Interventions to Reduce MSDs in Construction

Presenters:
Philip Bigelow Niki Carlan Catherine Brookman
What is CRE-MSD?
A centre to build diverse sector capacity to prevent and decrease costly work-related musculoskeletal disorders (MSD).

Goals
1. To support workplace-partnered, stakeholder-focused research into the primary prevention of MSD.
2. To generate transferable knowledge on the primary prevention of MSD at work
1) Knowledge Generation

2) Knowledge Transfer & Exchange

3) Capacity Building

4) Collaboration and Partnerships
Research Background

• Multi-year research program investigating effective ways to facilitate the adoption of new ideas to reduce musculoskeletal disorders (MSDs)

  • Phase I identified 13 companies willing to try hydraulic lifts to raise and lower ladders to and from the top of service trucks
  • Phase II identified innovative tools, processes and ideas & selected 15 innovations for more intensive study
  • Phase III, facilitated the dissemination of these innovative ideas using a variety of techniques and strategies.

• Additional research has been conducted on:
  • Introducing tools into the plumbing sector
  • Introducing simple interventions into micro and small workplace
Construction Safety Association of Ontario (CSAO) now part of the Infrastructure Health and Safety Association (IHSA)

Enzo Garritano, Peter Vi, Marek Plawinski

CRE- MSD, University of Waterloo and Institute for Work & Health

Richard Wells, Niki Carlan, Desre Kramer, Philip Bigelow, Jan Marshal, Betina Butler & Rebecca Meyer

Funding was provided by Ontario’s Workplace Safety and Insurance Board's Research Advisory Council.
Why is construction special?

• Construction under-researched (i.e. problems with follow up; identifying process)

• 1.2 million Canadian workers employed in the sector

• 35% of all loss time injuries are due to musculoskeletal disorders
Today’s Plan
What we learned about knowledge sharing in the Construction

• Research Background
• Theoretical perspectives
  • Work organization
  • Knowledge
• Case Studies
  • Ladder racks
  • Plumbing
  • Store it off the Floor
• What we learned about:
  • The workplace
  • The workers
  • Innovation characteristic
  • Sharing techniques
# Manufacturing vs Construction

<table>
<thead>
<tr>
<th></th>
<th>Manufacturing</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work process</td>
<td>continuous</td>
<td>project</td>
</tr>
<tr>
<td>Workmates</td>
<td>constant</td>
<td>changing</td>
</tr>
<tr>
<td>Workplace</td>
<td>fixed</td>
<td>transient</td>
</tr>
<tr>
<td>Supervision</td>
<td>linear</td>
<td>complex</td>
</tr>
<tr>
<td>Employment status</td>
<td>primarily permanent</td>
<td>mixed contingent and permanent</td>
</tr>
<tr>
<td>Education</td>
<td>primarily employer trained</td>
<td>primary skilled trades</td>
</tr>
<tr>
<td>Pay system</td>
<td>hourly and benefits</td>
<td>hourly and benefit premium or piece work</td>
</tr>
</tbody>
</table>
Open vs closed networks

• Open
  • Few rules
  • Easy membership
  • Multiple goals
  • Broad membership
  • Open to change

• Closed
  • Membership restricted
  • Tradition bound
  • Collective goal
# Alternative Forms of Knowledge

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits &amp; Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural</strong></td>
<td></td>
</tr>
<tr>
<td>Formalized communication</td>
<td>Often strong but can be affected by local culture</td>
</tr>
<tr>
<td>Explicit</td>
<td>Difficult to change</td>
</tr>
<tr>
<td>Rule oriented</td>
<td>Effective for transfer of information quickly</td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td></td>
</tr>
<tr>
<td>Shared language, meanings and assumptions</td>
<td>Effective for complex knowledge</td>
</tr>
<tr>
<td>Involves shared identity and social cohesion</td>
<td>Professionaltrade siloing can inhibit innovation</td>
</tr>
<tr>
<td><strong>Experiential</strong></td>
<td></td>
</tr>
<tr>
<td>Personal relationships governed by social norms</td>
<td>Forms strong ties and effective knowledge transfer</td>
</tr>
<tr>
<td>Trust and reciprocity key elements</td>
<td>Can lead to exclusionism</td>
</tr>
</tbody>
</table>
Finding credible ideas and EVIDENCE

**Multiple sources of innovations:**
- Found in trade publications.
- Identified on work sites.
- Evaluated by team.
- Regarded as practical by sector – productivity, quality, and costs. Not necessarily MSD priority.

Forming the evidence base

www.cre-msd.uwaterloo.ca
Ladder Rack

• Piloted a hydraulic ladder lift*
• VAC committee identified the innovation; was evaluated.
• 13 companies persuaded to adopt the new innovation.
• Became “opinion leaders”.
• Workers told their buddies.
• Companies planning on buying new ladder lifts.

Ladder Rack Results

• 30 companies approached to participate
• 13 companies persuaded to adopt the new innovation.
• Significant limitation in participation because there were few identified accidents
• Information shared through social networks
• Companies planning on buying new ladder lifts would purchase hydraulic rack
• No evidence of reduced accidents or Lost Time Claims
Plumbing The beginning of an initiative

IHSA contacted
Act as intermediary and collaborator
Link to CRE-MSD team
Provide expertise (ergonomics/sector knowledge)

CRE-MSD involved
Researchers working in sector
Expertise in ergonomics & diffusion of innovation

Workers notice increased MSK complaints
Residential low rise plumbers in Local 46 (GTA) report to H&S rep
Increase use of PEX and manual crimping
Issue investigation

- Contract plumbers who plumb new houses with PEX reported high prevalence of hand and forearm pain that interferes with their work.
- There were also reports of fatigue over a week, with a progressive loss of strength and decrements in productivity.
- These effects may be attributed to repetitive and high forces when cutting and crimping PEX piping.
Survey of plumbers

- 186 low rise residential plumbers responded to a questionnaire
- 94% reported pain after working
- 80% reported back pain
- 75% reported wrist pain
- Manual crimping requires the greatest grip force when compared to power crimping and soldering
- Complaints of wrist pain increase with the number manual crimps

Dose response with # of crimps

- Less than 50/day
- 50-100 crimps
- 100-200 crimps
- More than 200
### Task Analysis of 16 Plumbers

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning: Basements</td>
<td>Morning: Clean Up, Installation</td>
<td>Morning: Basement</td>
<td>Morning: Basements (approx 200 crimps)</td>
<td>Morning: Basements</td>
</tr>
<tr>
<td>Installation &amp; Finishing</td>
<td>Installation &amp; Finishing</td>
<td>Installation</td>
<td>Finishing</td>
<td></td>
</tr>
<tr>
<td>Installation &amp; Finishing</td>
<td>Installation &amp; Finishing</td>
<td>Installation</td>
<td>Finishing</td>
<td></td>
</tr>
<tr>
<td>Basements</td>
<td>Testing</td>
<td>Basements</td>
<td>Basements (approx 100 crimps total)</td>
<td>Basements</td>
</tr>
<tr>
<td>Basements</td>
<td>Testing</td>
<td>Basements</td>
<td>Basements (approx 100 crimps total)</td>
<td>Basements</td>
</tr>
<tr>
<td>Free Standing Bathtub</td>
<td>Free Standing Bathtub (Skirting)</td>
<td>Cut and Rough-In</td>
<td>Drops (approx 40 crimps)</td>
<td>Testing and Risers</td>
</tr>
<tr>
<td>Free Standing Bathtub</td>
<td>Free Standing Bathtub</td>
<td>Roaming</td>
<td>Drops (crimping and hammering)</td>
<td>Kitchen and Drops</td>
</tr>
<tr>
<td>Finishing</td>
<td>Finishing (approx 100 crimps)</td>
<td>Finishing (approx 50 crimps)</td>
<td>Drops</td>
<td></td>
</tr>
<tr>
<td>Piping</td>
<td>Finishing (approx 200 throughout day)</td>
<td>Finishing</td>
<td>Finishing (less than 20 crimps)</td>
<td></td>
</tr>
<tr>
<td>Rough-In</td>
<td>Finishing</td>
<td>Basements (5-6, 3/4” crimps)</td>
<td>Bathubs</td>
<td></td>
</tr>
<tr>
<td>Cut Pipes</td>
<td>Finishing</td>
<td>Installation</td>
<td>Finishing, fetching</td>
<td></td>
</tr>
<tr>
<td>ABS Piping</td>
<td>Finishing</td>
<td>Installation</td>
<td>Shower Pan</td>
<td></td>
</tr>
<tr>
<td>Rough-In</td>
<td>Finishing</td>
<td>Basements (10-12 crimps)</td>
<td>Cut pipes, repairs (2, 1/2” crimps)</td>
<td></td>
</tr>
<tr>
<td>Rough-In</td>
<td>Finishing</td>
<td>Bathubs</td>
<td>Bathubs (approx 10 crimps)</td>
<td></td>
</tr>
<tr>
<td>Cutting Pipe</td>
<td>Installation</td>
<td>Bathubs</td>
<td>Bathubs</td>
<td></td>
</tr>
</tbody>
</table>

### Task Breakdown

- **Basements**: Includes installation, testing, and cleaning.
- **Installation & Finishing**: Includes Basements, free standing batub (skirting), and cut and rough-in.
- **Free Standing Bathtub**: Includes installation and finishing.
- **Finishing**: Includes cutting pipes and ABS piping.
- **Rough-In**: Includes cutting, installation, and finishing.
- **Shower Pan**: Includes cut pipes and repairs (2, 1/2” crimps).
- **Cutting Pipe**: Includes installation and baths.
Task analysis of 16 plumbers
Plumbing results

• Most measures showed changes through the day consistent with the development of fatigue
• Measures of maximal handgrip strength, tremor and steadiness also showed between day effects consistent with a build up fatigue during the week with some evidence of recovery during the weekend
• Findings were consistent with the original reports of plumbers
• Consider the existence of within-shift and within-week effects when measuring occupational fatigue
• Measures respond differentially to fatigue at work
• New tool requires less force to operate (lab tests)
Plumbing results

• Innovations that increase productivity may be implemented without health consideration

• Bottom-up concern can lead to action
  • Factors facilitating bottom-up, participatory research
  • Social structure – influence of UA local 46
  • Trusted intermediaries – IHSA
  • Networked to industry/union/researchers

• Significant limitations if cost /benefit cannot be established
Store it Off the Floor: the study

• Lifting objects is a common hazard for low back pain.

• Recognition of situations where lifting could increase the risk of low back pain is needed to reduce risk.

• There are many assessment methods available to experts and ergonomists, however, they are too complex for small and micro businesses.

• This is limitation is critical as a large proportion of the population works in these small/micro businesses.

• The challenge was to develop an approach that matches the needs and knowledge of these businesses.
STORE IT OFF THE FLOOR

- Put heavier objects between knee and shoulder; waist level is best
- Put rarely used objects on the floor or at shoulder level
- Do your work on tables, benches, or even piled pallets
- Store things on shelves to decrease the numbers of times you need to bend forward in a day

www.cre-msd.uwaterloo.ca
STORE IT OFF THE FLOOR

◆ The closer your hands are to the ground when you are lifting, the more likely you are to hurt your back.

◆ You are more likely to hurt your back if you are lifting from the ground, even for a light object like a pencil!!!

◆ There is no “good” way to lift things from the ground. All methods are hard on your back... even if you bending your knees.

◆ So to prevent that problem altogether; ‘Store it off the floor!’

Preventing Low Back Injuries from Lifting

◆ Don’t work at floor level: do as much of your work as possible on benches, tables or even some piled pallets.

◆ Make effective use of your shelves: place most commonly used and/or the heaviest items at waist height.

◆ Make use of chairs and tables when putting things down.

◆ Use lift assist devices, hand trucks or handling devices to decrease manual materials handling.

◆ Rarely used things could be stored on the floor but if they are heavy, use handling devices.

◆ Team lift! Use a partner to help decrease the load.

What are we going to do at the work place today to prevent injuries while lifting?

1. _____________________________________________
   _____________________________________________

2. _____________________________________________
   _____________________________________________

3. _____________________________________________
   _____________________________________________

Have an example you’d like to share? Or are you interested in more information?
Send an email to avayzard@uwaterloo.ca to learn more.

www.cre-msd.uwaterloo.ca
Store It Off the Floor Results

- The survey of small/micro business showed limited knowledge of physical loading and musculoskeletal disorders.

- To control the hazards they relied heavily on the ineffective control of “proper lifting”.

- Employers expressed a preference for simpler knowledge transfer such as posters and tip sheets.

- The message was delivered in a letter-sized format that could function both as a small poster and the basis of a “tool-box-talk”.

- A sample of 40 small and micro businesses participated and were followed up 2-4 weeks later.

- The message and approach improved businesses’ knowledge of low back pain prevention.

- Approximately one quarter of businesses surveyed initiated change.
What we learned about Implementation

About the Workplace

• Lack of structure in workplace is a barrier
• Exposure to open networks a facilitator
• Work process critical to innovation
• Construction workers have significant power to organize work
• Small innovations valuable to small/micro workplaces
What we learned

Innovations (not all good ideas are usable)

Potential Success:

• If it will increase productivity!
• If there is more advantage than “just” safety improvements
• If there is an opportunity to try out the tool before buying it - “Trialability”
• If the innovation met the specific need of the sector or sub-sector
• If the innovation was needed often and by many workers
• If the innovations fit into the usual work process
• If the innovation was well developed... no bugs
What we learned

Techniques (not all good ideas are usable)

Increase potential for success:

• If KT is not limited to written reports
• If non-literate learners are respected (posters)
• If innovation introduced by co workers
• If innovation supported by unions and employers
• If paid worktime allocated for KT
• If there is an opportunity to exposure to open networks
Planning critical to Implementation

Successful Implementation

- Audience
- Innovation
- Organization of work


Desre M. Kramer, Richard P. Wells, Philip Bigelow, Niki Carlan, Donald C. Cole and C. Gail Hepburn. (2010) "Dancing the Two-Step: Collaborating with intermediary organizations as research partners to help implement workplace health and safety interventions": *WORK: A Journal of Prevention, Assessment and Rehabilitation,*
