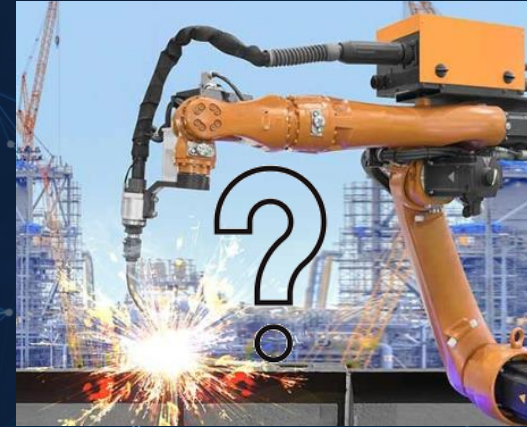
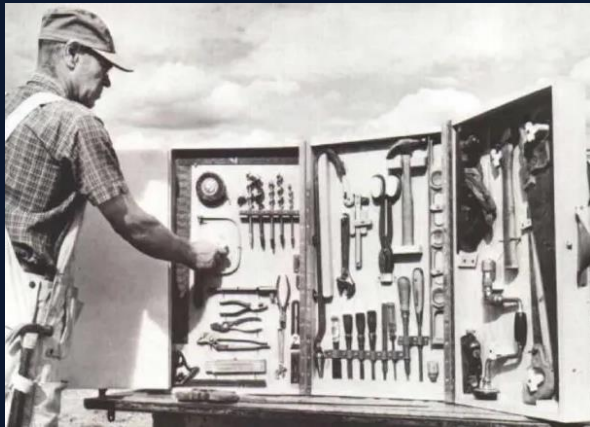


CONSTRUCTION ERGONOMICS: YESTERDAY, TODAY AND TOMORROW



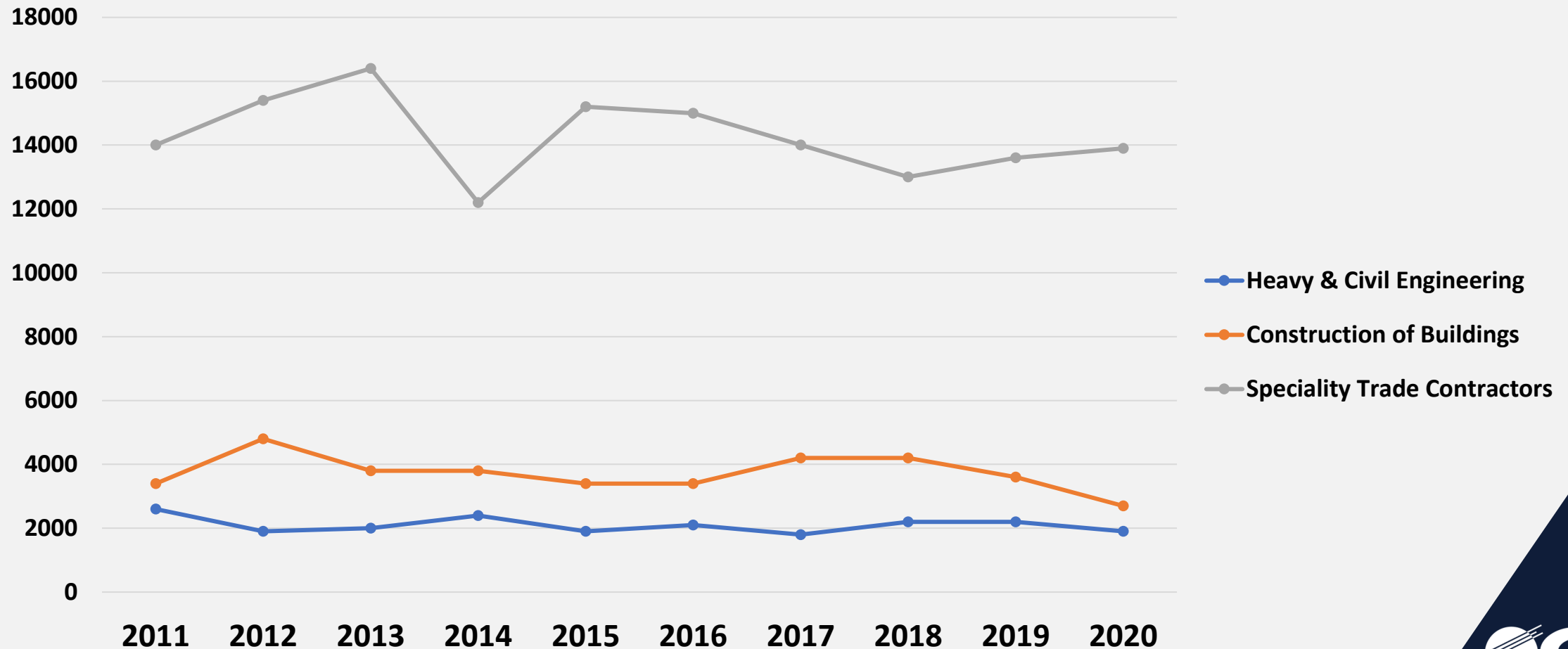
Ed Havey, M.S., CPE
Senior Ergonomist

WHAT WE WILL TALK ABOUT

- Making a case for construction ergonomics
- Causes of MSDs
- Ergonomics defined
- Challenges of construction ergonomics
- Construction ergonomics – Yesterday
- Construction ergonomics – Today
- Construction ergonomics – Tomorrow

THE CASE FOR CONSTRUCTION ERGONOMICS

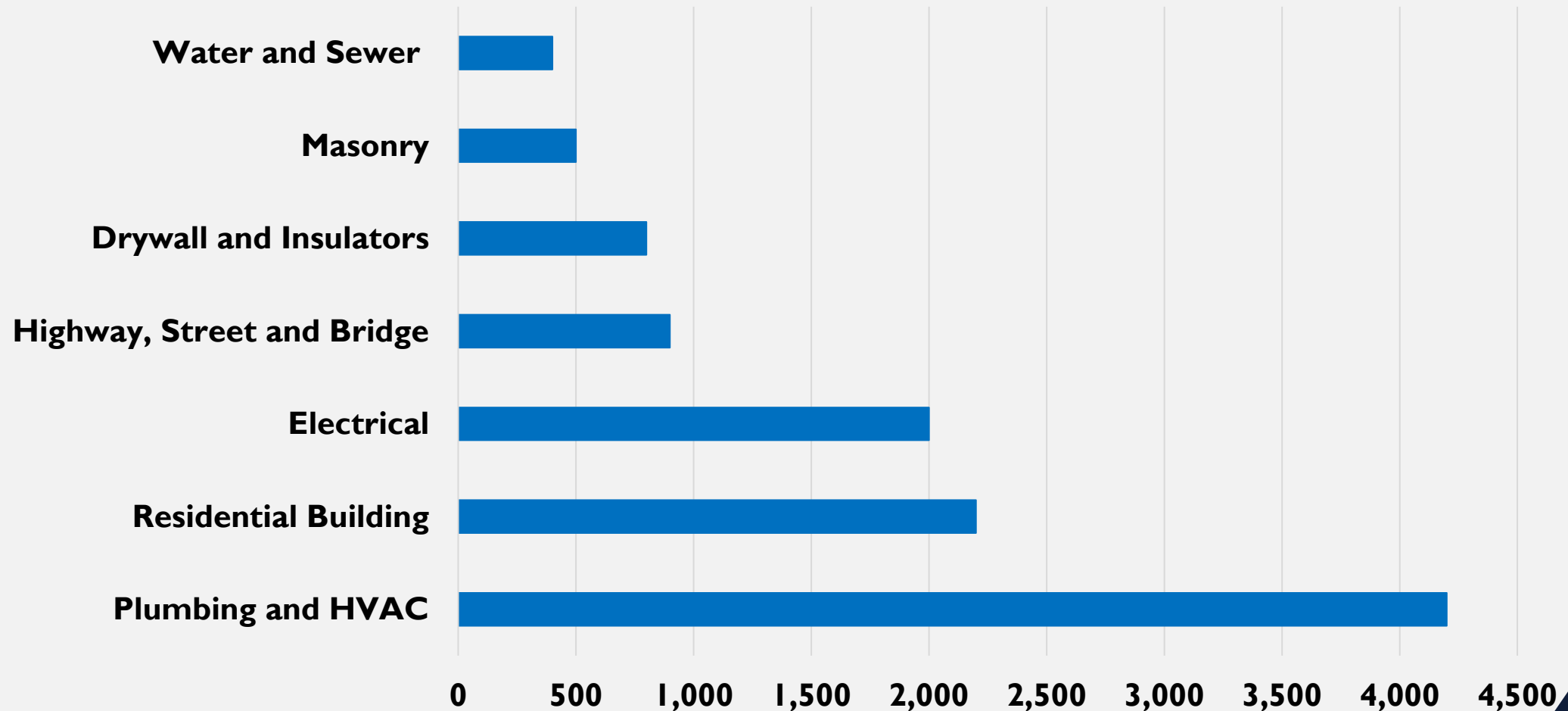
Annual Number of MSDs by Major Sector



Source: CPWR/BLS





THE CASE FOR CONSTRUCTION ERGONOMICS

Number of MSDs 2011-2020



Source: CPWR/BLS

THE CASE FOR CONSTRUCTION ERGONOMICS

Liberty Mutual 2024 Construction Safety Index			Cost in billions	Percent of total
1		Falls to lower level	\$2.62	24.6%
2		Overexertion involving outside sources <i>(handling object)</i>	\$1.89	17.7%
3		Falls on same level	\$1.30	12.2%
4		Struck by object or equipment <i>(being hit by objects)</i>	\$1.30	12.2%
5		Other exertions or bodily reactions <i>(awkward postures)</i>	\$0.72	6.8%

SOCIOECONOMIC IMPACTS OF MSDs

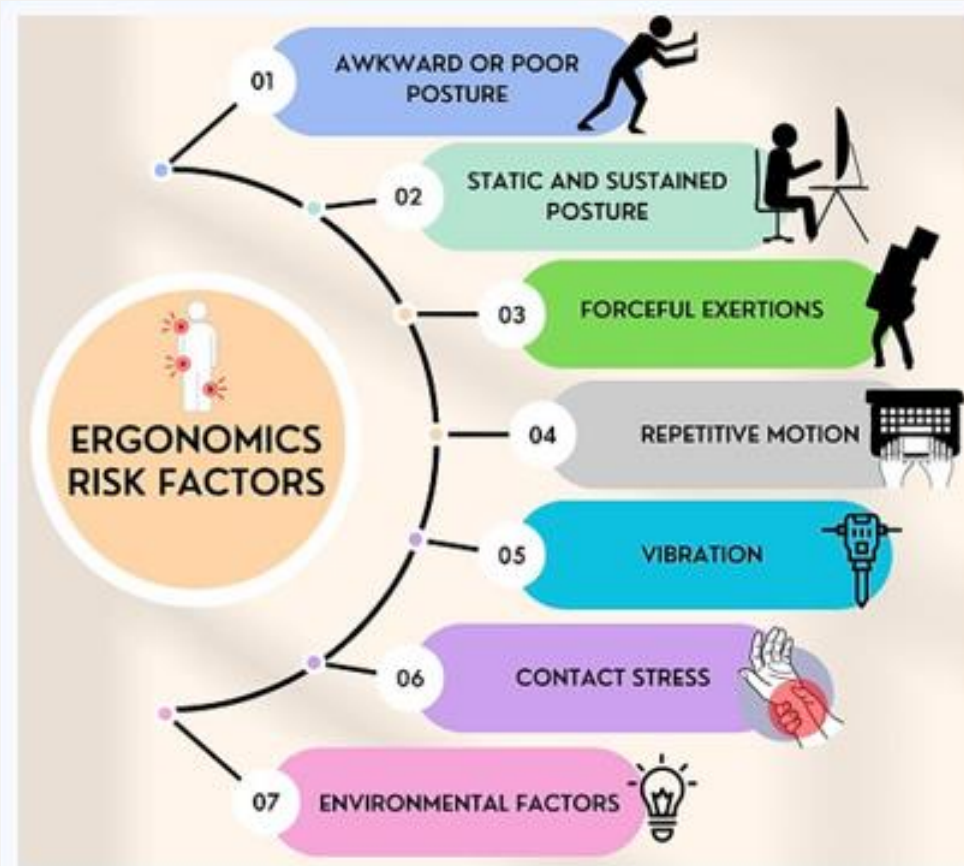
Business

- Lost productivity
- Greater workers' comp costs
- Poorer work quality
- Greater absenteeism and presenteeism
- More employee turnover

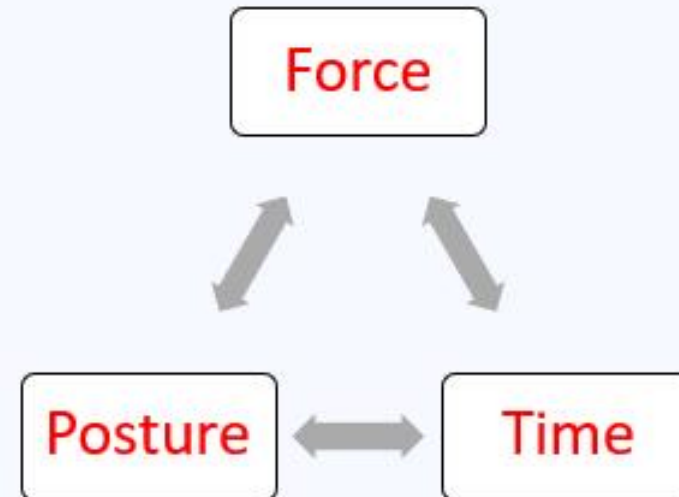
People

- Loss of income
- Loss of livelihood
- Less social connections
- Increase opioid abuse and addiction
- Lower quality of life – now and in retirement

WHAT CAUSES MSDs



The big 3 risk factors:



Physical tasks demands = forces x postures x time

RISK FACTORS



ERGONOMICS IS ABOUT...

Reducing injury risk and increasing productivity by designing (changing) work layouts and set-ups, equipment and tools to eliminate or minimize potential negative impacts of:

- Moving things – lifting, carrying, pushing and pulling
- Hand intensive work – using tools, assembling, sorting
- Work postures – bending, reaching, kneeling, squatting
- Work environments – temperature, lighting, and noise

CHALLENGES

- No regulatory mandate
- Worksites and tasks change daily
- Multi-employer worksites
- Labor shortages
- Aging workforce
- Culture – work is suppose to hurt
- Construction sector is not familiar with ergonomics

CONSTRUCTION ERGONOMICS – YESTERDAY

Construction advancements have mainly focused on increasing productivity.

And yet, many of these changes have also reduced the risk of injury.

These are the two outcomes of ergonomics!

CONSTRUCTION ERGONOMICS – YESTERDAY



CONSTRUCTION ERGONOMICS – YESTERDAY



CONSTRUCTION ERGONOMICS – YESTERDAY



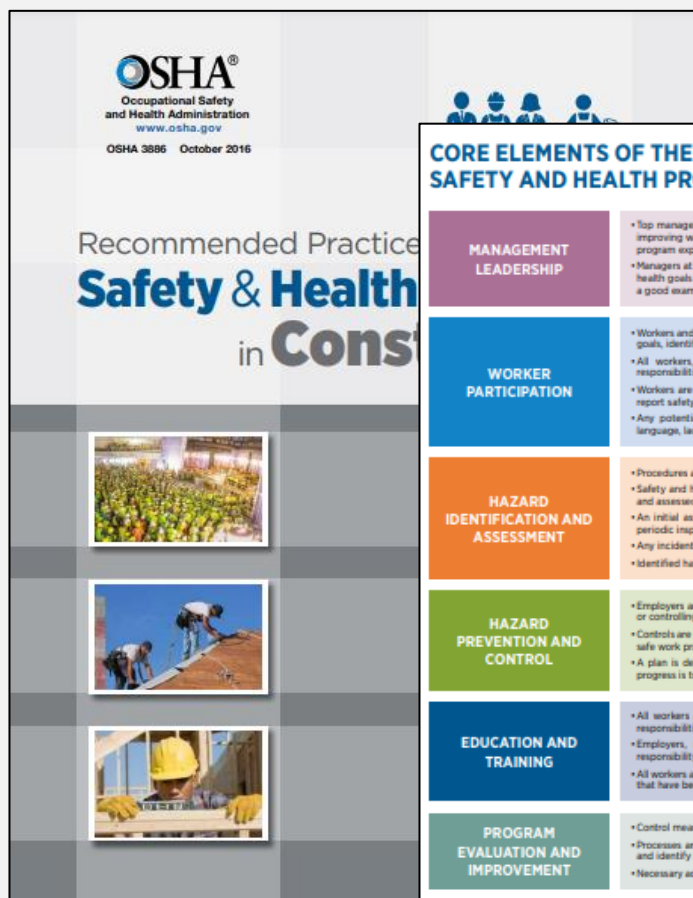
CONSTRUCTION ERGONOMICS – TODAY

Although there have been many advancements in methods, equipment and tools, the construction sector is still experiencing many work-related MSDs.

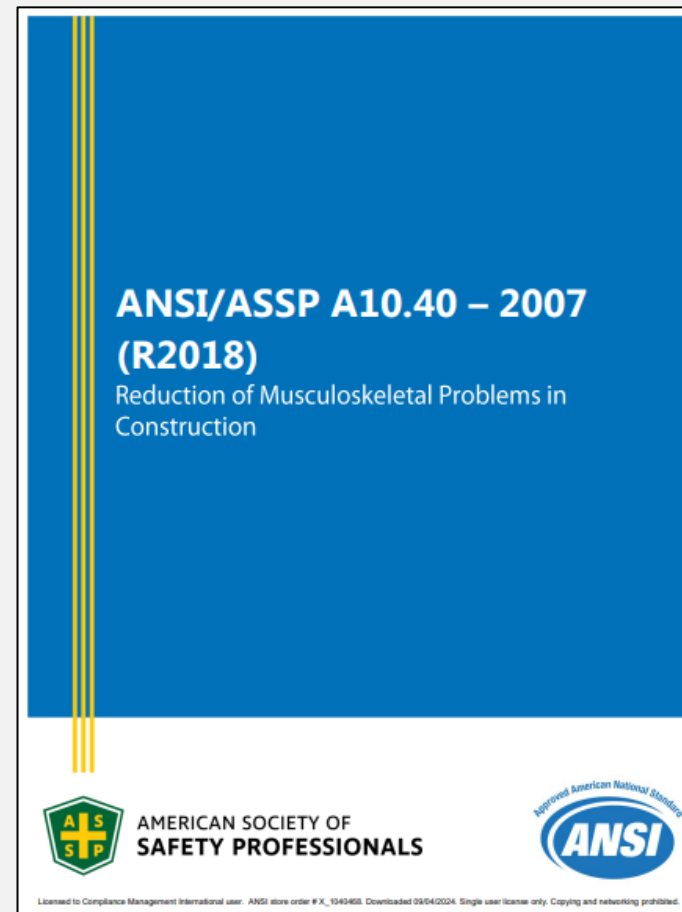
This means there are opportunities to more formally and consistently apply ergonomics.

CONSTRUCTION ERGONOMICS – TODAY

Incorporate ergonomics into a company's safety and health program



CORE ELEMENTS OF THE RECOMMENDED PRACTICES FOR SAFETY AND HEALTH PROGRAMS IN CONSTRUCTION	
MANAGEMENT LEADERSHIP	<ul style="list-style-type: none"> • Top management demonstrates its commitment to eliminating hazards and to continuously improving workplace safety and health, communicates that commitment to workers, and sets program expectations and responsibilities. • Managers at all levels make safety and health a core organizational value, establish safety and health goals and objectives, provide adequate resources and support for the program, and set a good example.
WORKER PARTICIPATION	<ul style="list-style-type: none"> • Workers and their representatives are involved in all aspects of the program—including setting goals, identifying and reporting hazards, investigating incidents, and tracking progress. • All workers, including contractors and temporary workers, understand their roles and responsibilities under the program and what they need to do to effectively carry them out. • Workers are encouraged and have means to communicate openly with management and to report safety and health concerns or suggest improvements, without fear of retaliation. • Any potential barriers or obstacles to worker participation in the program (for example, language, lack of information, or disincentives) are removed or addressed.
HAZARD IDENTIFICATION AND ASSESSMENT	<ul style="list-style-type: none"> • Procedures are put in place to continually identify workplace hazards and evaluate risks. • Safety and health hazards from routine, nonroutine, and emergency situations are identified and assessed. • An initial assessment of existing hazards, exposures, and control measures is followed by periodic inspections and reassessments, to identify new hazards. • Any incidents are investigated with the goal of identifying the root causes. • Identified hazards are prioritized for control.
HAZARD PREVENTION AND CONTROL	<ul style="list-style-type: none"> • Employers and workers cooperate to identify and select methods for eliminating, preventing, or controlling workplace hazards. • Controls are selected according to a hierarchy that uses engineering solutions first, followed by safe work practices, administrative controls, and finally personal protective equipment (PPE). • A plan is developed that ensures controls are implemented, interim protection is provided, progress is tracked, and the effectiveness of controls is verified.
EDUCATION AND TRAINING	<ul style="list-style-type: none"> • All workers are trained to understand how the program works and how to carry out the responsibilities assigned to them under the program. • Employers, managers, and supervisors receive training on safety concepts and their responsibility for protecting workers' rights and responding to workers' reports and concerns. • All workers are trained to recognize workplace hazards and to understand the control measures that have been implemented.
PROGRAM EVALUATION AND IMPROVEMENT	<ul style="list-style-type: none"> • Control measures are periodically evaluated for effectiveness. • Processes are established to monitor program performance, verify program implementation, and identify program shortcomings and opportunities for improvement. • Necessary actions are taken to improve the program and overall safety and health performance.
COMMUNICATION AND COORDINATION FOR EMPLOYERS ON MULTIEmployer WORKSITES	<ul style="list-style-type: none"> • General contractors, contractors, and staffing agencies commit to providing the same level of safety and health protection to all employees. • General contractors, contractors, subcontractors, and staffing agencies communicate the hazards present at the worksite and the hazards that work of contract workers may create on site. • General contractors establish specifications and qualifications for contractors and staffing agencies. • Prior to beginning work, general contractors, contractors, and staffing agencies coordinate on work planning and scheduling to identify and resolve any conflicts that could impact safety or health.



CONSTRUCTION ERGONOMICS – TODAY

HAZARD IDENTIFICATION AND ASSESSMENT

- OSHA 300 Logs/Workers' Compensation Data
- Incident Investigations (risk factors as root causes)
- Inspections – MMH, hand intensive work and postures
- JHA/JSA
- Planning – particularly for MMH!
 - Deliver materials close to where they will be used
 - Store materials higher off the ground/floor
 - Lifting and handling equipment is available

CONSTRUCTION ERGONOMICS – TODAY



Contractor Planning Tool

Bidding

WHO TO INVOLVE: Bidding on a new project may involve the estimator, project manager, safety director, and, if needed, the supplier/delivery driver, owner/general contractor.

PURPOSE & GOAL: Ensure resources are included in the estimate to cover the cost of the equipment and labor that will be needed to deliver, store, lift, and move materials without injury on the project.

KEY QUESTIONS	RESOURCES TO HELP
<ol style="list-style-type: none"> 1. What materials do you plan to use on the project? 2. What quantity of each material will you need? 3. How heavy are the units (bundles, bags, etc.) of each material that workers will need to lift and move? Which weigh more than 50 pounds? Are their light weight or lighter weight options (e.g., 40 lb bags instead of 80 lb bags)? 4. How will the materials be delivered and stored? Will you need storage equipment to ensure the materials are stored off the ground (at least 24" off the ground) to minimize bending and lifting? 5. What lifting equipment will be used to eliminate worker lifts of more than 50 pounds? 6. How will you keep track of the quantities and costs of the materials, weights, storage options, lifting equipment and assistance you need to prepare your bid? <p>TIP: Ask your employees for their ideas on how to improve manual materials handling to avoid injuries and improve productivity.</p>	<ul style="list-style-type: none"> • Weights of common building materials • Storage options for materials • Lifting equipment options • Manual Materials Handling Workbook – Worksheet #1 to help calculate and keep track of the cost of different material lifting and moving options

[← Back to Planning Tool Home Page](#)

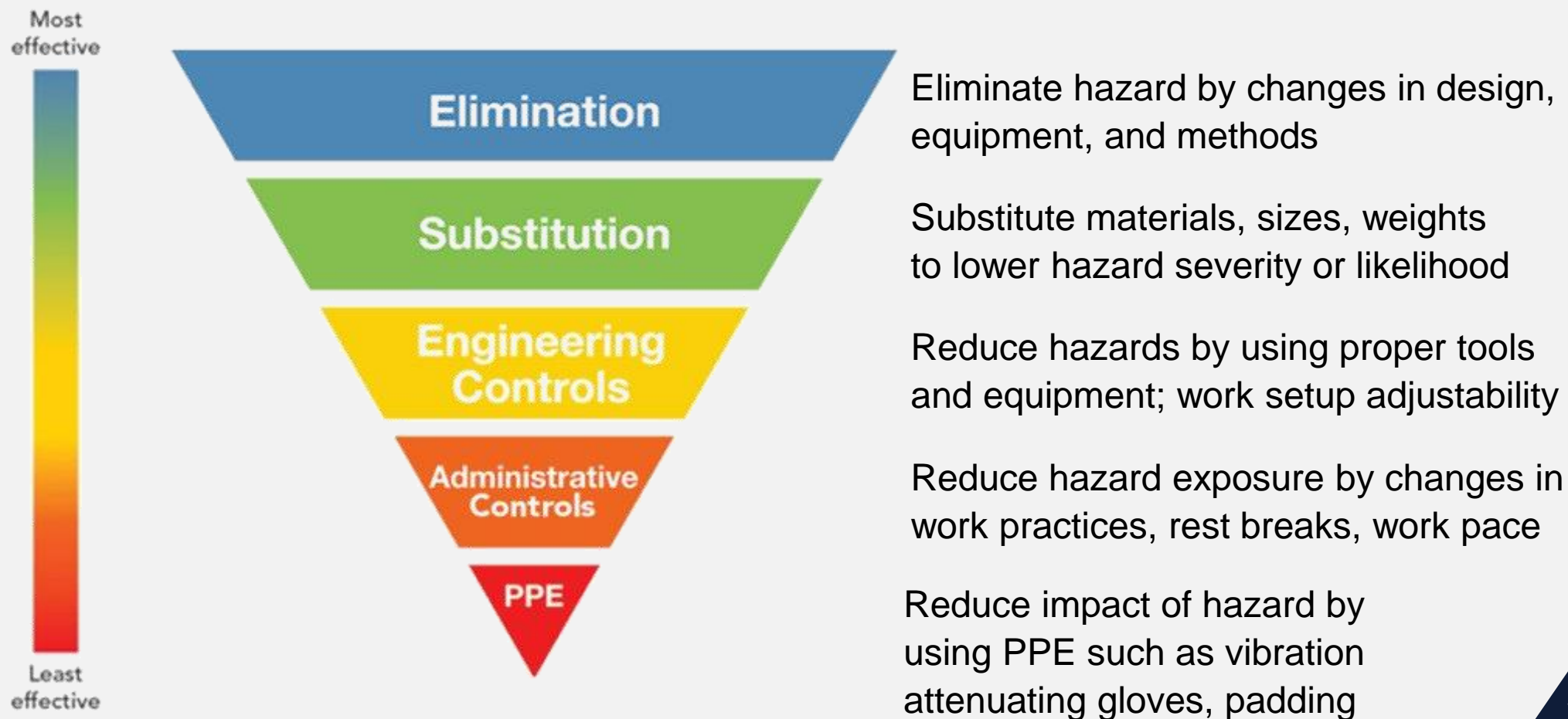
More Information

- [Bidding](#)
- [Pre-job](#)
- [On-the-Job](#)
- [Look Back](#)

[← Back to Best Built Plans Home Page](#)

CONSTRUCTION ERGONOMICS – TODAY

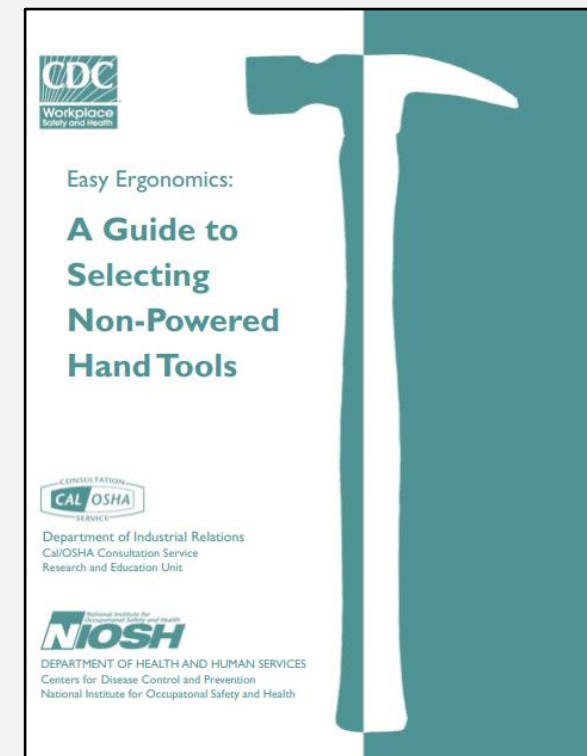
HAZARD PREVENTION AND CONTROL



CONSTRUCTION ERGONOMICS – TODAY

Solutions for all trades:

- MMH: store stuff off the floor, powered hand trucks, carts, vacuum lifts, dollies, cranes, lighter tool bags
- Hand Intensive Work: ergonomic hand tools, preferably powered
- Awkward/Static Postures – stands, stools, MEWP, creepers, kneeling pads, tool extensions
- Ergonomic tool belts



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Drywall/Painter/Glass and Floor Covering Trades:

- Drywall carts and lifts
- Pre-fabricated drywall pieces
- Door carts and lifts
- Adjustable tool handles
- Tool extensions
- Pneumatic drywall finishing systems/pneumatic tapers



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Drywall/Painter/Glass and Floor Covering Trades

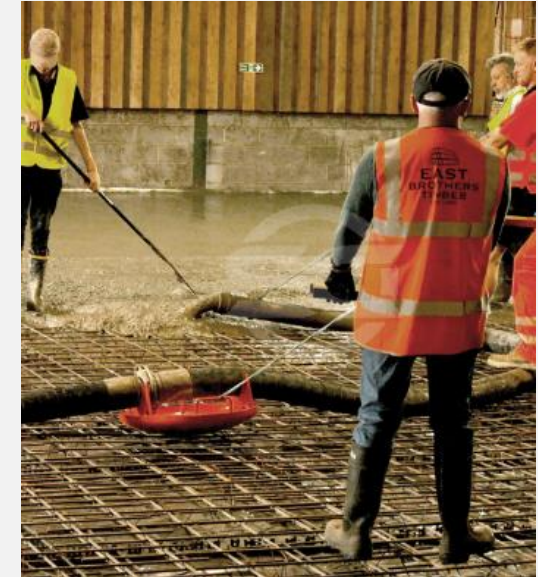
- Kneeling creepers/mats/knee pads
- Panel carts
- Light weight drywall panels
- Handles/grippers
- Suction handles



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Masons:

- Powered rebar tying extensions
- Lighter rebar
- Skid plates/hose placing disks
- Lightweight concrete blocks



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Masons:

- Powered caulking guns
- Lower vibration tools
- Anti-vibration gloves
- Grout delivery systems



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Electricians:

- Powered conduit benders
- Powered cable pullers
- Store wire and materials at waist level
- Store and sort conduit in racks
- Preassemble before installation
- Use lightweight templates to mark holes for drilling and mounting heavy boxes and panels



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Electricians:

- Drill bit extension
- Magnet/suction handles
- Work on stands at waist height
- Use mechanical lifting devices to hold large materials for fastening
- Use spool rollers/turntables
- Powered crimpers



CONSTRUCTION ERGONOMICS – TODAY

Solutions for HVAC/Sheetmetal Trades:

- Ergonomic hand tools
- Powered hand tools
- Prefabrication
- Drill bit extension
- Extension pole for Powder-Actuated Tools



CONSTRUCTION ERGONOMICS – TODAY

Solutions for HVAC/Sheetmetal Trades:

- Overhead drill stands
- Suction and magnet handles
- Use mechanical lifting devices to hold objects:
 - In place during installs
 - At waist height for assembly



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Plumbers:

- Drill bit extensions
- Kneeling creepers/kneeling pads
- Powered crimpers
- Powered pipe bending
- Work stands and mechanical lifting devices



CONSTRUCTION ERGONOMICS – TODAY

Solutions for Plumbers:

- Powered caulking gun
- Ergonomic manual and powered hand tools
- Extension pole for Powder-Actuated Tools
- Overhead drill stands
- Store and sort pipe in racks



CONSTRUCTION ERGONOMICS – TOMORROW

- Broader and accelerated applications of current methods and technologies
- More companies including ergonomics in their S&H programs
- Anticipation and leverage of new construction and ergonomics methods and technologies
- Productivity will primarily drive these changes (but cost avoidance will have greater emphasis)

Your guess is good as mine!



CONSTRUCTION ERGONOMICS – TOMORROW

Modular Building Methods: Prefabrication, Preassembly and Assembly:

- Precast concrete floor and wall panels
- Prefab modular systems
- Factory built HVAC and plumbing assemblies
- Materials with self-finishes
- Hybrid concrete construction



CONSTRUCTION ERGONOMICS – TOMORROW

New Construction Technologies:

- 3-D printing
- UAVs (drones)



CONSTRUCTION ERGONOMICS – TOMORROW

New Construction Technologies:

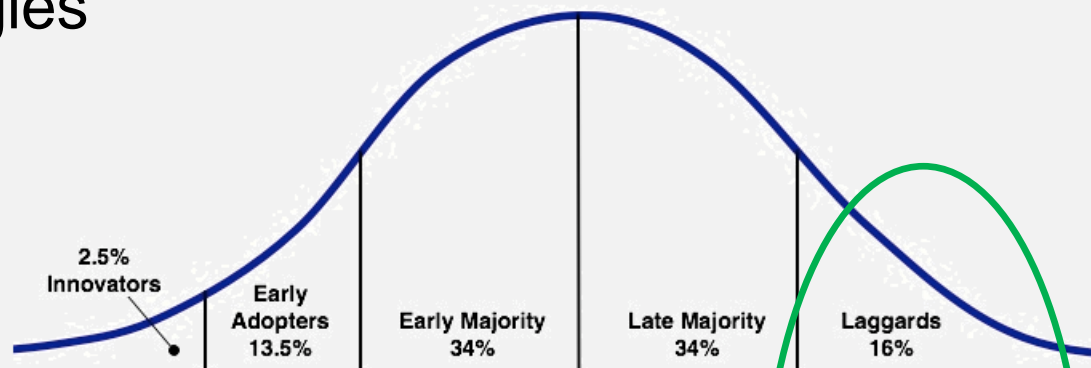
- Robotics and Teleoperation



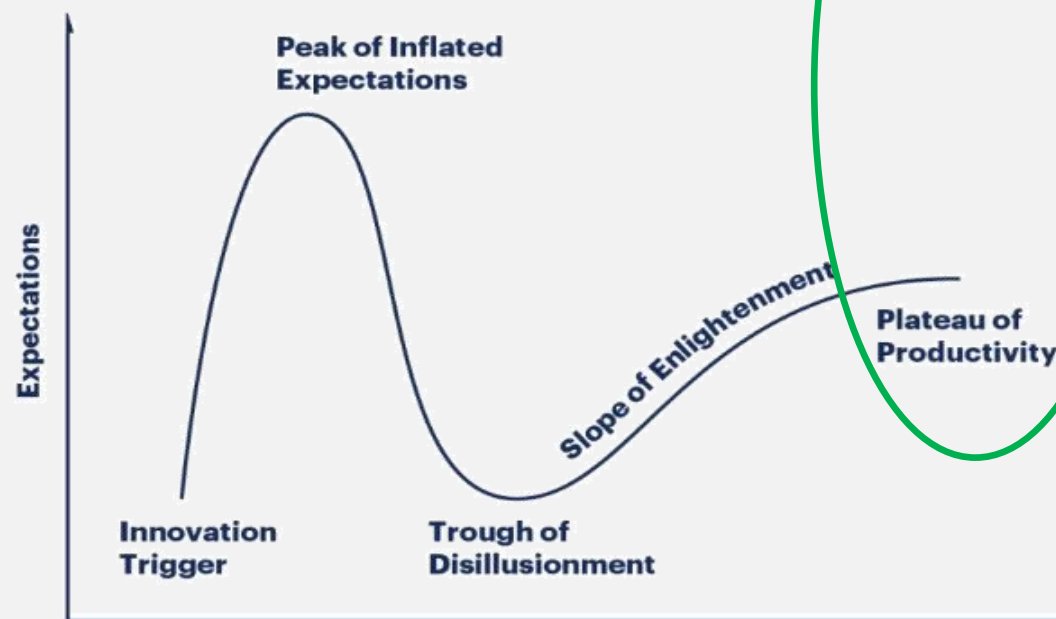
CONSTRUCTION ERGONOMICS – TOMORROW

Ergonomics Technologies

Adoption Cycle



Hype Cycle

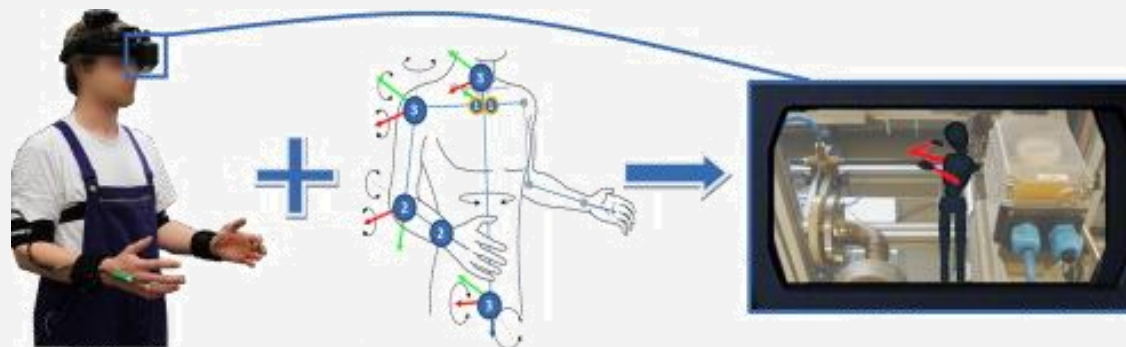
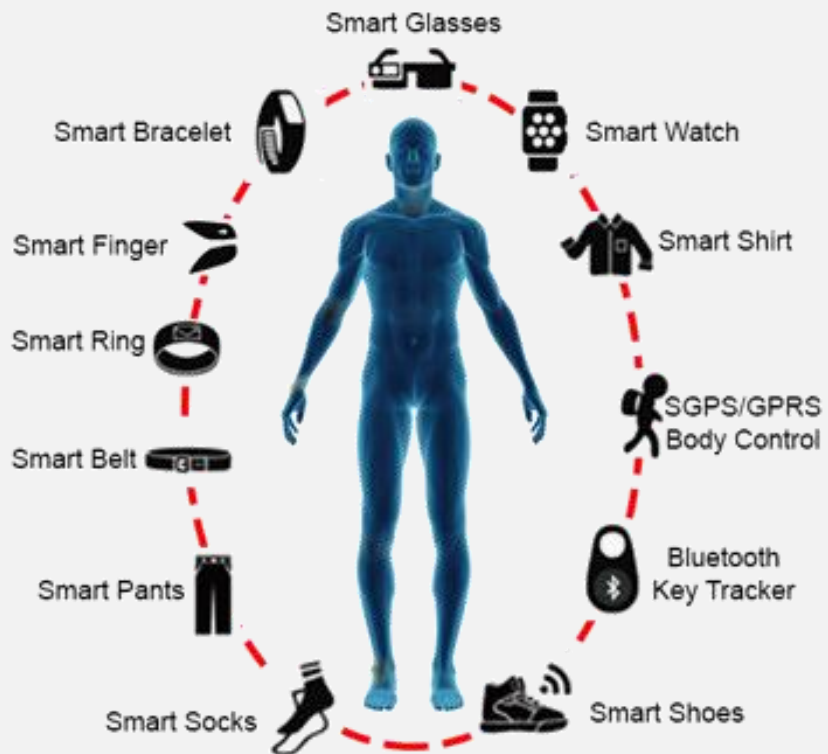


Me! ←

CONSTRUCTION ERGONOMICS – TOMORROW

Ergonomics Technologies:

- Wearables



CONSTRUCTION ERGONOMICS – TOMORROW

Ergonomics Technologies:

- Computer Vision and AI



CONSTRUCTION ERGONOMICS – TOMORROW

Wearables, and Computer Vision and AI:

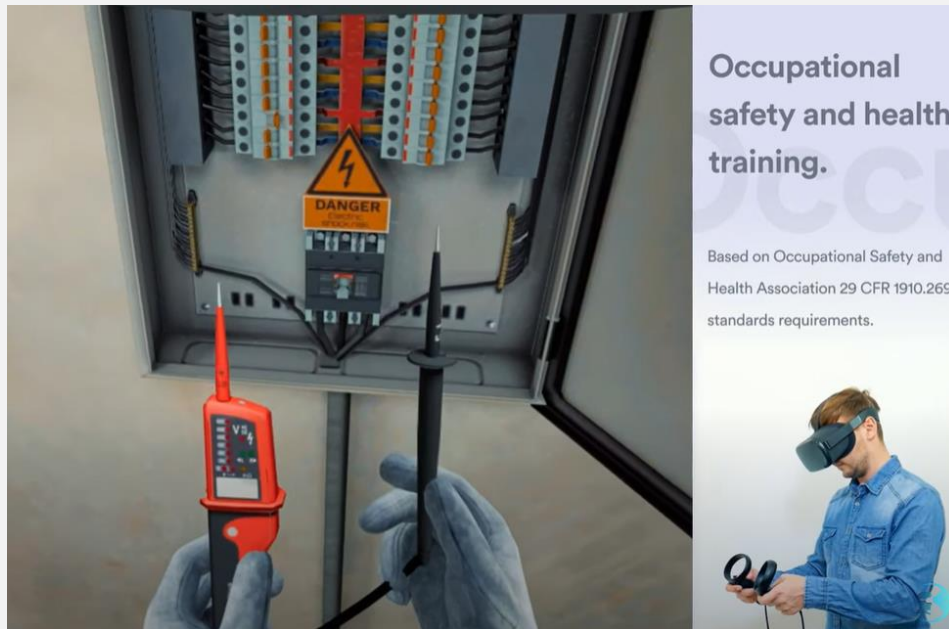
- Factors to consider:
 - DRIP: Data Rich, Information Poor?
 - Measurement accuracy/reliability
 - Validity of assessment methods
 - Proprietary software/cloud
 - Cost
 - Employee privacy: surveillance (stress, alienation, job satisfaction)

Future: fatigue and exertion (HR, respiration, temperature, EDA)?

CONSTRUCTION ERGONOMICS – TOMORROW

Ergonomics Technologies:

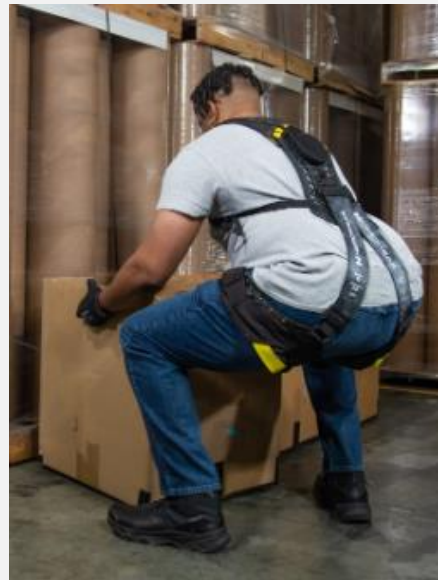
- Virtual and Augmented Reality Training (and design)



CONSTRUCTION ERGONOMICS – TOMORROW

Ergonomics Technologies:

- Active and Passive Exoskeletons and Exosuits



CONSTRUCTION ERGONOMICS – TOMORROW

Exoskeletons and Exosuits:

- Factors to consider:
 - Hierarchy of controls – engineering controls first
 - Task(s) specific
 - Cost
 - Other PPE
 - Training
 - Time – don, doff, adjustments, acceptance and use
 - Sizes, adjustability and sharing
 - Cleaning, maintenance and storage
 - Selection and deployment plan

QUESTIONS



Contact: ehavey@complianceplace.com