Enhanced Pre-Task Planning: Electrical Tasks

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CPWR's Project Team

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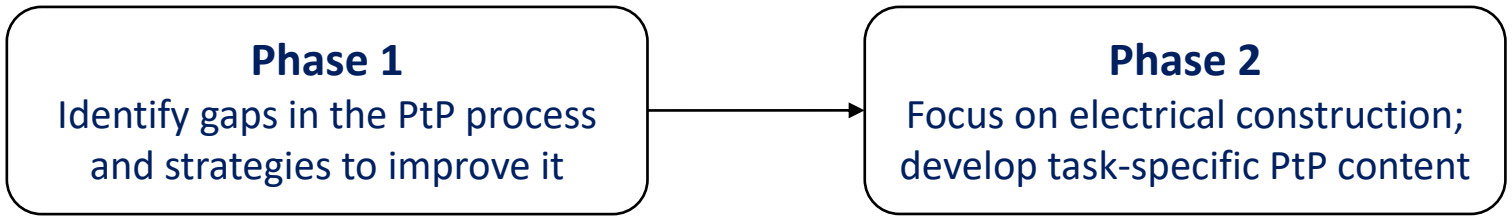
Project: “Prevention through Augmented Pre-task Planning”

AIM: Enhance the quality of Pre-task Planning (PtP) in construction, particularly in electrical construction.



Why Pre-Task Planning?

Prevention-through-Design (PtD):

"PtD encompasses all of the efforts to anticipate and design out hazards to workers in **facilities, work methods and operations, processes, equipment, tools, products, new technologies, and the organization of work**. The focus of PtD is on workers who execute the designs or have to work with the products of the design."

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"When and how to address hazards associated with work methods, operations, and work organization?"

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"When and how to address hazards associated with work methods, operations, and work organization?"

Pre-Task Planning

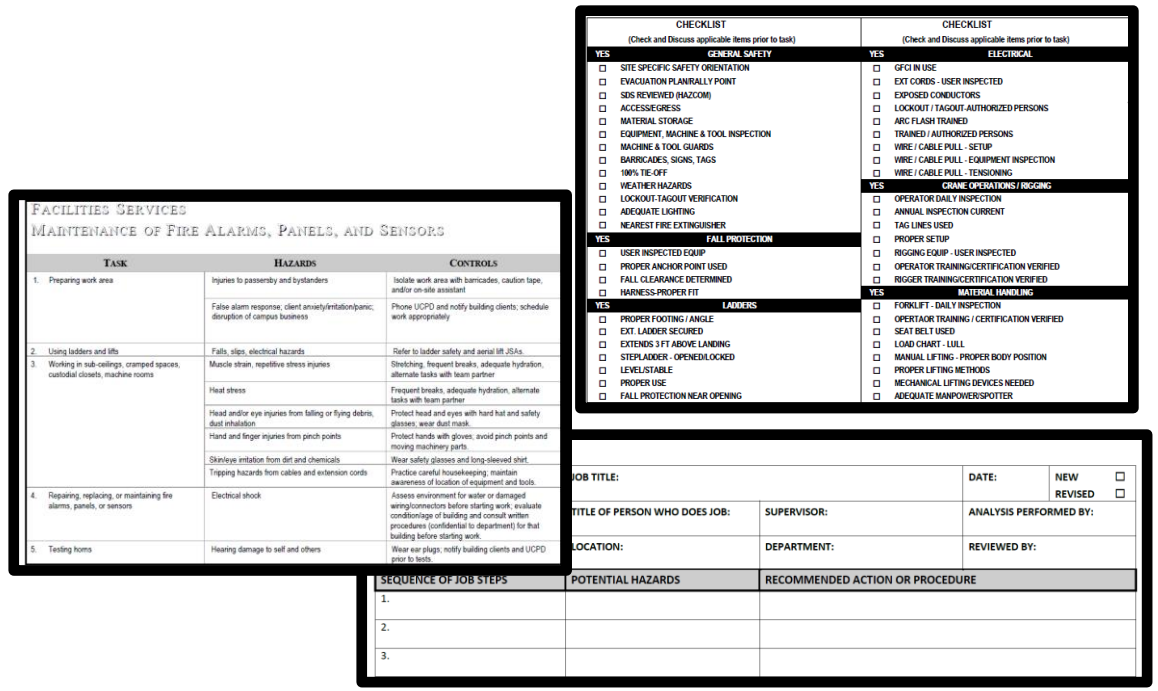
Pre-task Planning & Hazard Analysis

Pre-task Planning:

- Proactively identify hazards and unsafe conditions associated with each task, tools/equipment, materials, and jobsite
- Properly address hazards using effective controls before work begins

The gap in the process:

- Inconsistent terminology (JHA, JSA, PtP, AHA …)
- Inconsistent style
- Mainly from a compliance perspective
- Minimal opportunity for workers' input
- Lack of information on human performance and human factors
- Lack of workers' engagement in site safety planning
- Lack of task-specific content
- Inconsistency between content and task requirements
- Lack of comprehensive guidelines
- Confusion and conflicts on jobsites



FACILITIES SERVICES
MAINTENANCE OF FIRE ALARMS, PANELS, AND SENSORS

TASK	HAZARDS	CONTROLS
1. Preparing work area	Injuries to passersby and bystanders	Isolate work area with barricades, caution tape, and/or on-site assistant
	False alarm response; client anxiety/irritation/panic; disruption of campus business	Phone UCPD and notify building clients; schedule work appropriately
2. Using ladders and lifts	Falls, slips, electrical hazards	Refer to ladder safety and aerial lift JSAs
3. Working in sub-ceilings, cramped spaces, custodial closets, machine rooms	Muscle strain, repetitive stress injuries	Stretching, frequent breaks, adequate hydration, alternate tasks with team partner
	Heat stress	Frequent breaks, adequate hydration, alternate tasks with team partner
	Head and/or eye injuries from falling or flying debris; dust inhalation	Protect head and eyes with hard hat and safety glasses; wear dust mask
	Hand and finger injuries from pinch points	Protect hands with gloves; avoid pinch points and moving machinery parts
	Skin/eye irritation from dirt and chemicals	Wear safety glasses and long-sleeved shirt
	Tripping hazards from cables and extension cords	Practice careful housekeeping; maintain awareness of location of equipment and tools
4. Repairing, replacing, or maintaining fire alarms, panels, or sensors	Electrical shock	Assess environment for water or damaged wiring/connectors before starting work; evaluate condition/age of building and consult written procedures (confidential to department) for that building before starting work
5. Testing horns	Hearing damage to self and others	Wear ear plugs; notify building clients and UCPD prior to tests

CHECKLIST (Check and Discuss applicable items prior to task)		CHECKLIST (Check and Discuss applicable items prior to task)	
YES	GENERAL SAFETY	YES	ELECTRICAL
☐	SITE SPECIFIC SAFETY ORIENTATION	☐	GFCI IN USE
☐	EVACUATION PLAN/RALLY POINT	☐	EXT CORDS - USER INSPECTED
☐	SDS REVIEWED (HAZCOM)	☐	EXPOSED CONDUCTORS
☐	ACCESS/EGRESS	☐	LOCKOUT / TAGOUT-AUTHORIZED PERSONS
☐	MATERIAL STORAGE	☐	ARC FLASH TRAINED
☐	EQUIPMENT, MACHINE & TOOL INSPECTION	☐	TRAINED / AUTHORIZED PERSONS
☐	MACHINE & TOOL GUARDS	☐	WIRE / CABLE PULL - SETUP
☐	BARRICADES, SIGNS, TAGS	☐	WIRE / CABLE PULL - EQUIPMENT INSPECTION
☐	100% TIE-OFF	☐	WIRE / CABLE PULL - TENSIONING
☐	WEATHER HAZARDS	YES	CRANE OPERATIONS / RIGGING
☐	LOCKOUT-TAGOUT VERIFICATION	☐	OPERATOR DAILY INSPECTION
☐	ADEQUATE LIGHTING	☐	ANNUAL INSPECTION CURRENT
☐	NEAREST FIRE EXTINGUISHER	☐	TAG LINES USED
YES	FALL PROTECTION	☐	PROPER SETUP
☐	USER INSPECTED EQUIP	☐	RIGGING EQUIP - USER INSPECTED
☐	PROPER ANCHOR POINT USED	☐	OPERATOR TRAINING/CERTIFICATION VERIFIED
☐	FALL CLEARANCE DETERMINED	☐	RIGGER TRAINING/CERTIFICATION VERIFIED
☐	HARNESS-PROPER FIT	YES	MATERIAL HANDLING
YES	LADDERS	☐	FORKLIFT - DAILY INSPECTION
☐	PROPER FOOTING / ANGLE	☐	OPERTAOR TRAINING / CERTIFICATION VERIFIED
☐	EXT. LADDER SECURED	☐	SEAT BELT USED
☐	EXTENDS 3 FT ABOVE LANDING	☐	LOAD CHART - LULL
☐	STEPLADDER - OPENED/LOCKED	☐	MANUAL LIFTING - PROPER BODY POSITION
☐	LEVEL/STABLE	☐	PROPER LIFTING METHODS
☐	PROPER USE	☐	MECHANICAL LIFTING DEVICES NEEDED
☐	FALL PROTECTION NEAR OPENING	☐	ADEQUATE MANPOWER/SPOTTER

JOB TITLE:		DATE:	NEW ☐ REVISED ☐
TITLE OF PERSON WHO DOES JOB:	SUPERVISOR:	ANALYSIS PERFORMED BY:	
LOCATION:	DEPARTMENT:	REVIEWED BY:	

SEQUENCE OF JOB STEPS	POTENTIAL HAZARDS	RECOMMENDED ACTION OR PROCEDURE
1.		
2.		
3.		

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Preliminary Findings

Challenges	Recommendations & Strategies
Optimizing content ▪ Long and wordy documents ▪ Inconsistency between content and task requirements ▪ Lack of management presence on jobsites ▪ Minimal opportunity for workers' input	▪ Provide task-specific information ▪ Use one-page summaries ▪ Replace text with visual aids when possible (photos, videos) ▪ Frequent site visits by management ▪ Perform post-job review/debrief
Buy-in ▪ Pencil-whipping ▪ Resistance to change	▪ Personalize the process ▪ Incorporate real-life incidents and near-misses ▪ Designate workers to serve as liaison with management ▪ Actively solicit worker feedback
Communication & Coordination ▪ Lack of consistency in communicating jobsite changes ▪ Lack of mentorship ▪ Language barrier ▪ Absenteeism	▪ Perform site audits regularly ▪ Engage all stakeholders equally in site safety planning ▪ Recognize hazards from adjacent crews ▪ Pair non-English speaking workers with bilingual coworkers ▪ Brief workers who were absent on current site condition

Pre-task planning assessment checklist

Pre-Task Planning (PTP) Assessment Checklist

Why should you use this checklist? PTP is a process performed before each task starts to discuss the steps of the task, the hazards, and how the hazards will be controlled. This process may also be known as JHA, JSA, AHA, morning huddle, job briefing, daily task analysis, etc.

This checklist helps field supervisors (e.g., crew leads, foremen, superintendents, etc.) evaluate their PTP process and identify ways to improve it. *Please note that this form is not a replacement for your PTP.*

1.	Do you conduct PTP before each task starts?	Yes ☐ No ☐
2.	Do you conduct daily walkthroughs to get a better understanding of the current site conditions? ***(If you answered 'NO,' please skip to question #3.)* a. Are workers involved in daily walkthroughs?	Yes ☐ No ☐ Yes ☐ No ☐
3.	Do you update PTP content when conditions change? ***(If you answered 'NO,' please skip to question #4.)* a. Do you communicate these changes with workers immediately?	Yes ☐ No ☐ Yes ☐ No ☐
4.	Does your PTP break the task up into manageable steps or sub-tasks?	Yes ☐ No ☐
5.	Does your PTP specify hazards associated with each step of the task?	Yes ☐ No ☐
6.	Does your PTP discuss ways to control each hazard? ***(If you answered 'NO,' please skip to question #7.)* a. Does your PTP identify who is responsible for implementing the controls?	Yes ☐ No ☐ Yes ☐ No ☐
7.	Does your PTP discuss hazards posed by other crews working close by?	Yes ☐ No ☐
8.	Do you provide any formal training to conduct or lead the PTP meeting?	Yes ☐ No ☐
9.	In addition to the crew supervisor, do workers have the opportunity to lead the PTP meeting?	Yes ☐ No ☐
10.	Do you gather workers' feedback on PTP content and delivery? ***(If you answered 'NO,' please skip to question #11.)* a. Do you incorporate their feedback?	Yes ☐ No ☐ Yes ☐ No ☐
11.	Does your PTP use photos or other visual aids instead of text where possible?	Yes ☐ No ☐
12.	To make your PTP process more interactive, do you use educational aids like a whiteboard or live demonstration?	Yes ☐ No ☐
13.	Does your PTP include supplemental information such as: a. Site layout? b. Medical facility location and contact information? c. Evacuation plan and muster point for emergencies? d. Work schedule? e. Tools? f. Equipment? g. Materials? h. Specific types of PPE?	 Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐
14.	Do you conduct end-of-shift review with your crew to discuss what went well and what didn't?	Yes ☐ No ☐
15.	Is PTP information easily accessible to workers after the meeting is completed?	Yes ☐ No ☐

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Let's think beyond compliance!

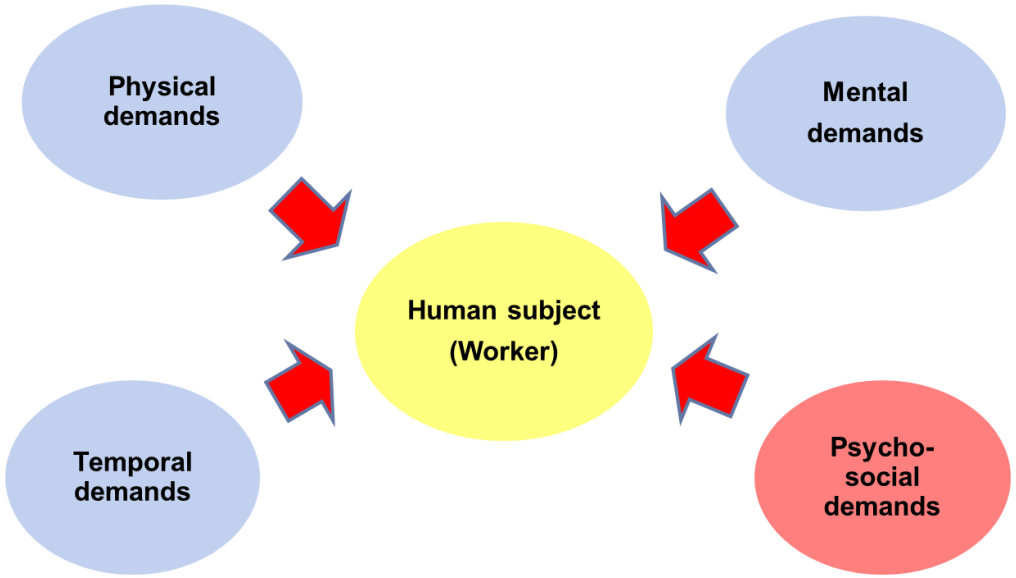
What else should be included in the pre-task planning process?

"PtD encompasses all of the efforts to anticipate and design out hazards to workers in facilities, work methods and operations, processes, equipment, tools, products, new technologies, and the organization of work. The focus of PtD is on **workers** who execute the designs or have to work with the products of the design."

"Learn and incorporate what workers say about the task."

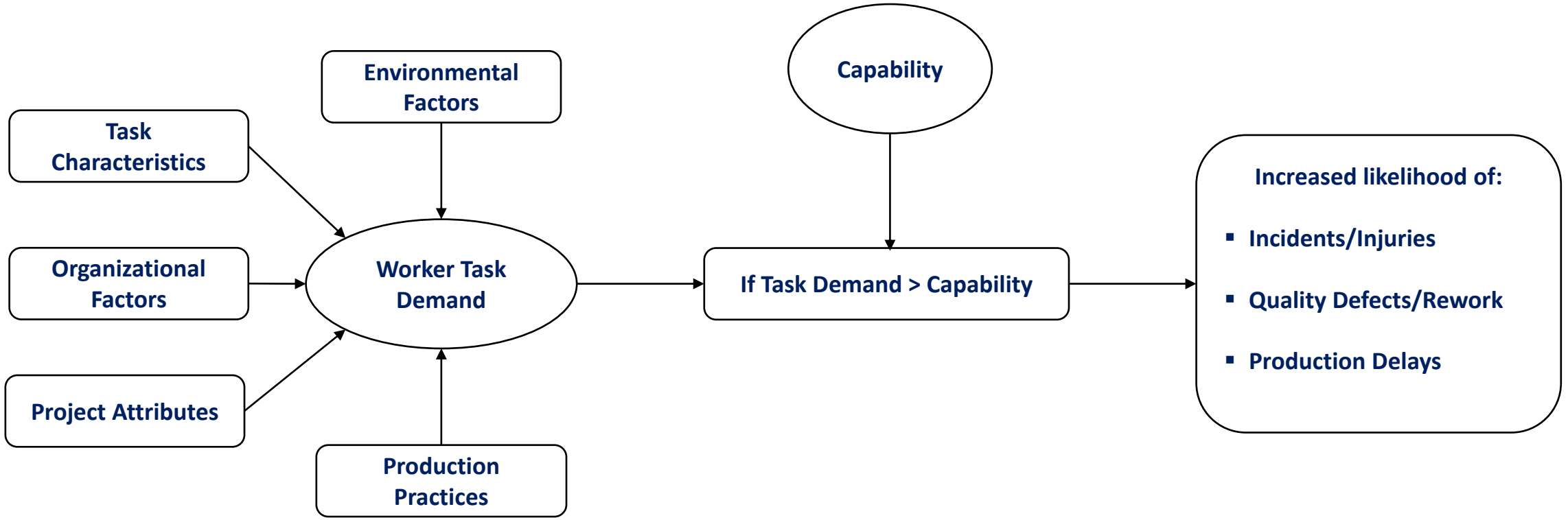
Task Design

- **What have other high-risk sectors done?**
  - Focused on **task design.**
  - Aviation (NASA) initiated **Task Demand Vs. Capability.**
  - Adopted by other high-risk sectors like healthcare and military.



- **How about the construction industry?**
  - Very limited.
  - Studied in masonry, roofing, and concrete work (Memarian & Mitropoulos).

Task Demands in Construction



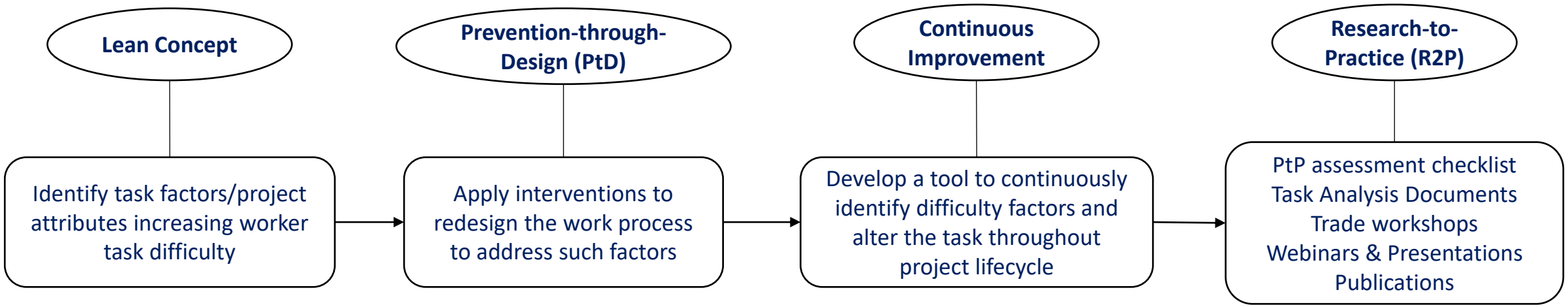
Human Performance & Workplace Safety

- In line with the NFPA 70E "*Human Performance and Workplace Electrical Safety*"
  - **Error Precursors:** Task Demands; time pressure, high workload, repetitive actions, multi-tasking, unclear goals, unclear standards, etc. (NFPA Q 6.1, Table Q5)
  - **Human performance tools:** pre-job briefing/planning, post-job review, jobsite review, etc.

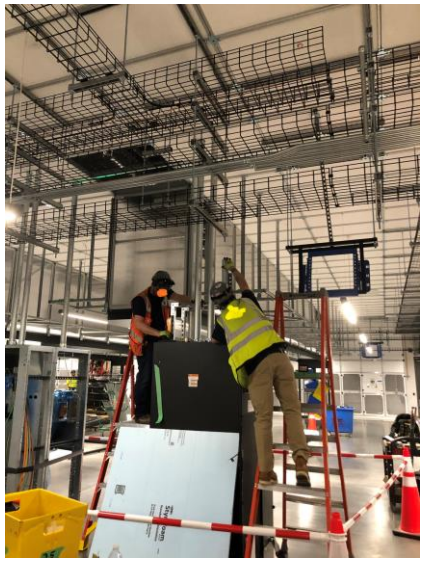
"Learn and incorporate what workers say about the task."

Objectives

Electrical Construction



Explore Task Factors & Project Attributes



- Interviews with workers to assess task difficulties and explore contributing work factors:
  - Physical loads
  - Mental loads
  - Time pressure
  - Environmental factors
  - Frustration
  - Other
- One-on-one, anonymous onsite interviews during task performance.
  - **First;** measure physical, mental, temporal (time), and frustration (1= very low and 10=very high).
  - **Second;** identify contributing factors – what makes your task challenging?
  - **Third;** what tips and tricks do you suggest to simplify the task?
- To date conducted 10 field studies and 98 in-person onsite interviews with electrical workers.

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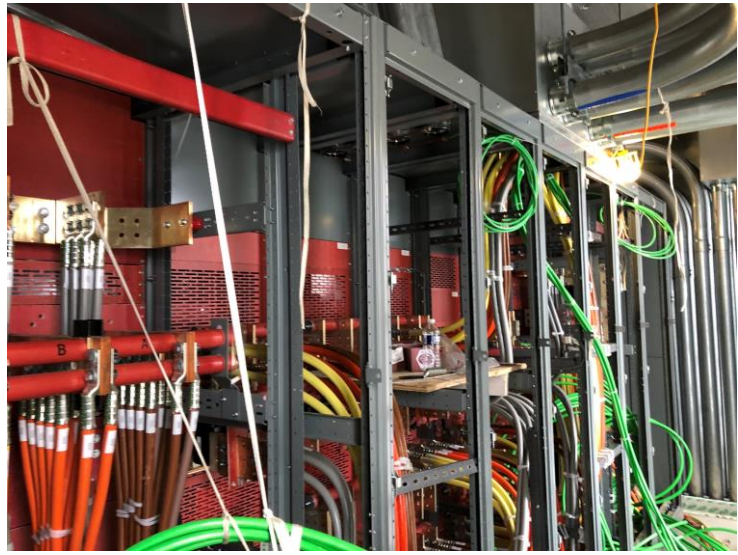
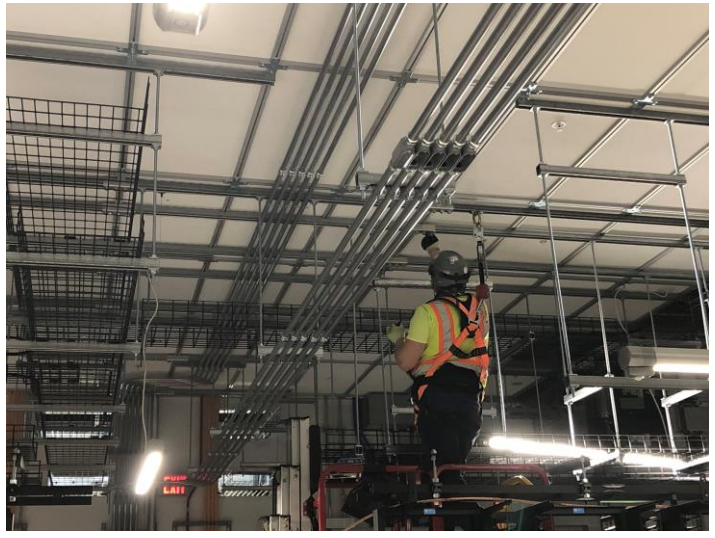
Electrical Tasks Studied to Date

Electrical tasks studied to date:

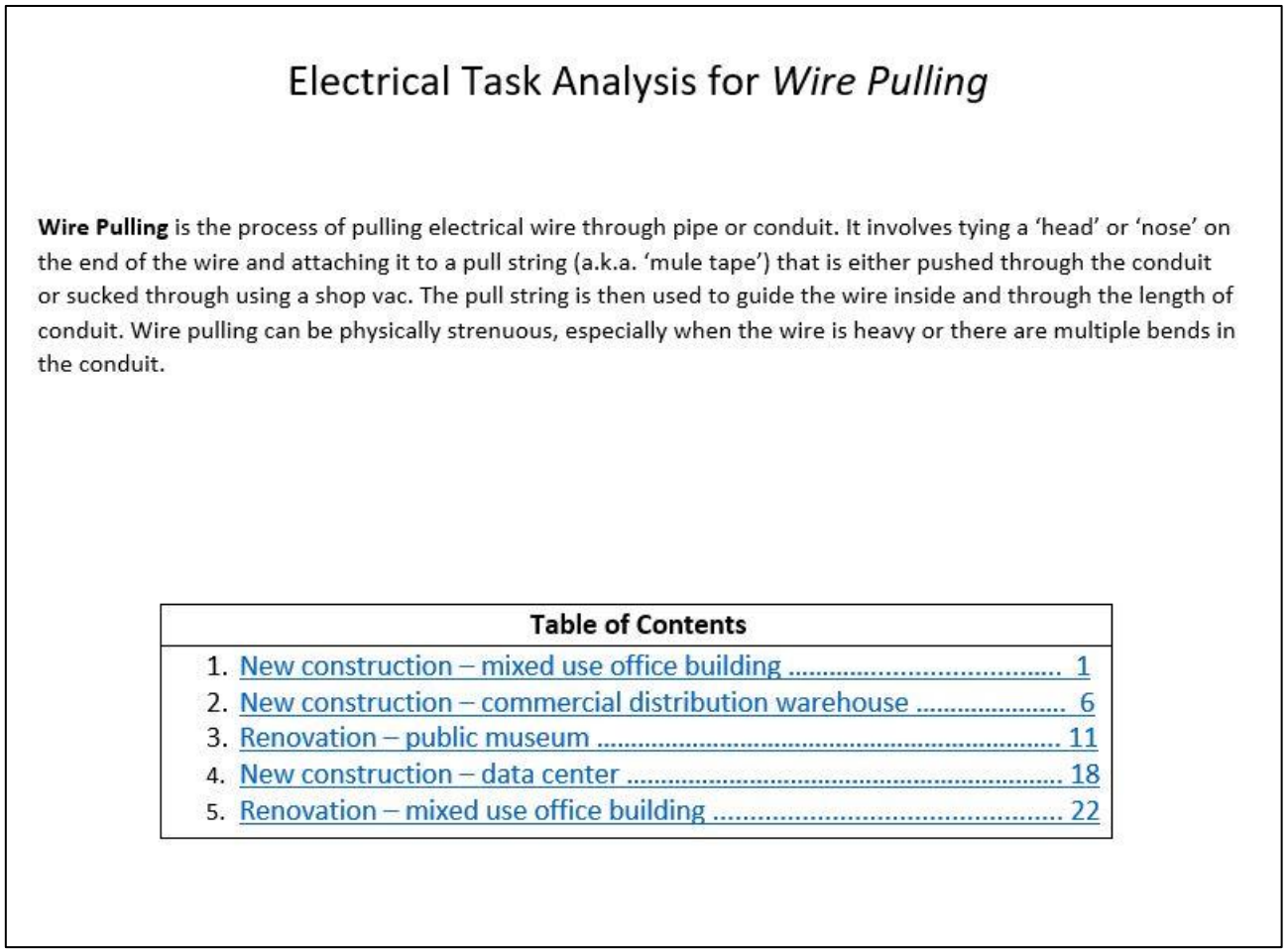
- Overhead Conduit Installation
- Installing Lighting Tracks & Supports
- Site Preparation and Layout
- Pulling Wire
- Terminations
- Electrical Demolition
- Cable Tray Installation
- Grounding
- Busway Installation
- Material Handling/Logistics
- Wiring AC Units
- Connecting Building-to-Building Conduit
- Access Card Readers Installation
- Fire Alarm Components Installation
- Receptacles Installation
- Branch Circuits Installation
- Pre-fabricated Components
- QA/QC





Task Analysis Documents

- Organized based on Task and Project Type
- Applicable for Pre-Task Planning, JHA, and Training
- Contains task-specific conditions raised by workers
- Visualizes the situation using images
- Recommends solutions
- Easy to download and use in PDF and MS Word format
- Customizable for specific project needs



Electrical Task Analysis for *Wire Pulling*

Wire Pulling is the process of pulling electrical wire through pipe or conduit. It involves tying a 'head' or 'nose' on the end of the wire and attaching it to a pull string (a.k.a. 'mule tape') that is either pushed through the conduit or sucked through using a shop vac. The pull string is then used to guide the wire inside and through the length of conduit. Wire pulling can be physically strenuous, especially when the wire is heavy or there are multiple bends in the conduit.

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Sample Task Analysis Documents

Task: Wire Pulling

PROJECT DESCRIPTION: New construction for a 14-floor mixed-use office building in the US mid-Atlantic region during springtime. The building consists of a lobby, 4 levels of parking structure, a data center/command center and 7 floors of offices. Construction took place in a dense commercial district. The project experienced multiple owners, which resulted in frequent change orders. There was also high turnover at the management level.

CONDITIONS	CONDITION TYPE	RECOMMENDATIONS
Manual wire pulling in tight spaces: Wire must be pulled manually with mule tape because mechanical tuggers will not fit in tight workspace, resulting in work delays and raising the risk of ergonomic injury. It can also increase workers' frustration. 	Physical ☒ Mental ☒	• Puller attachment for cordless drill • Pulling sheaves • **Wire Pulling Coordination:** the person feeding the wire should communicate regularly with the person pulling to keep the wire tension consistent (e.g., keep an even flow, try to match up with the person on the other end). Using walkie-talkies for communication is recommended.
Handling heavy cables: Manually lifting and handling heavy cables can lead to exhaustion and raise the risk of ergonomic injury. 	Physical ☒ Mental ☐	• Mechanical wire and cable puller (tugger) • Best Built Plans for safe material handling • Southwire SIMpull™ Flange • Avoid handling heavy material alone.

Sample Task Analysis Documents

Task: Grounding

PROJECT DESCRIPTION: New construction for a commercial distribution warehouse took place in an industrial park in the US Mid-Atlantic region in springtime. The warehouse had a forty-foot ceiling and tapered roof, and close to a two-million square foot footprint. The GC required harnesses/tie-off on scissor lifts, and no overhead work was permitted if it was directly above other crews.

CONDITIONS	CONDITION TYPE	RECOMMENDATIONS
Working with grounding rods: Lifting, carrying, driving, and cad-welding grounding rods is strenuous and repetitive and can raise the risk of ergonomic injury (e.g., working with 10-foot rods). 	Physical ☒ Mental ☐	• Post Driver • Sledgehammer • Best Built Plans for safe material handling
Bending heavy wires: Bending heavy wires can raise the risk of ergonomic injury (e.g., 250 lbs). 	Physical ☒ Mental ☐	• Greenlee hickey • Greenlee cable bender

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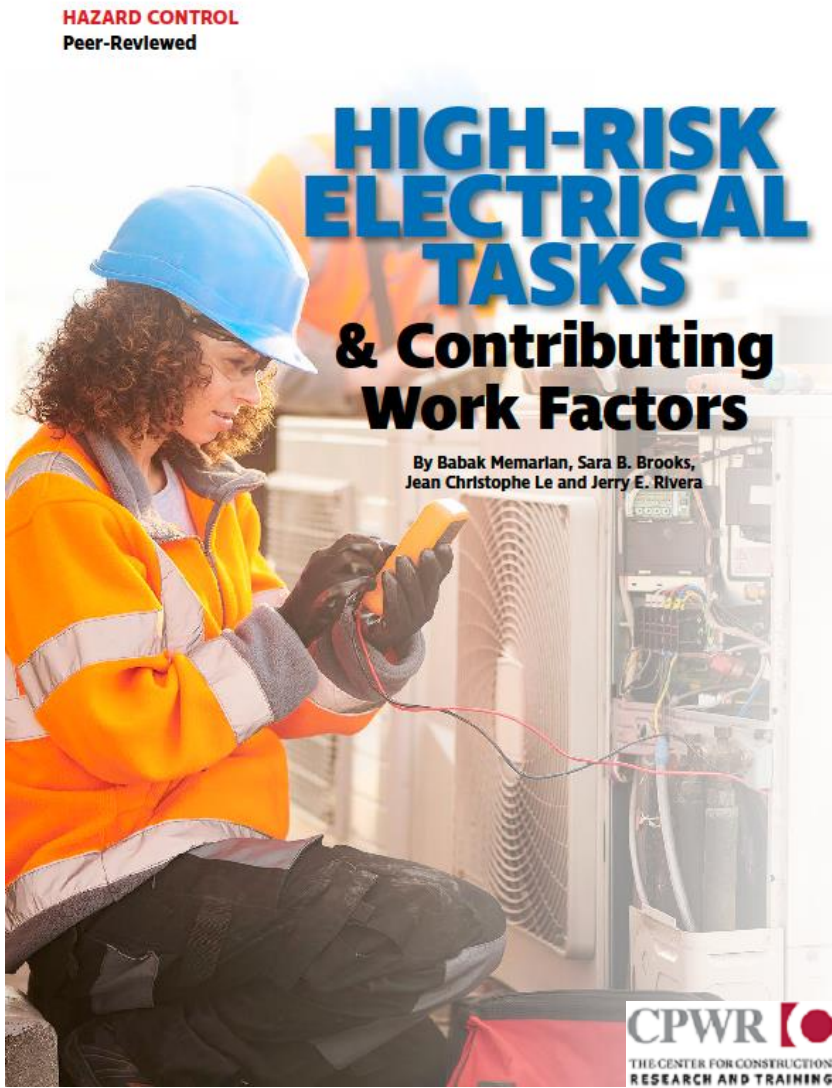
High-risk Electrical Tasks Article

High-risk Electrical Tasks and Contributing Work Factors

Babak Memarian, Sara B. Brooks, Jean Christophe Le, and Jerry E. Rivera

Professional Safety Journal (August 2022)

https://www.assp.org/docs/default-source/psj-articles/f1mem_0822.pdf?sfvrsn=d8b99447_0



JHA Article

Obstacles and Solutions to Implementing Job Hazard Analysis in Construction: A Case Study

Babak Memarian, Sara B. Brooks, and Jean Christophe Le.

International Journal of Construction Education and Research (January 2022)

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INTERNATIONAL JOURNAL OF CONSTRUCTION EDUCATION AND RESEARCH
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Obstacles and Solutions to Implementing Job Hazard Analysis in Construction: A Case Study

Babak Memarian, Sara B. Brooks, and Jean Christophe Le

CPWR – The Center for Construction Research and Training, Silver Spring, Maryland, USA

ABSTRACT

Construction workers experience a disproportionately high rate of work-related injuries. However, if hazards are properly recognized and addressed, most of these incidents are preventable. Job hazard analysis (JHA) is a method for identifying and mitigating workplace hazards that emphasizes proactive risk control. Despite its importance, the construction industry currently lacks comprehensive guidelines on how to effectively design and implement JHA on a consistent basis. To fill this gap, this case study pursued two objectives: (1) to explore challenges and shortcomings of current practices in developing and implementing JHA in construction and (2) to identify effective practices and interventions employed by contractors to address these challenges. To this end, 30 sample JHA documents were analyzed, and 23 semi-structured interviews were conducted with construction safety professionals representing 17 companies. Findings of this study identified a lack of worker involvement in the process, lack of buy-in, management absence, complacency, and inadequate coordination and communication as major issues. Solutions explored to address these challenges included incorporating visual aids, rotating JHA meeting leaders, and continuously updating JHA information to reflect the current work conditions. The practical implications of these findings and the path forward for further research are discussed.

KEYWORDS

Job hazard analysis; job safety analysis; JHA; construction safety; pre-task planning

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Industry Advisory Group & Partners

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- Freestate Electric (Ron Michael, Terry Sage, and Dean Speelman)
- Aldridge Electric (Scott Lange)
- MC Dean Building Intelligence (John Bennett and Aaron Schoemaker)
- Valley Electric (Jamie Stuart)

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General Contractors

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- Penta Group (Rodd Webber and Elias Brooks)

Thanks!

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