazards are addressed (e.g. permits, tools, equipment, training, procedures). However, potential hazards in surrounding work areas, or associated with adjacent work, are not discussed. Alternative 'means and methods' are not discussed.	Pre-job discussion takes place away from the site of the job (e.g. construction trailer, gang box, conex, office). Final Supervisor verbal approval to proceed with the work takes place away from the job site. Inspection of tools, equipment and plants are not done.	Supervisor or Crew Lead facilitates the pre-job discussion and asks specific questions of multiple workers to obtain their input regarding planning and conducting the work safely. Supervisor does not discuss STOP-Work Authority.	Multiple crew members offer input, ask questions, and actively listen during the pre-job discussion.	All components of the pre-job meeting are accurately documented on the appropriate project form. The pre-job form is reviewed and signed by each crew member, and is approved by the Supervisor or Crew Lead. Changes to the work are not noted on the pre-job form.	After lunch or breaks, the Supervisor revisits the job site(s) and assesses and identifies any changes or potential changes for the job (e.g. work or equipment change, change in crew members, visitors). However, the Supervisor only regroups the crew if there are any changes to discuss.	Areas of concerns are pointed out by the Supervisor, at the end of the day. Unidentified hazards are not recorded and no feedback is obtained.	22 21 20 19 18 17 16 15 14
Least Mature (1) To meet the criteria for an overall score at the Least Mature (1) Level, the score must total be 9 - 13.	The job as discussed is not specific; subsequently the job activity is inadequately identified.	The basic steps of the job are discussed. However, the steps are not discussed sequentially and do not accurately describe the entire process of completing the job.	Only a few energy sources are addressed and only basic hazards and controls are discussed (e.g. permits and procedures).	Pre-job discussion takes place away from the site of the job (e.g. construction trailer, gang box, conex, office). Work commences prior to Supervisor verbal approval, but eventually, the Supervisor does approve the pre-job.	Supervisor or Crew Lead facilitates the pre-job discussion. There are only minimal attempts by the Supervisor or Crew Lead with workers to obtain their input regarding planning and conducting the work safely.	Only a few members of the crew offer input, ask questions, and actively listen during the pre-job discussion.	Most of the components of the pre-job meeting are documented properly. The pre-job form is reviewed and signed by each crew member, and is approved by the Supervisor or Crew Lead Supervisor.	The Supervisor revisits the job site but only if known changes have taken place (e.g. job shut downs or facility emergencies). The Supervisor may or may not regroup the crew to discuss the changes.	No follow-up of performance is conducted.	13 12 11 10 9

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Making Crew Leaders Better Communicators

- What a good safety meeting (communication) looks like
- Who, what, where, how to communicate
- Encourages healthy dialogue
- Crew participation

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Safety Execution at The Workface Using The Hazard Identification and Transmission Board (HIT)

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HIT Board

Radiation
Radiación

Temperature
Temperatura

Gravity
Gravedad

Sound
Ruído

Biological
Biológico

Motion
Movimiento

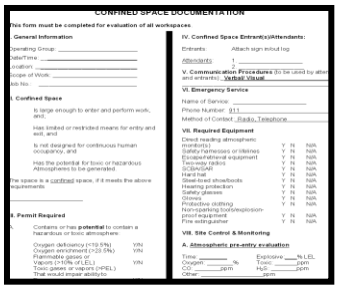
Electrical
Eléctrico

Chemical
Químico

Mechanical
Mecánico

Pressure
Presión

Work Permit


CONFINED SPACE DOCUMENTATION

This form must be completed for evaluation of all workspaces

I. General Information

II. Confined Space

III. Permit Required

IV. Confined Space Entrant(s)/Attendants:

V. Communication Procedures (to be used by attendants and entrants): Verbal/ Visual

VI. Emergency Service

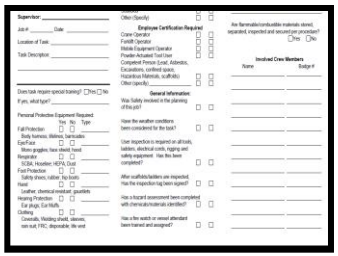
VII. Required Equipment

VIII. Site Control & Monitoring

A. Atmospheric pre-entry evaluation

Hazard ID Tool

JSA


Supervisor:

Employee Certification Required

General Information:

Involved Crew Members

Task Hazards

Cranes lifting heavy loads. Obey designated safety zones

Cranes swinging loads from ground level to pipe rack. Never walk under the load.

Cutting and grinding 6” pipe. Use hearing protection while grinding.

Use 2 ton come-a-long to align 10” pipe. Wear your gloves and be aware of pinch points.

New Hazards

Welding overhead (south side). Seal drain openings and install spark containment. Remove combustible materials from the area.

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A Lasting Visual Reminder

- Encourages participation & dialogue
- Verbal and visual communication
  - Adults learn differently by reading, hearing, seeing, and doing
- Communication at the work interface to crew and others in the area
- Lasts and changes for the duration of the job

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Field Testing

Many research projects stop there but….

How do we know these strategies really work?

Hypothesis: Each strategy causes a measurable improvement in hazard recognition skill

A new experimental method: Multiple Baseline testing

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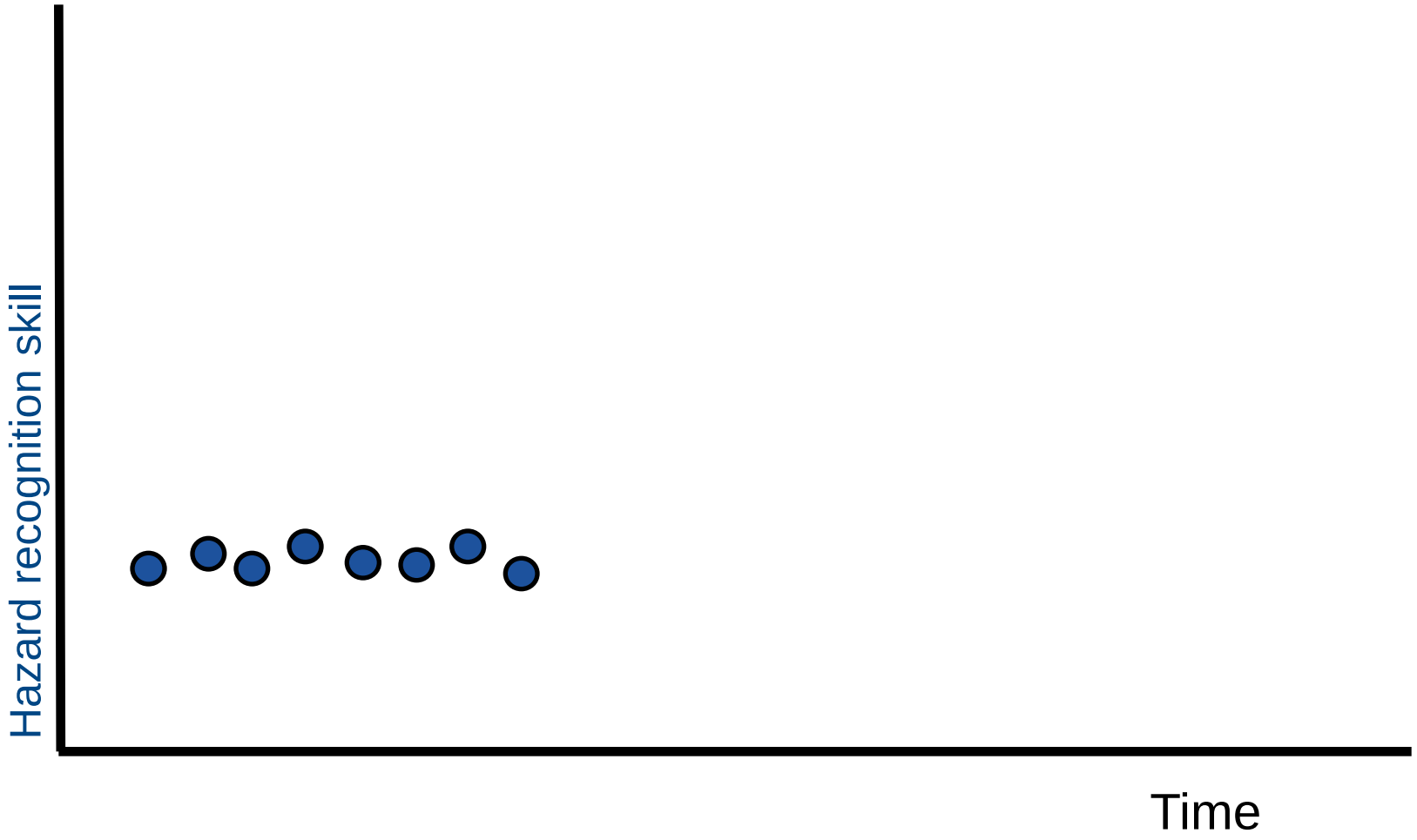
Multiple Baseline Testing Approach



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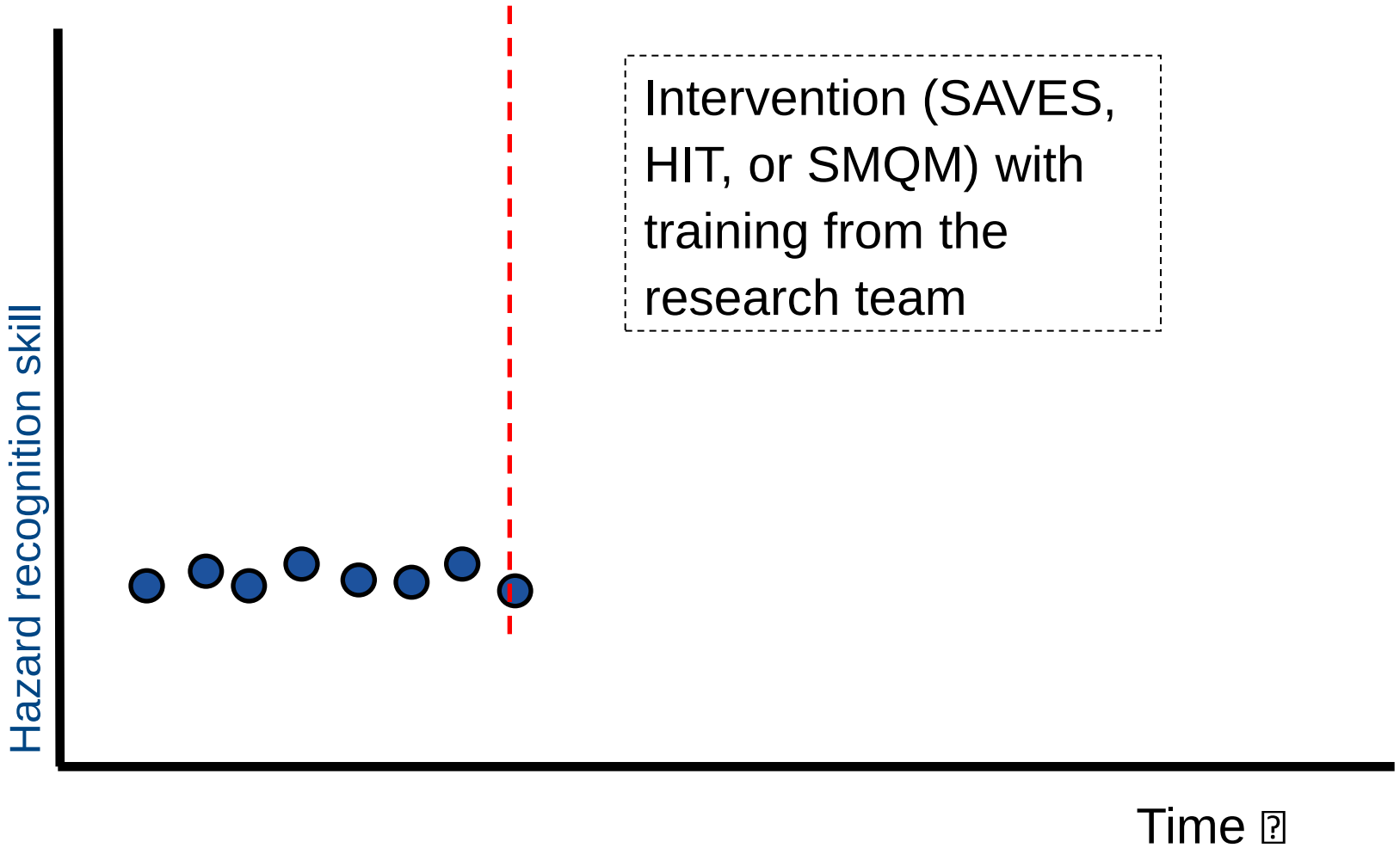
Multiple Baseline Testing Approach



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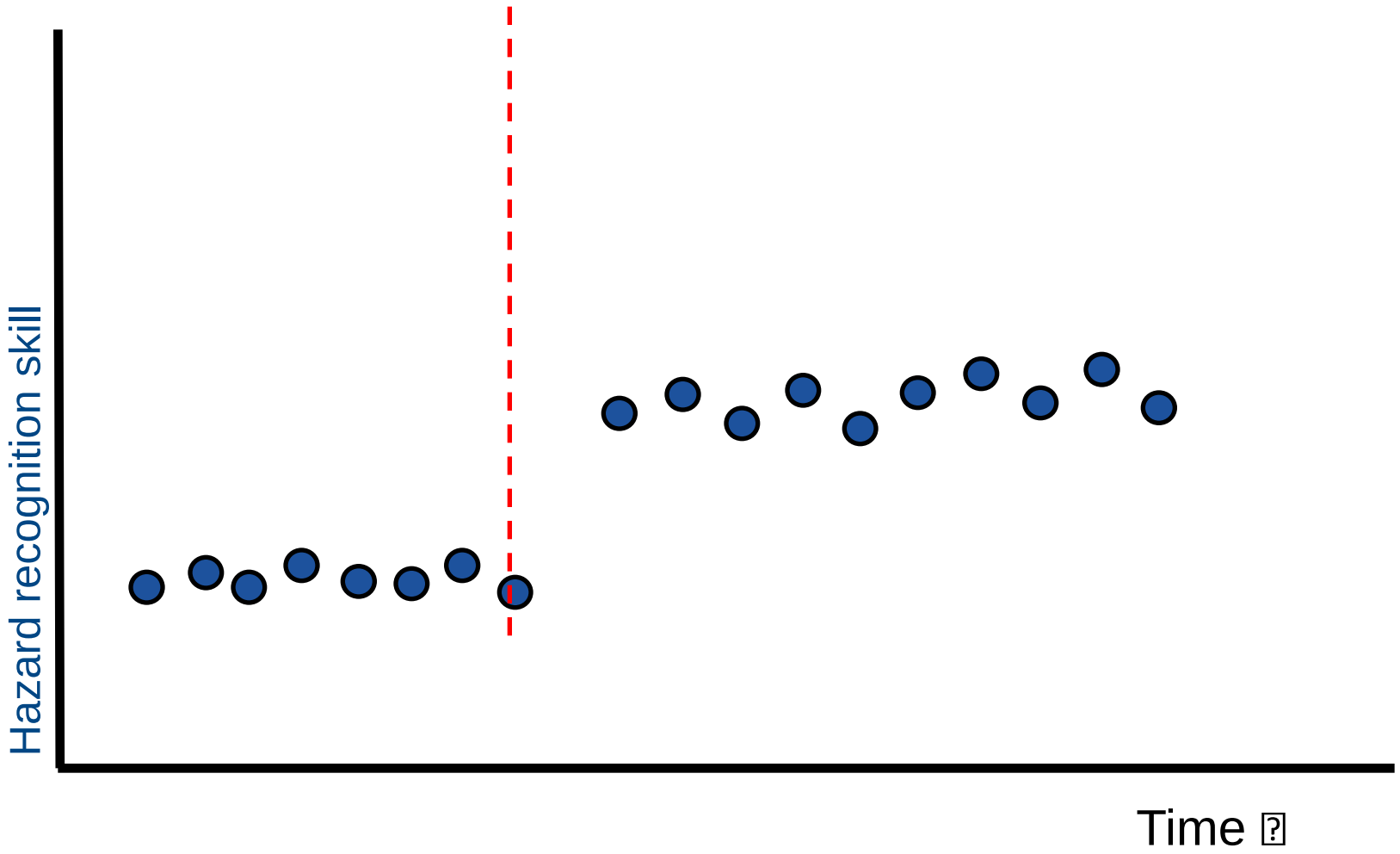
Multiple Baseline Testing Approach



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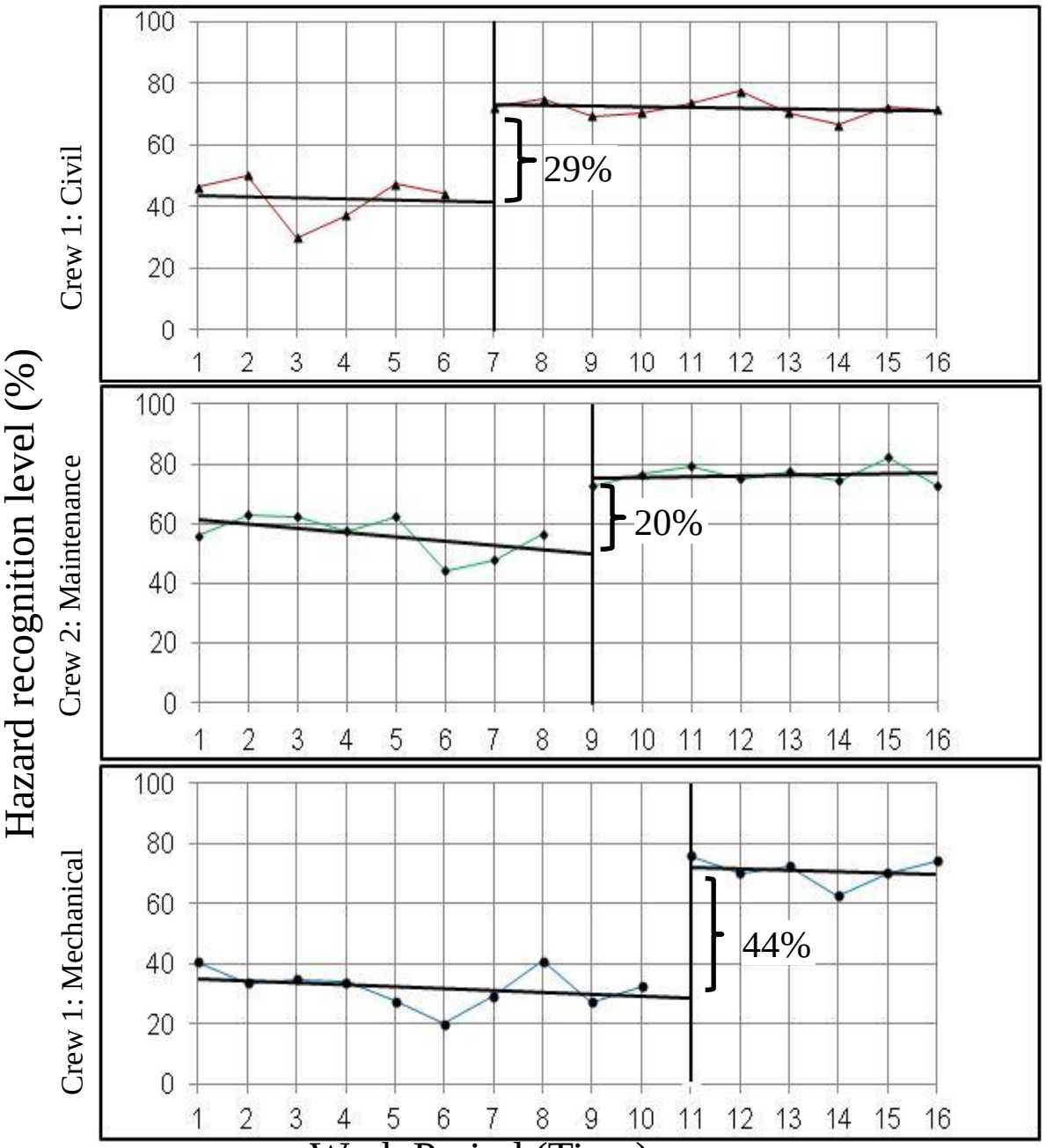
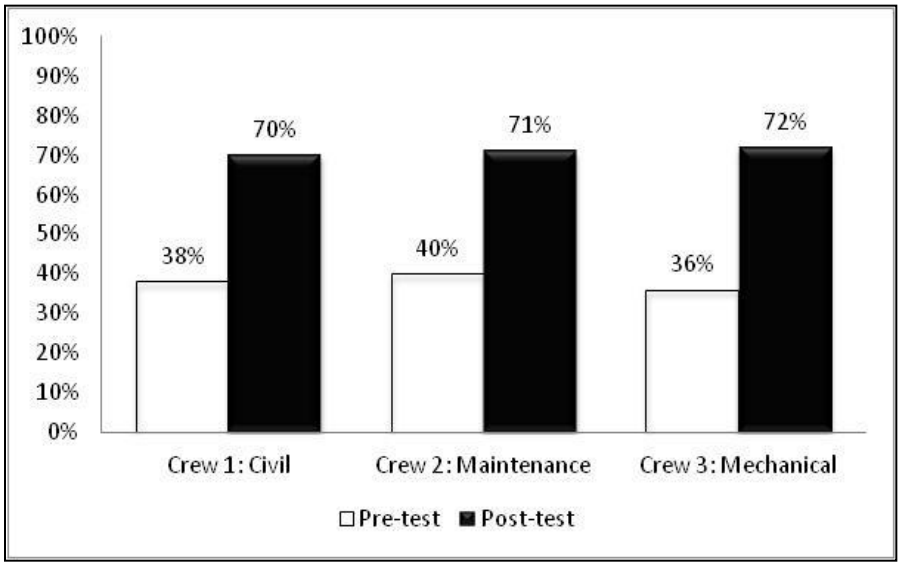
Training: SAVES Case 1 Results



$LC_{overall}$ = 27%

Pretest – Post test results



Summary

- Researched, developed, and empirically tested three innovative strategies for hazard recognition
  - SAVES – a training strategy
  - SMQM – a planning strategy
  - HIT – a worksite strategy
- Conducted rigorous safety field tests
  - 100 participants from 8 craft disciplines
  - 100 days of field tests
  - 6 sites in 5 different states
- All three strategies led to significant, measurable improvements

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Questions?