Integrating Occupational Safety and Health into Sustainability using Prevention through Design

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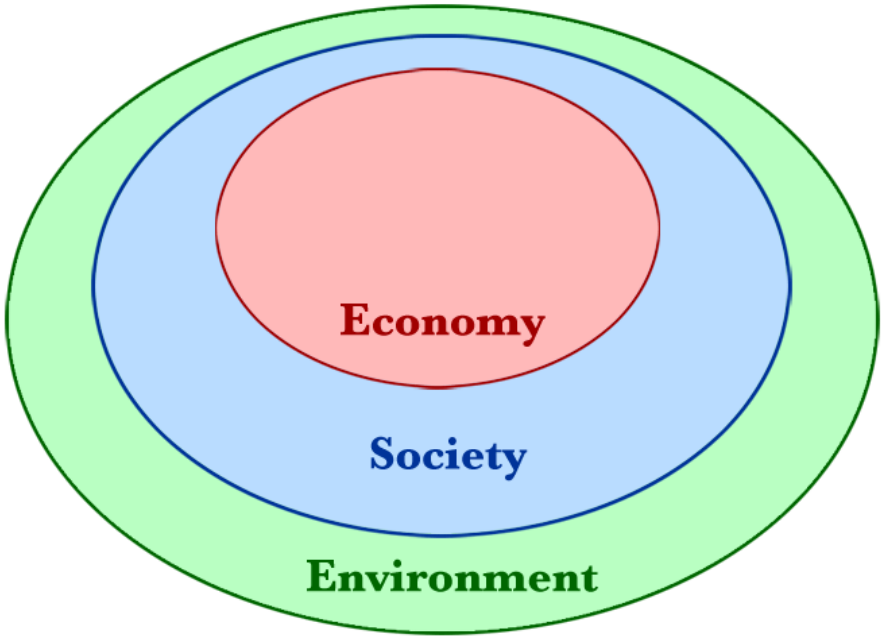
Are Green Jobs Safe for Workers?

Not Always…

Social Pillar of Sustainability Must Include Workers



- Just as the sustainability of society depends on the environment, the strength of our economy depends on a safe and healthy workforce
- Teach market to demand accountability for S&H just like they are beginning to demand for carbon emissions and toxic chemicals

Discussion Topics

- Overview of Prevention through Design (PtD)
  - Successful Case Studies
  - Incentives
- Links to Sustainable Design
- Current PtD activities
- PtD next steps

What is Prevention through Design?

Eliminating work-related hazards and minimizing risks associated with:

- Construction
- Manufacture
- Use, re-use and disposal
- Maintenance

…of

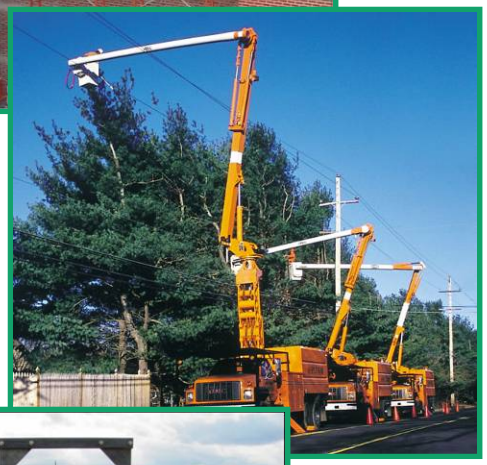
- Facilities
- Materials and
- Equipment

PtD™ Prevention through Design

Yearly Burden of Occupational Morbidity and Mortality

- Morbidity and mortality
  - 5,800 Deaths due to injury (8th leading cause)
  - Approximately 50,000 Deaths due to illness
  - 228,00 Illnesses
  - 3.9 million Serious injuries
- Comprehensive estimates of US costs of occupational injury and disease
  - Direct and indirect: $128 billion - $155 billion
    - $81 billion in Workers' Compensation
- Social consequences of occupational morbidity and mortality
  - Pain; impact on families, community, and personal mental health

Design Contribution to Occupational Fatalities: Australian Study 2000-2002



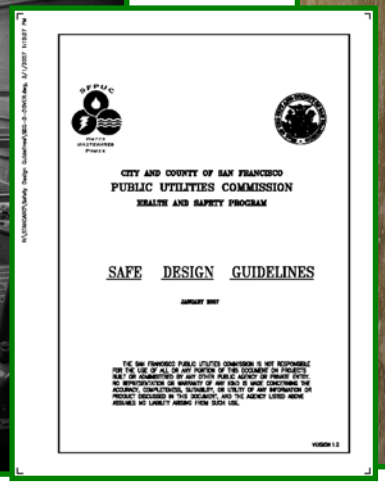
- Main finding: design continues to be a significant contribution to work-related serious injury.
- 37% of workplace fatalities involved design-related issues.
- In another 14% of fatalities, design-related issues may have played a role.

International PtD Efforts

- Australia
  - National OHS Strategy 2002 – 2012
    - “Eliminate hazards at the design stage”
    - Coordinates compliance activities between the OHS jurisdictions
- EC Directive 92/57/EEC
  - Requires all parties, including designers, to address OSH hazards and risks on construction sites
- UK Construction (Design and Management) Regulations
  - Place a duty on designers to ensure that foreseeable hazards and risks to construction workers are avoided
- Canada Minerva

Successful Case Studies

Using PtD to “design-out” permit-required confined spaces



CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION
HEALTH AND SAFETY PROGRAM

SAFE DESIGN GUIDELINES

Two Goals:

1. Eliminate the hazard s by making the vaults NOT confined spaces
   - Provide access/egress
   - Design for continuous human occupancy
2. If this is not possible, reduce the risks

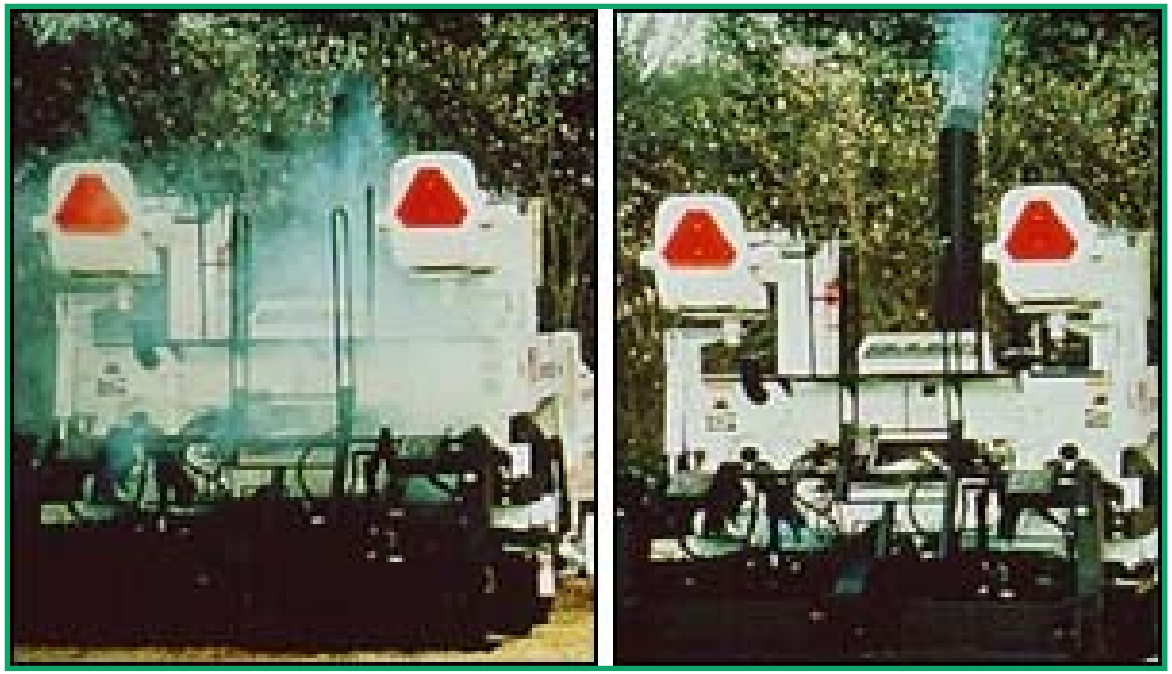
Source: Carolyn Jones, San Francisco Public Utilities Commission

Nanotechnology Research Center design supports handling hazardous materials

Sub-fab of the Birck Nanotechnology Center at Purdue University, West Lafayette, Indiana

- Dumbwaiter used to transport hazardous materials between floors to eliminate need for transport on passenger elevator
- Local exhaust available along transport route; hatches strategically placed throughout the sub-fabrication facility connected to a metal duct system containing elephant trunks
- In the event of an emergency, the ring pulled by worker and the elephant trunk drops to the floor
- Chemical gases and vapors immediately exhausted after scrubbing.

Industry-wide equipment re-design protects workers' health



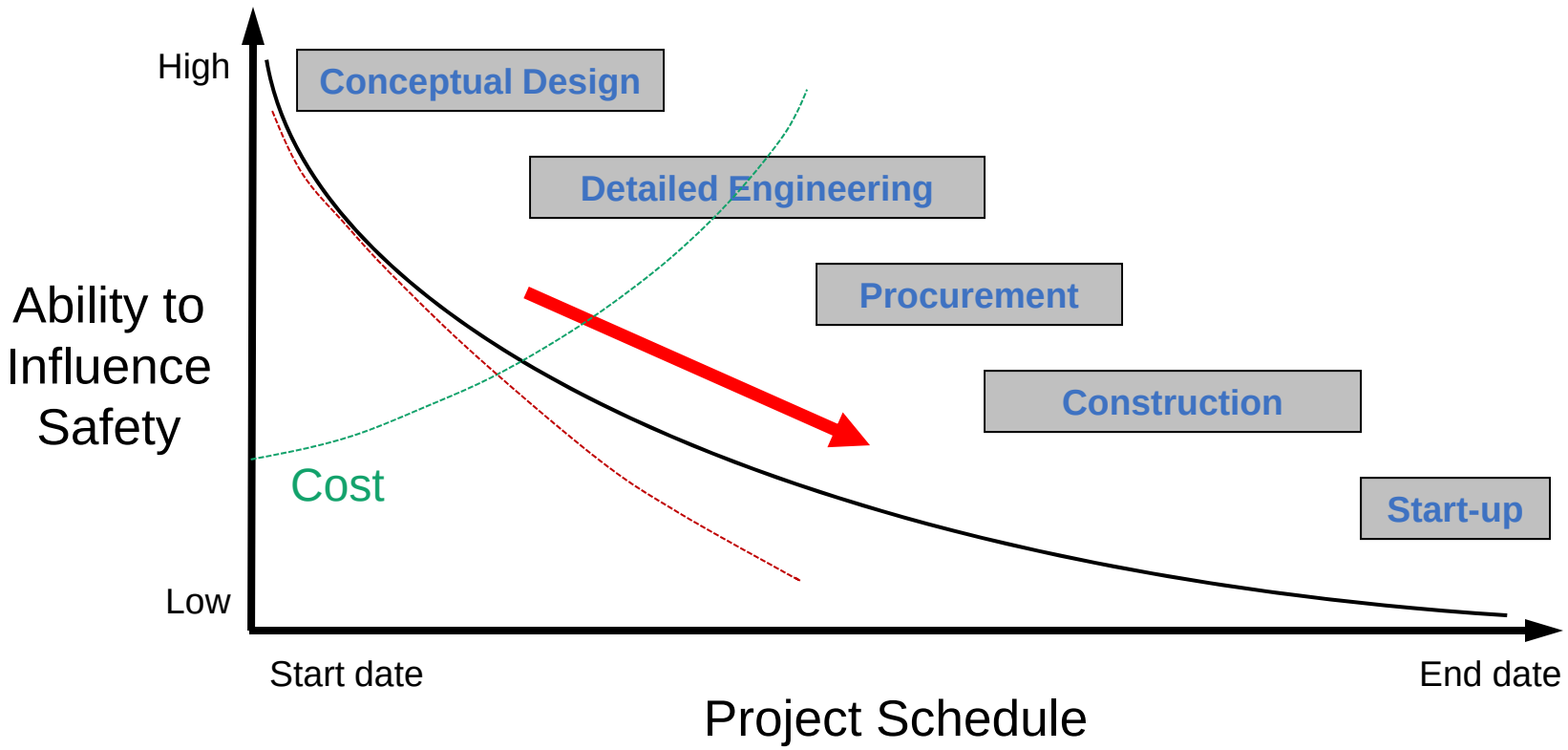
Before and after photos of asphalt fume emissions from highway-class pavers

Source: Cervarich MB [2008] Prevention through Partnerships. PtD in Motion, Issue 2.

Incentives for PtD

- PtD provides a framework to deliver on the vision of an injury and illness-free workplace
  - Success will only be achieved by integrating occupational safety and health (OSH) with ***key business processes***
- Limited resources drive the need for increased efficiency and cost effectiveness
  - "Lean is Better"
- PtD lays the foundation for OSH sustainability
  - Essential to include OSH into sustainable design

Ability to influence design



(Source: Szymberski, R., "Construction Project Safety Planning." TAPPI Journal, Vol. 80, No. 11, pp. 69-74.)

Capital Project Delivery Process

Example PtD deliverables for each phase of design

- Conceptual Design
  - H&S goals for the project
  - Identify occupational hazards
- Preliminary Design
  - Design out hazards, if possible
  - Assess risks / develop risk control alternatives
- Detailed Design
  - Select controls
  - Process Hazard Reviews
- Procurement
  - Develop specifications and include in procurements
  - Develop “checks and tests” to support FAT and Commissioning
- Construction
  - Construction site safety and contractor safety
  - Conduct “checks and tests” including factory acceptance
  - Pre-start up safety reviews
  - Development of SOPs
  - Education
- Start Up
  - Risk / exposures Assessments
  - Management of residual risks
  - Modification of standards
  - Management of change

Incentives for PtD

- PtD provides a framework to deliver on the vision of an injury and illness-free workplace
  - Planning for success by integrating OSH with key business processes
- Limited resources drive the need not only for increased efficiency and cost effectiveness…
  - "Lean is Better"
- …but also for demonstrating business value
- PtD lays the foundation for OSH sustainability
  - Essential to include OSH into sustainable design

Business Value

- The AIHA Value Strategy* demonstrated the most significant business contributions result from…
  - Anticipating worker exposures and designing process improvements to reduce or eliminate these exposures
  - Aligning health and safety interventions with business goals
  - Integrating health and safety risk management requirements into the design process
    - Facilities, equipment, tools, processes, products and work flows
- …resulting in significant contributions to business profitability

PtD™ Prevention through Design

***www.ihvalue.org**

Prevention through Design using Hierarchy of Controls
Elimination
Eliminate the hazard during design or re-design
Substitution
Substitution of less hazardous materials, processes, operations, or equipment
Engineering Controls
"Design-in" engineering controls to minimize risk
Warnings
Automatic and manual warning systems; signs and labels
Administrative Controls
Training, well-designed work methods & organization
PPE
Available, effective, easy to use
Control Effectiveness
Financial Value

Incentives for PtD

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Warm-mix asphalt: achieving worker safety, environmental and cost goals

- Cooler paving sites
- No asphalt fume
- Able to haul for longer distances
- Reduced energy requirements
- More consistent pavement quality
- Longer duration product
- 95% re-used/recycled

Source: Cervarich MB [2009] Warm-Mix Asphalt: Preventing Exposure at Its Source. PtD in Motion, Issue 5.

Are Green Jobs Always Safe for Workers?

How do we eliminate hazards and minimize risks in emerging industries/technologies?

Making Green Jobs Safe

- 170 Stakeholders discussed activities to ensure that green jobs, technologies and products are safe for workers
  - Construction / Infrastructure / Re-purposing
  - Manufacturing / Emerging Technology
  - Energy / Mining
  - Agriculture, Forestry and Fishing
  - Transportation
  - Waste Management and Recycling
- 48 compelling activities included in the PtD Plan for the National Initiative

Conflicts/Barriers

- "Environmental concerns drive the sustainability process"
  - "Drive to Green" vs. "Push for OSH"
    - Can lead to shifting of risk
- "Green has a market value, OSH has a market cost"
- Lack of awareness that there are OSH risks
- Knowledge transfer needs
- Some new hazards with unknown risks
- Limited / irregular data collection

Lack of integrated practice leads to unintended consequences

- Lack of coordination between safety/energy/environmental decision makers can lead to **“risk shifting”**
  - Example – wrapping bridge to minimize lead emissions causing higher exposures for workers inside
  - Example – Implementing LEED® Construction IAQ Management Plans during Construction
    - Sealing ductwork to “protect” it
- Health and safety requirements must be integrated into capital project delivery
  - Beginning with Conceptual / Preliminary Design

Weatherproofing—Isocyanate Exposure

Additional engineering controls are needed

- Irritates mucous membranes, gastrointestinal and respiratory tracts
- Marked skin inflammation possible
- Severe asthma possible
- PPE and administrative controls not sufficient

Example: Coal Ash Bricks and Cement

- Keeps the coal ash out of land fills
- Does not leach
- Recycle and reuse

Coal Ash Contains:

- **Dioxins / Arsenic**
- **Beryllium / Boron**
- **Cadmium / Chromium Cobalt / Lead**
- **Manganese**
- **Mercury**

National Renewable Energy Lab: LEED® Platinum

CDC Building 110: LEED® Gold

Should worker safety and health be included in LEED® rating system?

- Construction?
- Occupancy?
- Operations/maintenance?

Example: Dry Cleaning Alternatives

1-Bromopropane

- Selected as an environmentally-acceptable replacement for PERC (perchloroethylene) and other chlorofluorocarbons, but….
- It is flammable (flash point 21 – 25 C) and…
- Worker exposure risks include nervous system disorders, and…
- There is evidence of reproductive and developmental effects in animals
- PtD question: “Are there other alternatives that meet environmental goals while assuring the safety and health of the workers?”

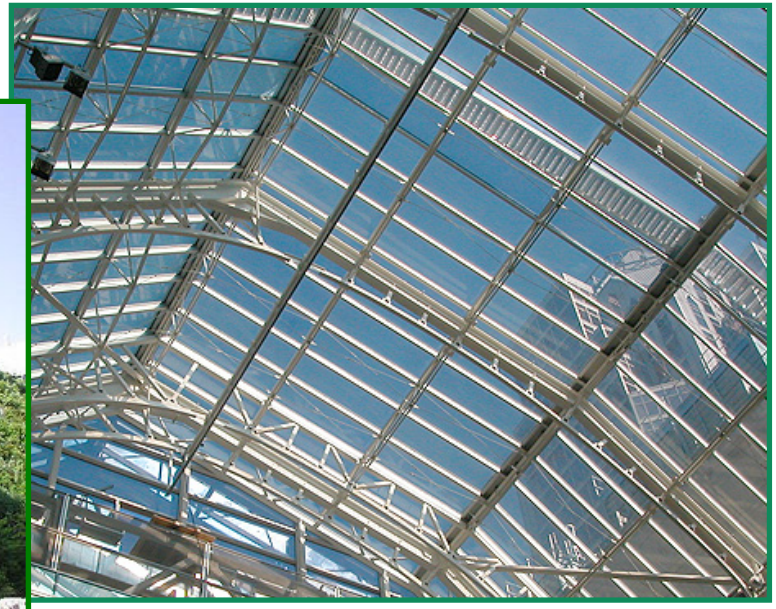
“Limited awareness of OSH risks”

- *Limited adoption of controls*
- Knowledge to control risks to many “green jobs” hazards is known
- Need to adopt a “Prevention through Design” approach to green jobs
- Use existing knowledge for new technologies
- Develop new standards

Promote what we know

- Asbestos
- Spray foam insulation
- Lead
- PCBs in caulk

Research and knowledge transfer



How do we (quickly) support research and disseminate results?

- **Skylight / atria window installation and maintenance**
- **Increased materials handling due to recycling**
- **Green roofs**

Develop new standards

Untapped synergy opportunities

Adding OSH to green construction acknowledges that workers are a valued resource that should be protected

- Consider worker exposure risks in the life cycle analysis (supply, fabrication, installation, use, demolition) of green construction materials
- Project site health issues are a logical construction site management issue
- Federal leadership

Current Activities to Drive PtD Culture

- Research
  - Benchmarking
- Education
  - Educate engineers in design aspects of occupational safety and health
- Practice
  - Develop PtD process and tools
  - Wiki to share PtD successes
- Policy
  - Include of PtD in industry consensus standards
  - ASSE-ANSI PtD standard
  - Include worker health and safety into sustainable design and construction practices

PtD National Initiative Next Steps

- Include PtD into certification
  - E.g., BCSP, ABIH
- Include PtD into accreditation
  - E.g., ABET
    - Accreditor for college and university programs in applied science, computing, engineering, and technology
- Include design-related root causes in injury/illness investigations
  - Address them!
- Build PtD requirements into procurements
- Develop a occupational H&S rating system to integrate with or supplement LEED®

To Learn More…

- Visit the NIOSH PtD Program Portfolio Pages
  - http://www.cdc.gov/niosh/programs/ptdesign/
- Visit the NIOSH Going Green: Safe and Healthy Jobs Topic Page
  - http://www.cdc.gov/niosh/topics/greenjobs/