# PREVENTION THROUGH DESIGN:

## Sustainable Innovation in Safety Management

36TH ANNUAL SCIENTIFIC MEETING

New York/New Jersey Educational Resource Center

New York, NY

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Based on past presentations with

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Professor, Civil and Construction Engineering, Oregon State University

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## Prevention through Design

### Design for Construction Safety


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## News and Updates:

PtD has been added to the LEED rating system!

Here's a new online course on Ptd offered by East Carolina University that allows participants to earn CEUs.

The American Society of Civil Engineers are sponsoring a student essay contest on PtD!

Consider attending a CIB W099 conference on PtD: International Health and Safety Conference: Benefitting Workers and Society through Inherently Safe(r) Construction 10th - 11th September 2015, Jordanstown Campus, Northern Ireland

PtD will be one of the presentations at the NY/NJ Educ. Research Center Scientific Meeting at Mt. Sinai Hospital in NYY on March 20.

PtD will be one of the presentations at the Safety Executives of New York Professional Development Conference on March 24.

An ANSI A10 Prevention through Design Workgroup has been formed, with the goal of producing a PtD in Construction Technical Report. The workgroup is being chaired by Mike McCullion at SMACNA.

Several reports and presentation files have been added to the Resources tab (July 7, 2014).

NIOSH Rolls-out New Web Resources to Support Buy Quiet Programs

NIOSH released a report on the State of the National (NIOSH) Initiative on Prevention through Design

# COURSE DESCRIPTION

The presentation will summarize the PtD concept and the ethical and sustainability-related reasons for PtD, provide common examples, and summarize tools and processes that enable PtD. The presentation will conclude with suggestions for how to move forward with implementing PtD in your organization.

# LEARNING OBJECTIVES

Participants will be able to:

- Define Prevention through Design (PtD)
- Identify common examples of PtD
- Describe tools and processes that enable PtD
- Summarize steps in implementing PtD in an organization.

# OVERVIEW

- PtD Concept
- Motivation
- Examples
- Leaders
- Tools and Processes
- Moving forward in your organization

**Prevention through Design**

**= Design for Safety**

**= Safety by Design**

# IMPORTANT MANAGEMENT CONCEPTS UNDERLYING PTD

- Sustainability
- Collaboration
- Innovation and Managing Change


# PREVENTION THROUGH DESIGN (PTD)

"Addressing occupational safety and health needs in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment."

(http://www.cdc.gov/niosh/topics/ptd/)

# PTD IN CONSTRUCTION IS…

- Explicitly considering construction safety in the design of a project.
- Being conscious of and valuing the safety of construction workers when performing design tasks.
- Making design decisions based in part on a design element's inherent safety risk to construction workers.

**“Safety Constructability”**

# WHY PTD? ANNUAL CONSTRUCTION ACCIDENTS IN U.S.

- Nearly 200,000 serious injuries
- Nearly 1,000 deaths

# WHY PTD? DESIGN-SAFETY LINKS

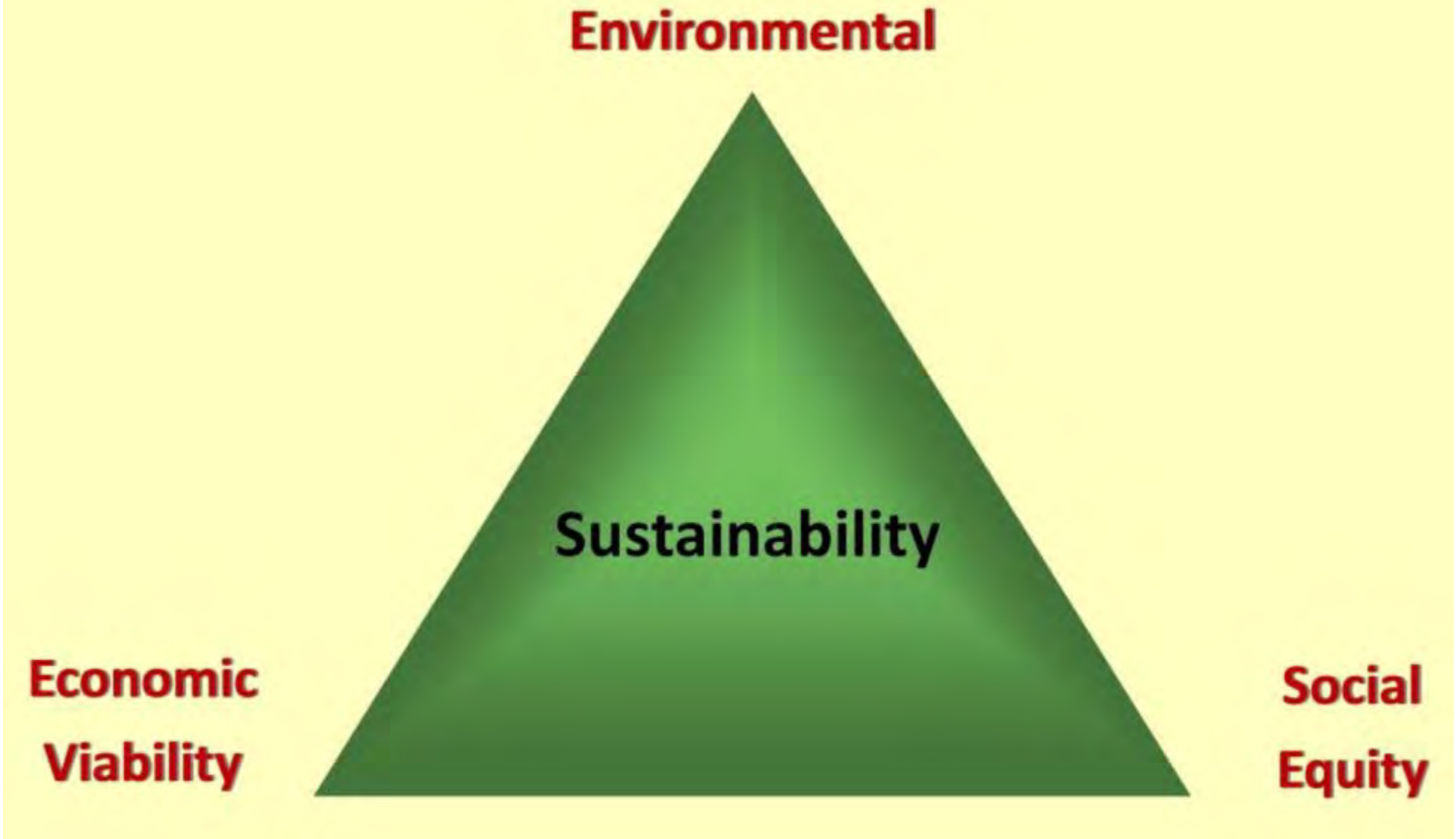
- 22% of 226 injuries that occurred from 2000-2002 in Oregon, WA, and CA[1]
- 42% of 224 fatalities in US between 1990-2003[1]
- 60% of fatal accidents resulted in part from decisions made before site work began[2]
- 63% of all fatalities and injuries could be attributed to design decisions or lack of planning[3]

[1] Behm, M., "Linking Construction Fatalities to the Design for Construction Safety Concept" (2005)
[2] European Foundation for the Improvement of Living and Working Conditions
[3] NSW WorkCover, *CHAIR Safety in Design Tool*, 2001

# WHY PTD? PROFESSIONAL ETHICS

- National Society of Professional Engineers (NSPE) Code of Ethics:
  - Engineers shall hold paramount the safety, health, and welfare of the public.
- American Society of Civil Engineers (ASCE) Code of Ethics:
  - Engineers shall recognize that the lives, safety, health and welfare of the general public are dependent upon engineering decisions ….

# WHY PTD? SUSTAINABILITY



# PTD'S TIE TO SUSTAINABILITY

- Definition of Sustainable Development in Brundtland Commission Report (1987)
- Focus on people as much as on the environment
  - Meet the needs of people who can't speak for themselves

United Nations

**Report of the World Commission on Environment and Development: Our Common Future**

Transmitted to the General Assembly as an Annex to document A/42/427 - Development and International Co-operation: Environment

**Table of Contents**

# CORPORATE SOCIAL RESPONSIBILITIES

- "Commitment by business to behave ethically and contribute to economic development;
- "Improve quality of life of the local community and society at large."
- "Improve quality of life of the workforce and their families;

Source: World Business Council for Sustainable Development

# CSR: SUPPLY CHAIN MANAGEMENT

- Supplier social equity
  - Anti-Sweatshop movement
  - Fair Trade
  - Bangladesh factory collapse

# SUSTAINABILITY IS NOT JUST BEING GREEN

# PTD AND SOCIAL SUSTAINABILITY/EQUITY

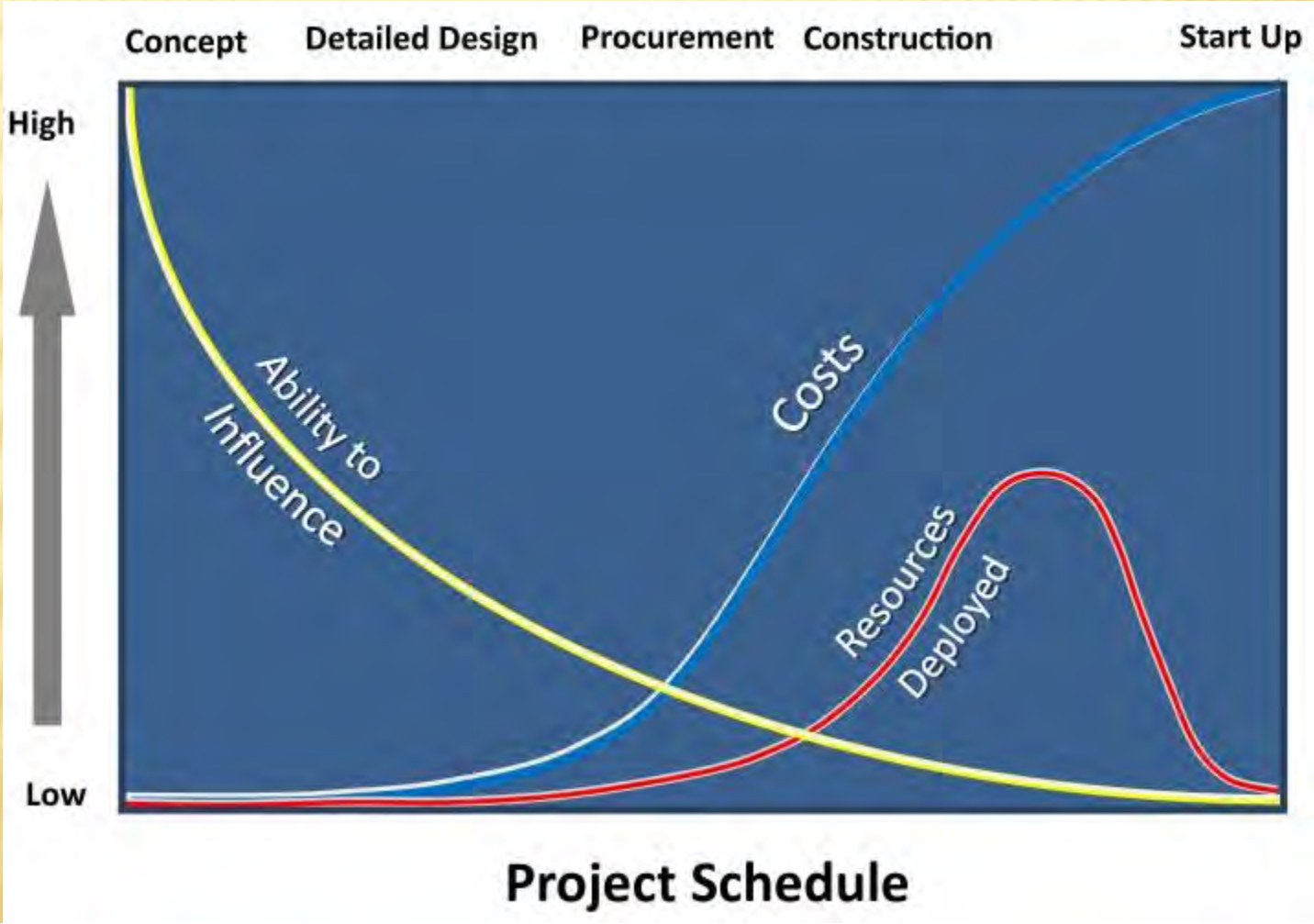
- Do not our duties include minimizing all risks that we have control over?
- Do we not have the same duties for construction, maintenance, line workers as for the “public”?
- Is it ethical to create designs that are not as safe as they could (practically) be?

# DESIGN HAS MAJOR LEVERAGE

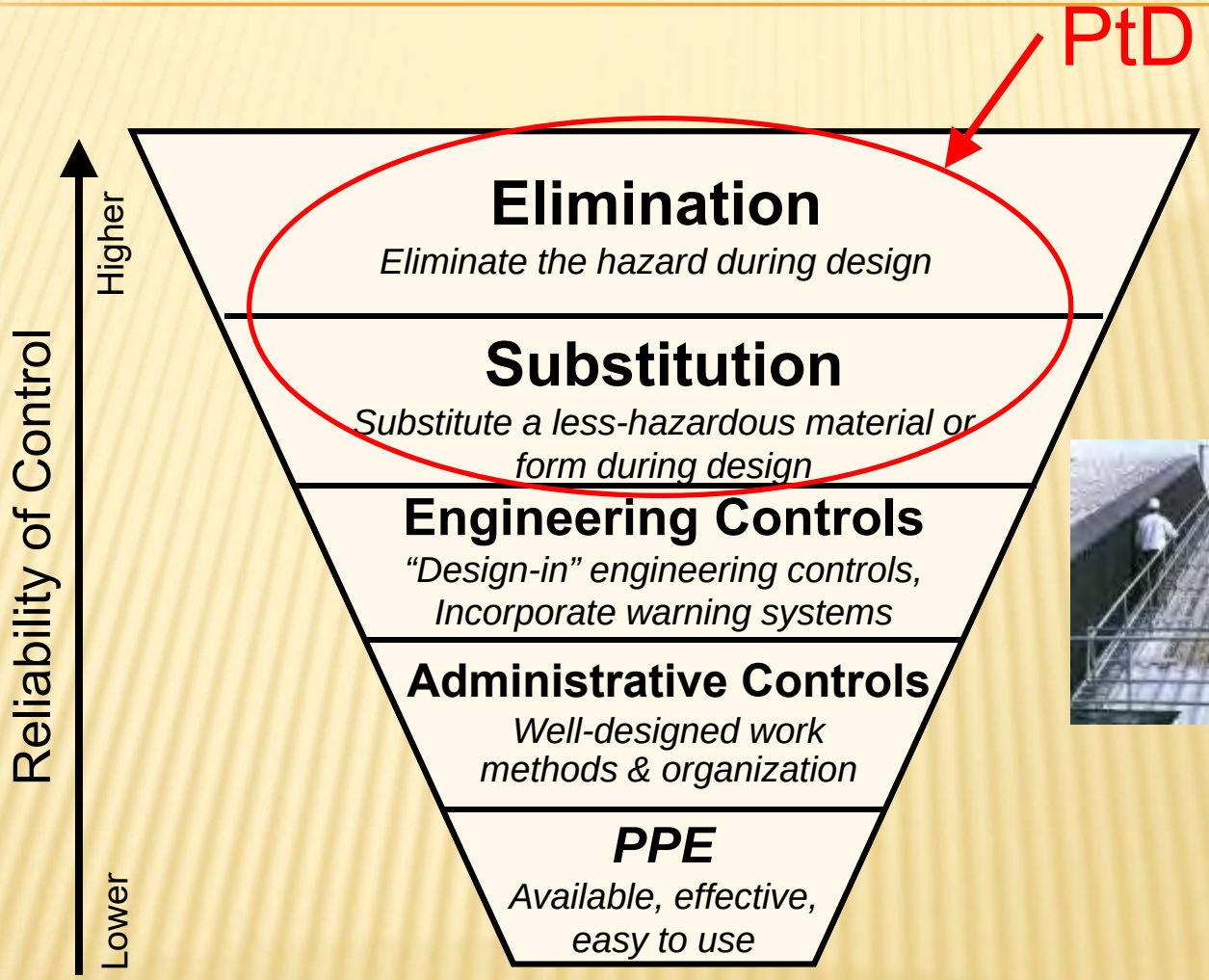
- The Right thing to do and…
- The Smart thing to do

# WHY PTD? BANG FOR THE BUCK

- Ability to influence safety is greatest early in the project schedule during planning and design (Szymberski, 1997)



# HIERARCHY OF CONTROLS




# WHY PTD? TANGIBLE BENEFITS

- Reduced site hazards
  - Fewer worker injuries and fatalities
- Reduced workers' compensation premiums
- Increased productivity and quality
- Fewer delays due to accidents
- Encourages designer-constructor collaboration
- Improved operations/maint. safety

# OVERVIEW

- PtD Concept
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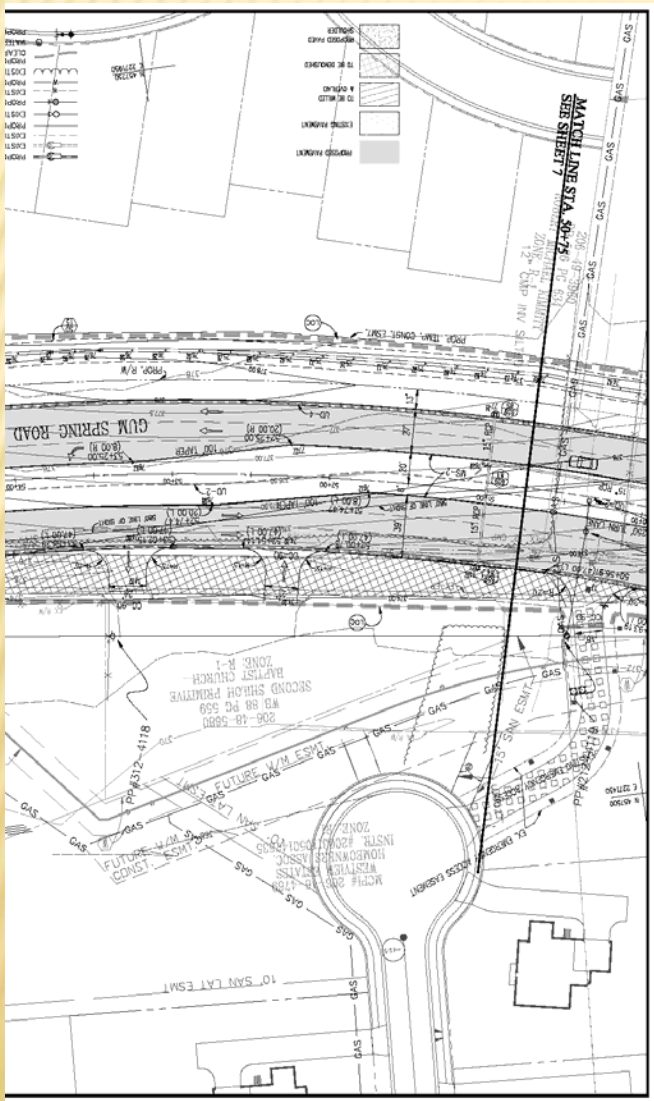
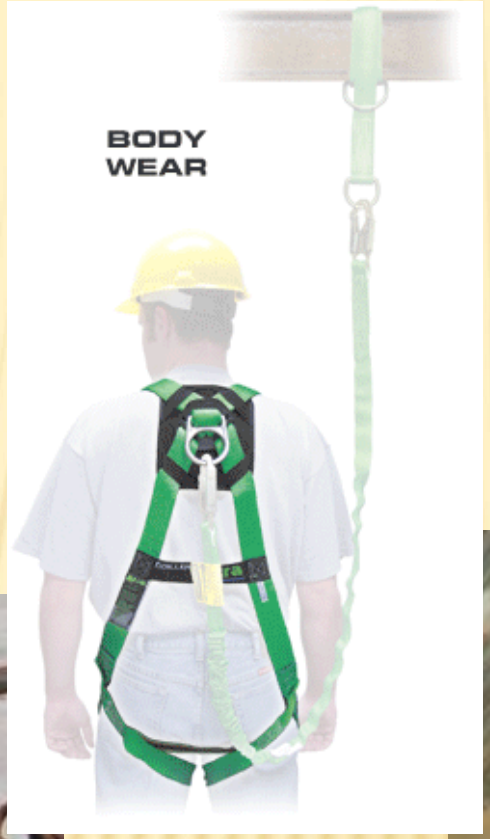
- **Examples**
- Leaders
- Tools and Processes
- Moving forward in your organization

# EXAMPLE OF THE NEED FOR PTD




- Design spec:
  - Dig groundwater monitoring wells at various locations.
  - Wells located directly under overhead power lines.
- Accident:
  - Worker electrocuted when his drill rig got too close to overhead power lines.
- Engineer could have:
  - specified wells be dug away from power lines; and/or
  - better informed the contractor of hazard posed by wells' proximity to powerlines through the plans, specifications, and bid documents.

# PTD EXAMPLE:  ANCHORAGE POINTS




# PTD EXAMPLE: ROOFS AND PERIMETERS

**Skylights**

**Upper story windows**

**Parapet walls**

# PTD EXAMPLE: PREFABRICATION

**Steel Stairs**

**Concrete Wall Panels**

**Concrete Segmented Bridge**

# PTD EXAMPLE: STRUCTURAL STEEL DESIGN

*Detailing Guide for the Enhancement of Erection Safety*

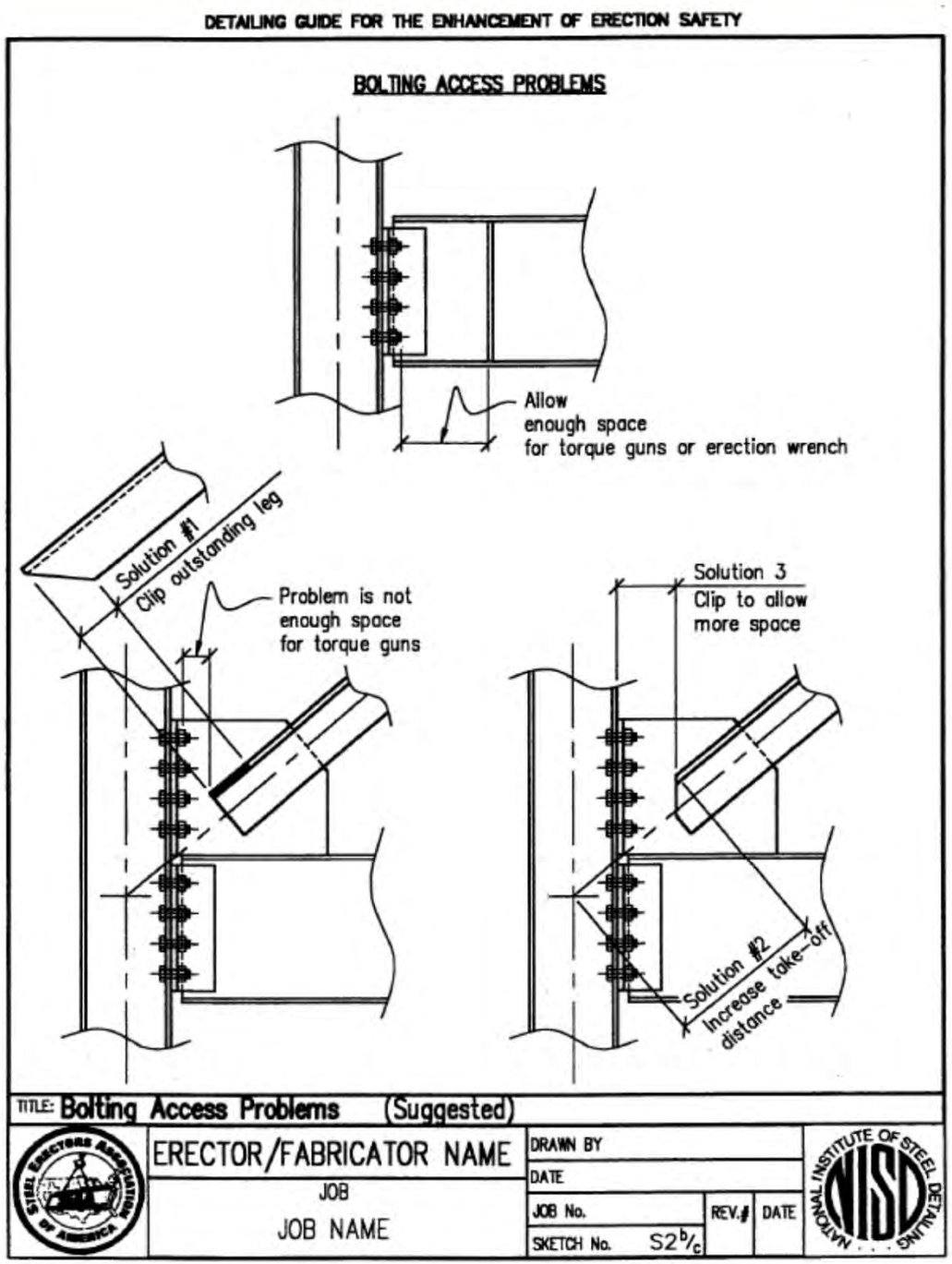
Published by the National Institute for Steel Detailing and the Steel Erectors Association of America

# The Erector Friendly Column

- Include holes in columns at 21” and 42” for guardrail cables and at higher locations for fall protection tie-offs
- Locate column splices and connections at reasonable heights above floor

Photo: AISC educator ppt

- Provide enough space for making connections



- Know approximate dimensions of necessary tools to make connections

Photo:  AISC educator ppt

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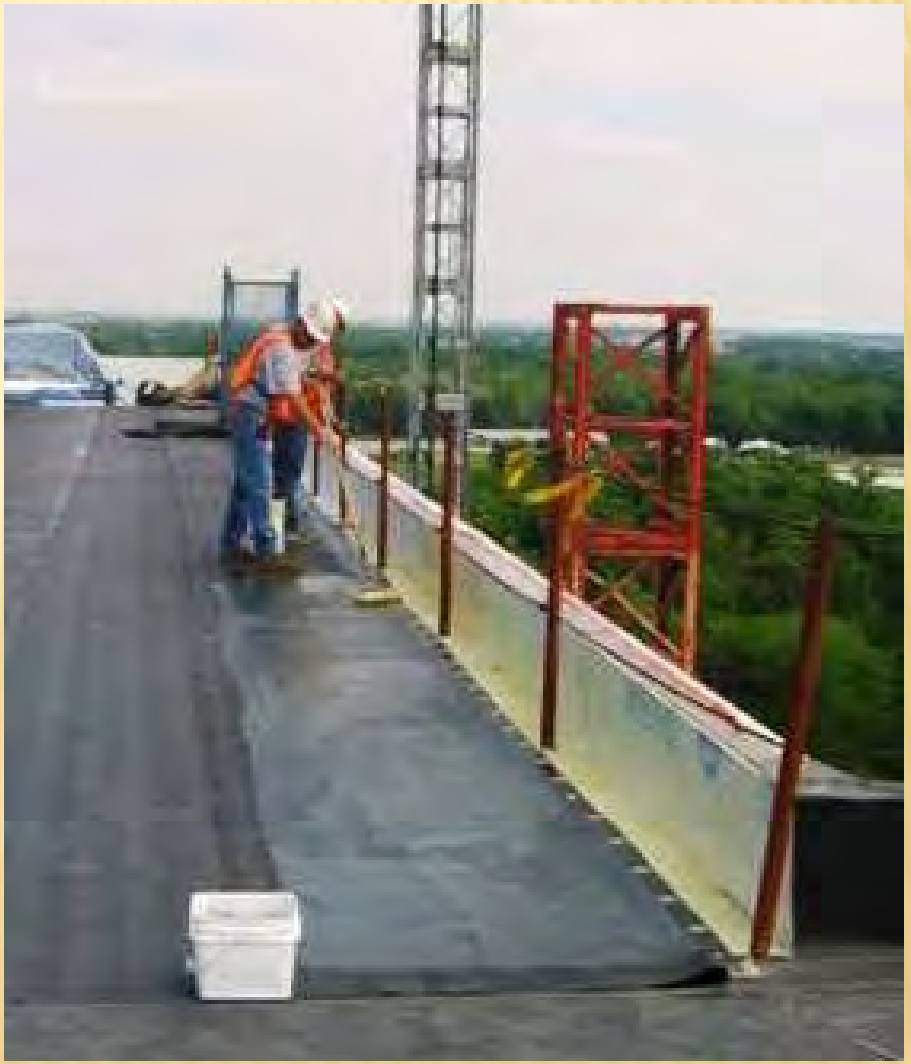
# URS CORP. PTD PROCESS


| PEPs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 202 | 207 | 208 | 212 | 314 | 315 | 363 | 364 | 365 | 368 |
| Project Execution Plan | Licenses, Permitting, Codes and Hazard Requirments | Environmental, Safety and Health | Preparation of Project Risk Management Plans | Change Control | Project Quality Control | Project Hazard Review | Regulatory Compliance Plan and Compliance Review | Constructability Review | Design for Safety |

# DFCS IN PRACTICE: OWNERS

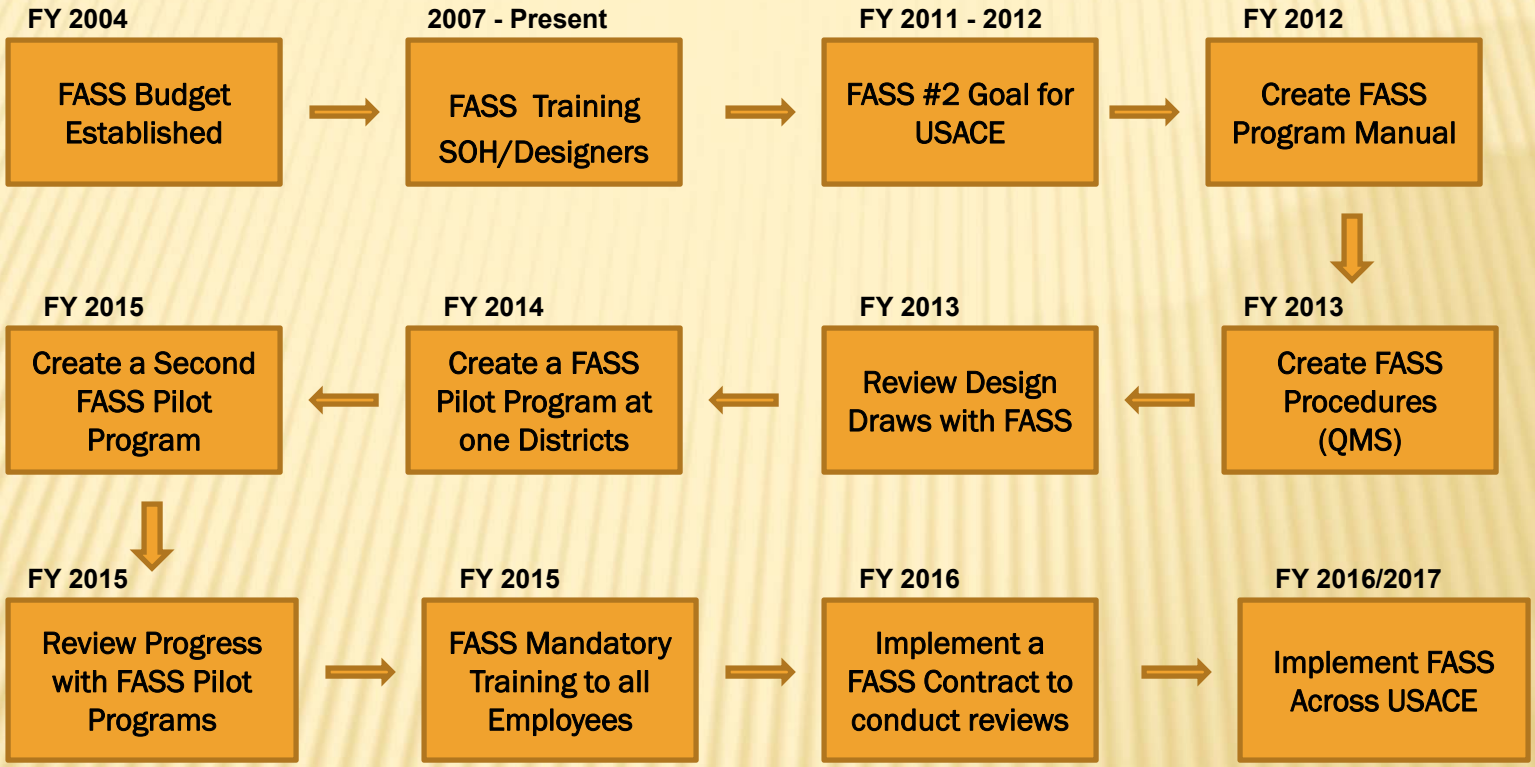
- USACE
- ExxonMobil
  - MWCS
- Intel
- BHP Billiton
- Southern Co.
- Sutter Health



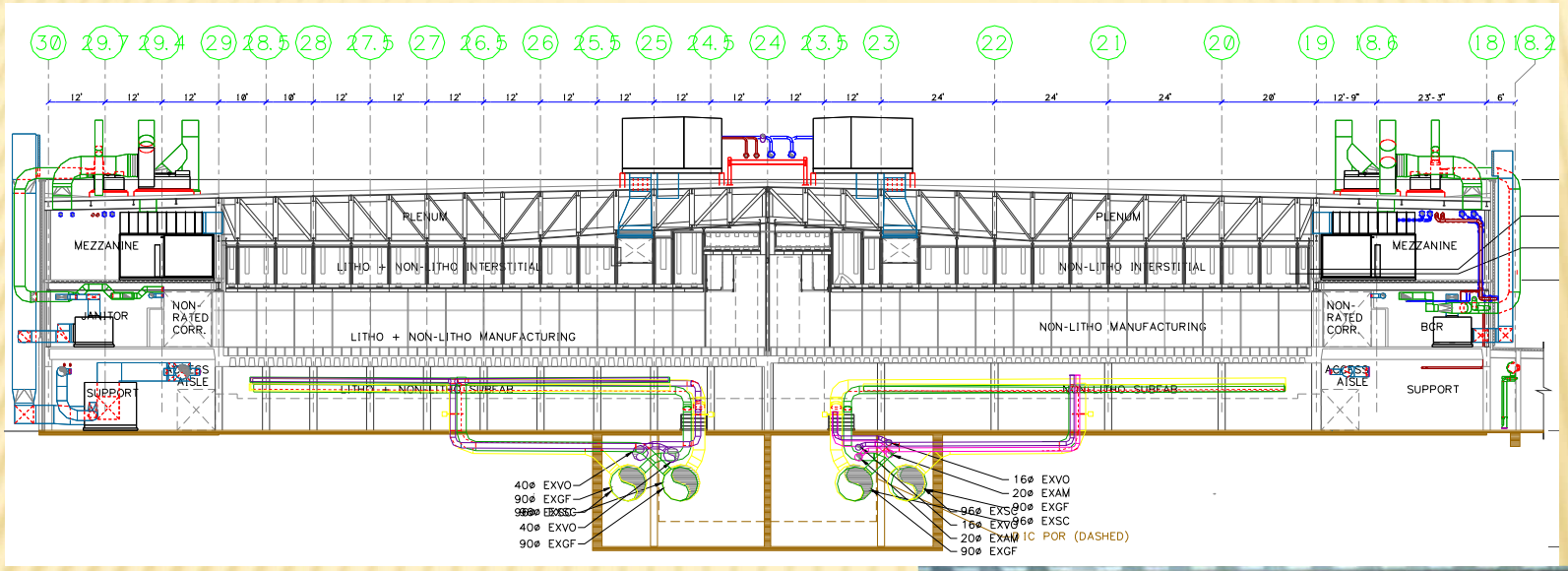
# USACE FACILITY SYSTEMS SAFETY

To incorporate systems safety engineering and management practices into a facility life cycle process used in the conceptual phase, planning stages, construction of facilities, and facility reduction (demolition).

# FACILITY SYSTEMS SAFETY
## PATH FORWARD

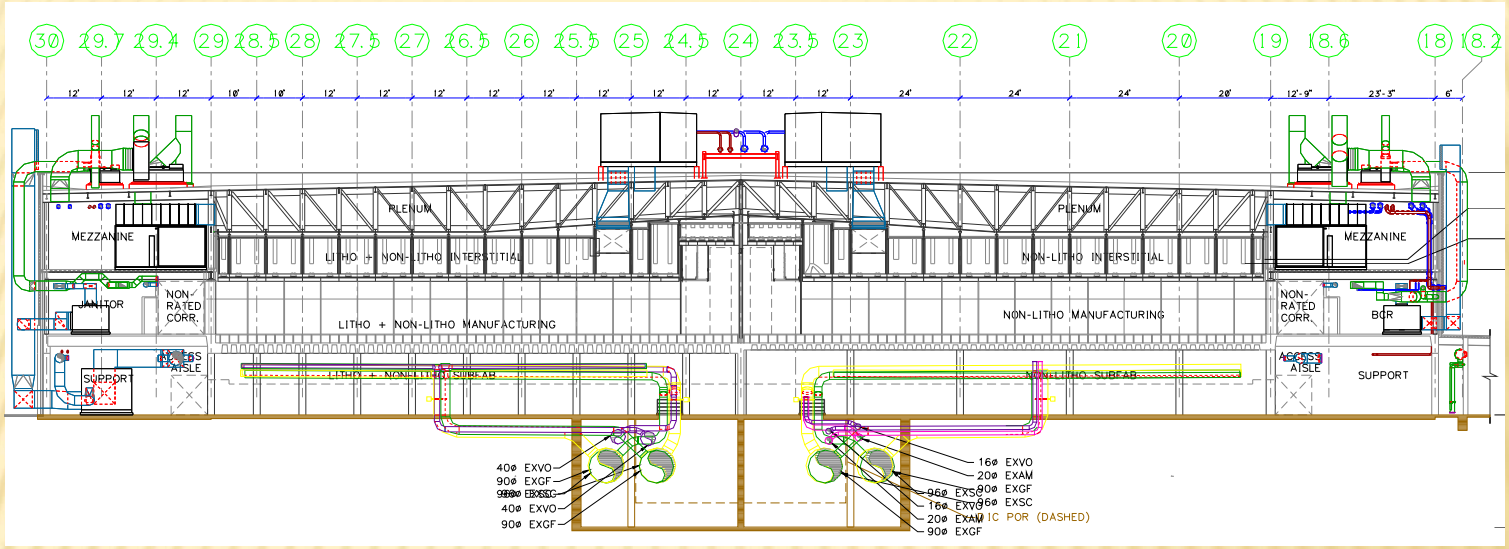


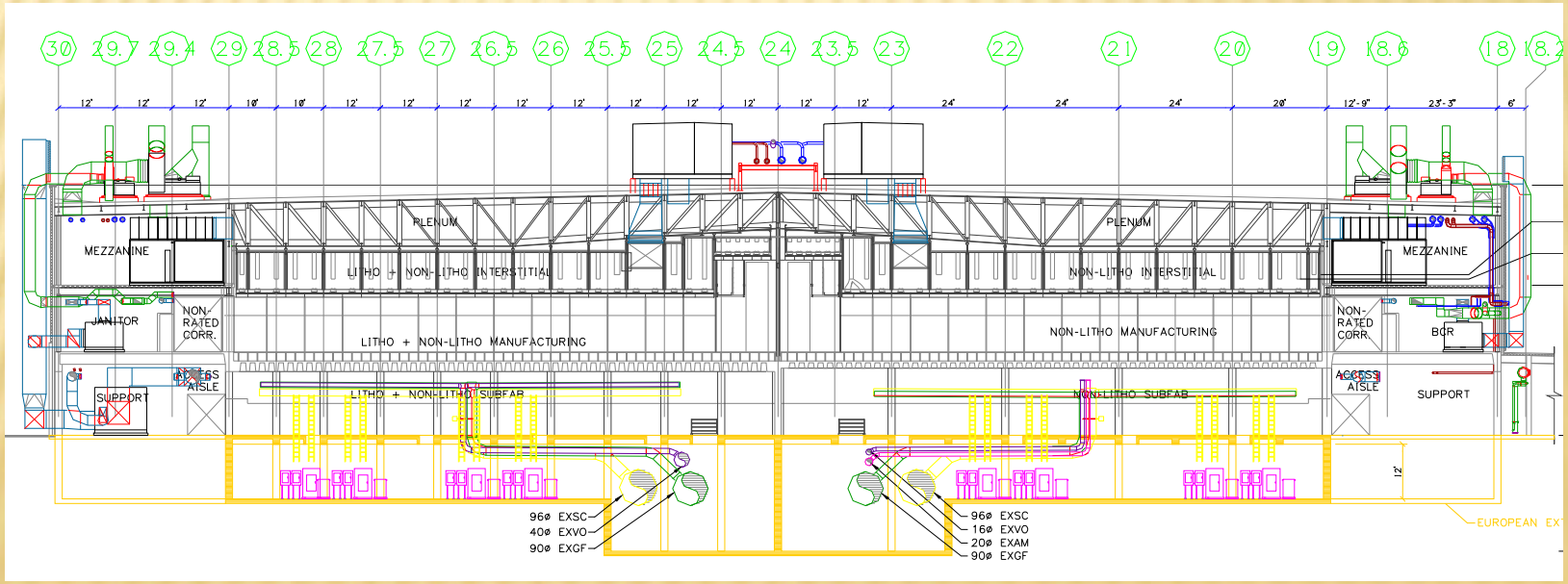
# INTEL'S PROBLEM: ACCESS TO UTILITIES




Original design: Trench below equipment

# INTEL'S SOLUTION: NEW FULL BASEMENT



# BHP BILLITON'S PTD INITIATIVES

- PtD staff embedded in procurement and design
- PtD in technical specifications
- Required designer PtD training
- Design reviews includes 3D models

# SOUTHERN CO.'S DESIGN CHECKLISTS

## DESIGN SAFETY CHECKLIST
## CIVIL

THIS HAZARD OR CONCERN NEEDS TO BE ADDRESSED ON THIS PROJECT? Y=YES; N=NO

↓ THIS HAZARD OR CONCERN:
↓ HAS BEEN ADDRESSED IN OUR DESIGN
↓ ↓ WILL BE ADDRESSED IN OUR DESIGN
↓ ↓ ↓ OTHER
↓ ↓ ↓ ↓

Design Lead: _____
Project No.: _____
Plant: _____
Date: _____

| Double-click to add "x" to boxes. ⇩ | | | | Item No. | |
|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | 1. | Project Engineer has communicated "**HAZCOM**" **project information** required for design engineering personnel making a site visit. (Each person that is sent to the job site must be informed of any potential hazards.) |
| | ☐ | ☐ | ☐ | 2. | Discipline Lead Engineer and civil team understand our safety goal: All engineering drawing and specifications will be prepared with a consideration for **safety and constructability**. |
| | ☐ | ☐ | ☐ | 3. | Construction people working near **fiberglass manufacturing** need to understand the **toxic air pollutants**. |
| | ☐ | ☐ | ☐ | 4. | Locations are identified where guard posts, walls, or barriers should be provided to **prevent access** to potentially unsafe areas. |
| | ☐ | ☐ | ☐ | 5. | **Underground hazards** and reference drawings locating any potential hazards are identified. (Examples: buried pipes, electrical cables, etc.) |
| | ☐ | ☐ | ☐ | 6. | Process engineer, construction project manager, customer, and vendor representatives have identified **special loads** that should be considered in our design. |
| | ☐ | ☐ | ☐ | 7. | Required quality records will be identified, collected, filed, and stored with proper disposition for structural specified **materials**. (Examples: high strength bolts, U-drain grates, concrete cylinder breaks.) |

# NATIONAL INITIATIVES AND ACTIVITIES

- NIOSH
  - PtD National Initiative
  - PtD Workshops:  July 2007 and August 2011
  - NORA Construction Sector Council CHPtD Workgroup
- OSHA Construction Alliance Roundtable
- ANSI/ASSE PtD Standard (Z590.3-2011)

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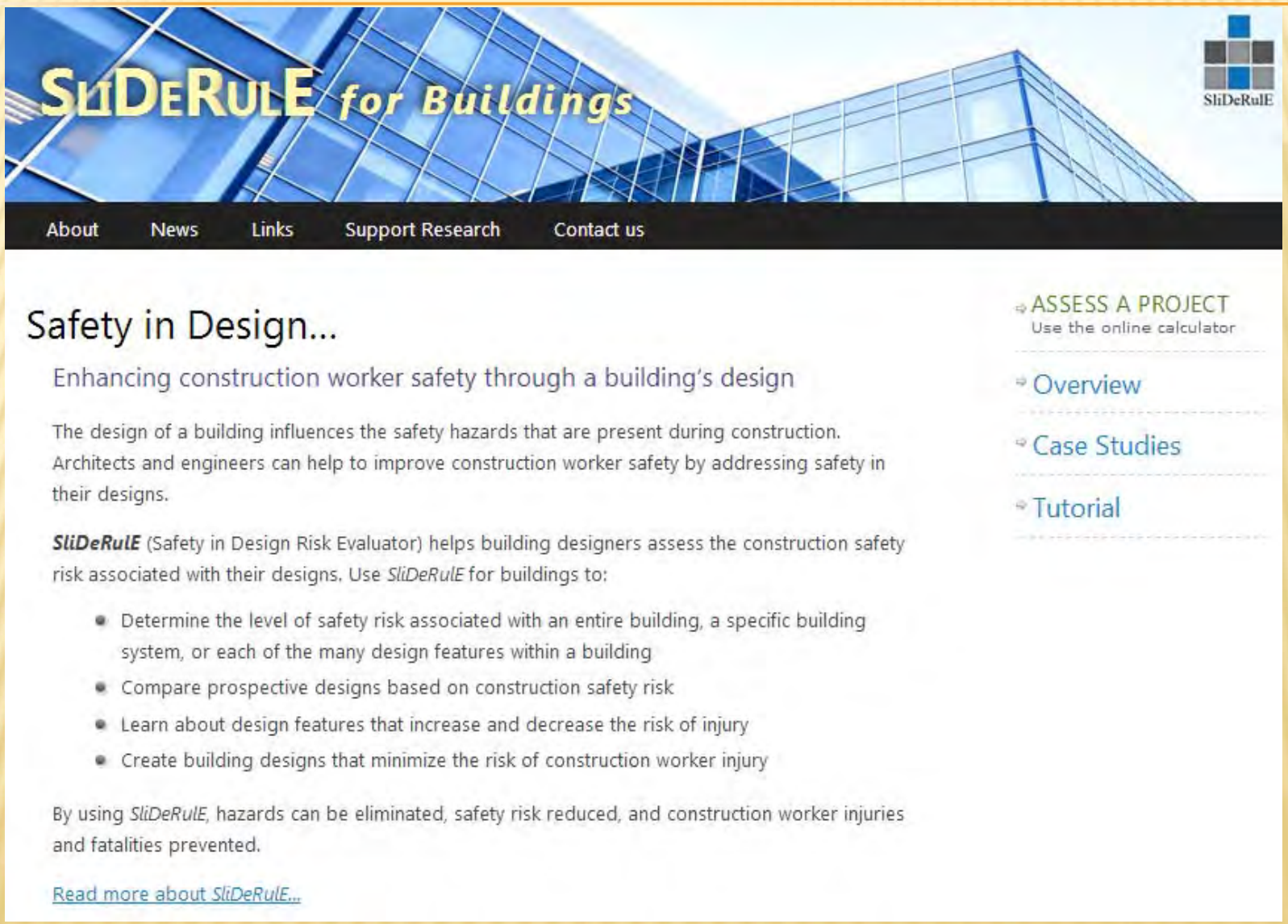
# PTD DESIGN REVIEW

- Hazard identification
  - What construction safety hazards does the design create?
- Risk assessment
  - What is the level of safety and health risk associated with each hazard?
- Design option identification and selection
  - What can be done to eliminate or reduce the risk?
  - Remember the hierarchy of controls.....

# PTD TOOL – DESIGN RISK ASSESSMENT




www.constructionsliderule.org

# PTD PROCESS

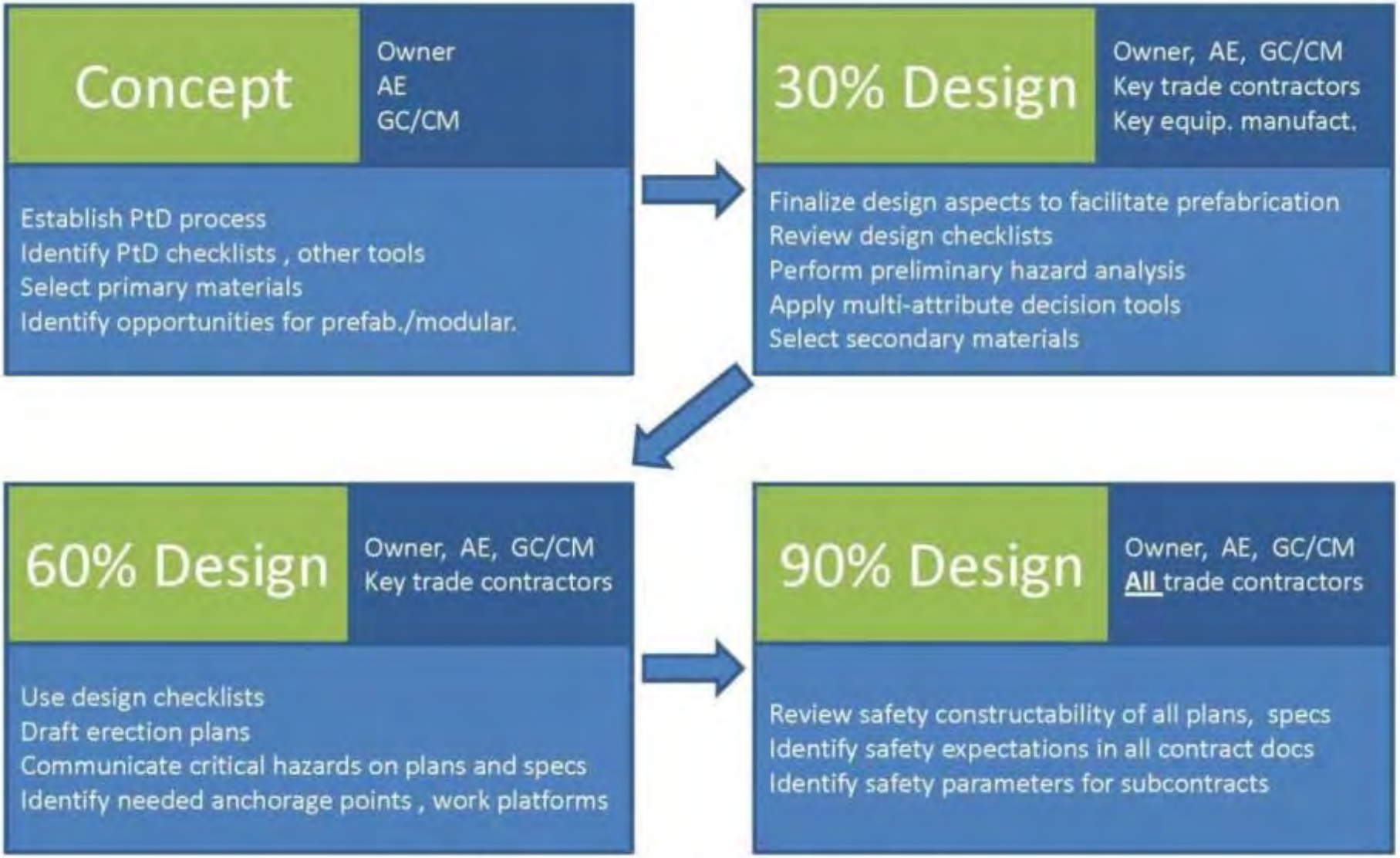
Get the right people

talking about the right things

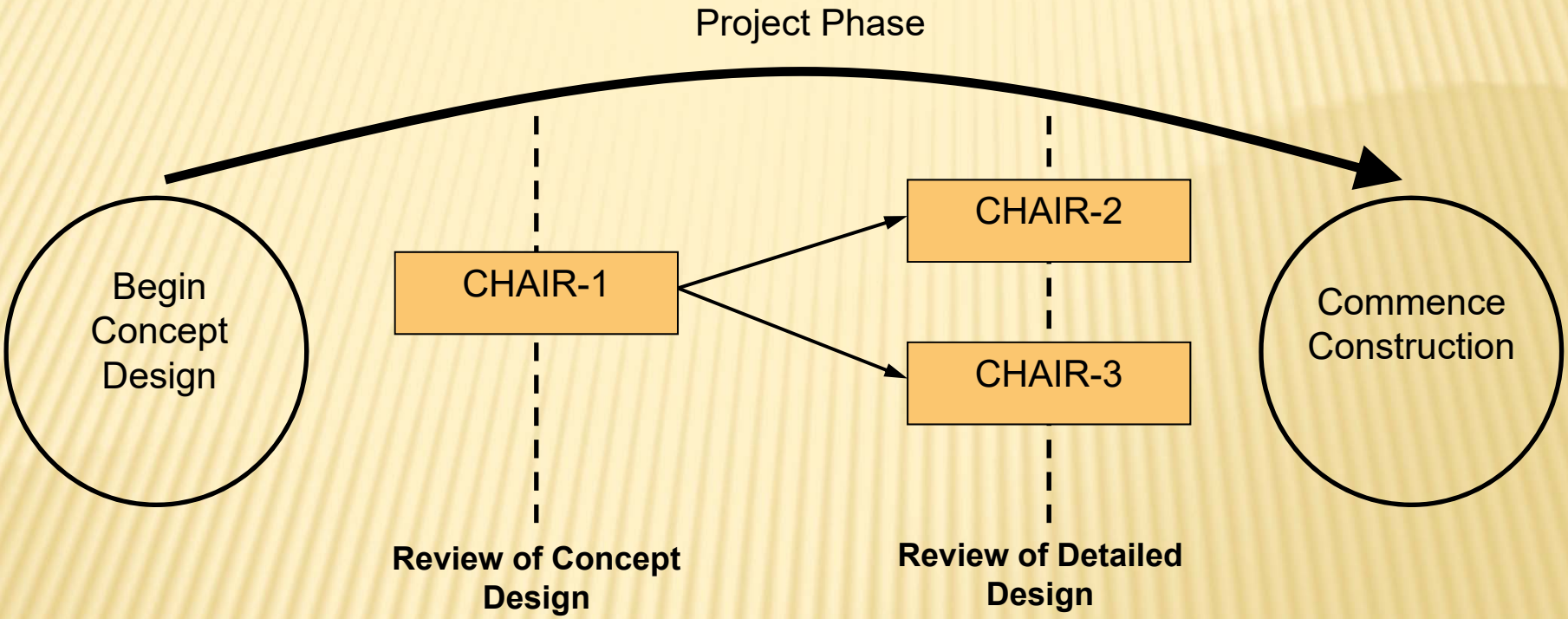
at the right time!

www.seagrave.com/

# PTD PROCESS



# CHAIR SAFETY IN DESIGN TOOL




Construction Hazard Assessment and Implication Review (CHAIR)

(Source: NSW WorkCover, *CHAIR Safety in Design Tool*, 2001)

Safety In Design

All Sector Skills Councils are in the process of being relicensed by UKCES

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FEEDBACK Form

## CDM Guidance for Designers

**Compliance with these guidance notes does not necessarily confer immunity from prosecution under health and safety legislation.**

Flexible opportunities for feedback and contributions are allowed for in **A 003 Review Sheets**. Such contributions would be welcomed.

**NOTE:** Always check you have the latest revision.

Home • Design Guides

# Safety In Design - Design Guides

1 A000 - Preface
2 A001 - Index
3 A003 - Review Sheets
4 A004 - How To Use Guidance
5 G 10.001 - Practice Policies
6 G 10.003 - Health and Safety File
7 G 30.001 - CDM - What Designers Should Know
8 H 10.001 - Hazardous Materials
9 H 10.003 - Lead Paint Design Guide
10 H 20.001 - Musculo-Skeletal
11 H 20.002 - Noise
12 T 10.002 - Excavations
13 T 20.001 - Erection of Structures
14 T 20.002 - Steelwork Erection
15 T 20.005 - Refurbishment

## Design Guides

- -- File Administration --
- Preface
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- Temp Works Equip
- Work At Height
- Roofs
- Spatial Designs
- Susp Access Equip
- Concrete Blockwork
- -- Building Services --

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# Designing to make management of hazards associated with working on roofs easier

## INTRODUCTION

1. Designers can play a major part in making it easier to manage the hazards associated with roof working.

2. Roofs are hazardous places to work, because they are at height and have coverings, which are lightweight and often fragile and deteriorate over time through being exposed to the elements.

3. While work on roofs is an infrequent activity, the opportunity for a fatal or serious accident is very high. And, designers who see roofs only as a means making the building watertight, exacerbate the situation. They forget that people have to construct roofs and maintain them. Consequently, little provision is made for this.

4. People are often killed or injured when falling from roofs. Therefore, designers need to consider alternative designs to ensure roof work can be eliminated or significantly reduced where reasonably practicable.

5. This guidance note makes designers aware of the issues and gives information on how they can help to make roof work safer through their designs.

## HAZARDS ASSOCIATED WITH WORK ON ROOFS

6. Workers on roofs are exposed to the hazard of falling from height. This can either be off an unguarded edge or through a fragile surface.

7. Manual handling and premature collapse hazards also exist.

## WHAT DESIGNERS SHOULD DO

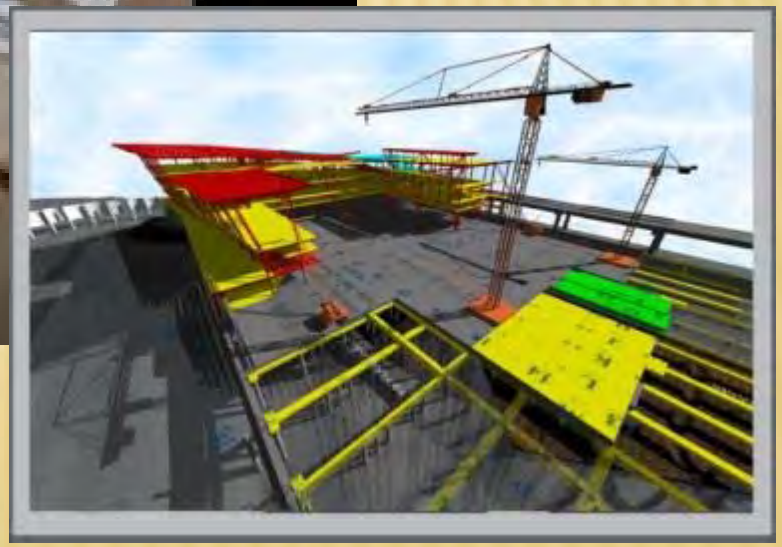
8. Designers should consider two phases: the construction phase and the maintenance phase.

### The construction phase

9. During this phase, it is inevitable that people will need to be on the roof and designers should consider providing for systems that will help a contractor to manage the hazard of falling from height.

**Falls off unguarded edges**

# PTD TOOLS – BIM AND VISUALIZATION



# PTD INFORMATION SOURCES


www.designforconstructionsafety.org

# OVERVIEW

- PtD Concept
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- Moving forward in your organization

# THREE STEPS TOWARDS PTD

1. Establish a lifecycle safety culture
2. Establish enabling processes
3. Team with organizations who value lifecycle safety

Culture

Processes

Partners

# ESTABLISH A LIFECYCLE SAFETY CULTURE

- Instill the right safety values
- Secure management commitment
- Training
- Confirm Life Cycle Costing criteria
- Ensure recognition that designing for safety is the smart thing to do and the right thing to do
  1. Professional Codes of Ethics
  2. Payoff data

# ESTABLISH ENABLING PROCESSES

- Designer training and tools
- Qualifications-based contracting
- Negotiated or Cost-Plus contracting
- Collaborative decision processes
- IPD or enabled safety constructability input

# SUTTER HEALTH'S IPD PROCESS

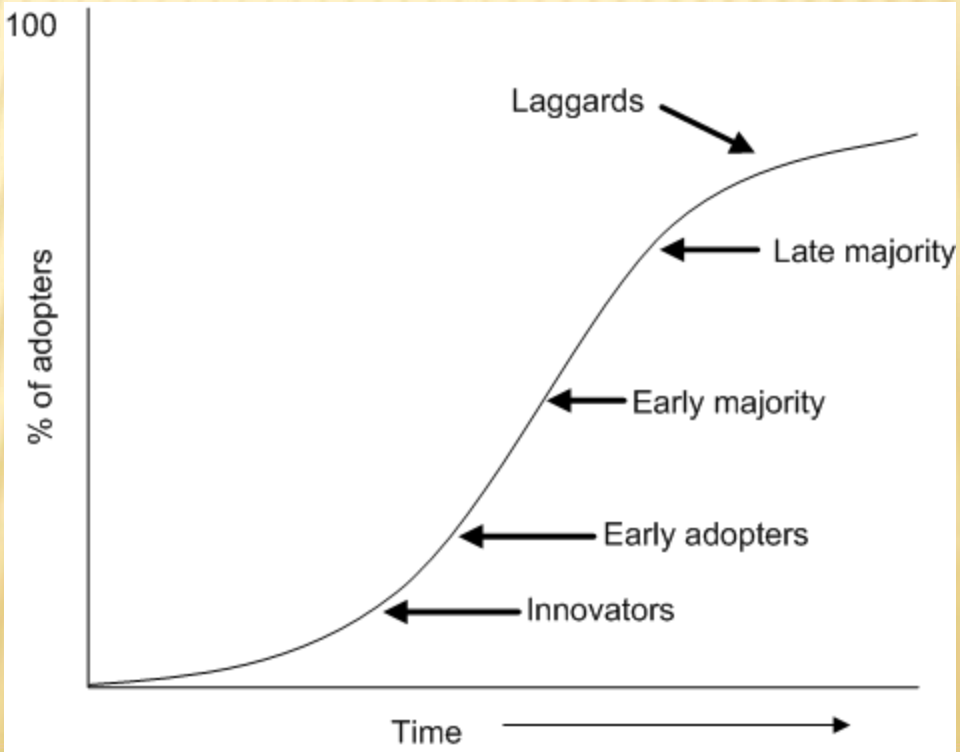
- Integrated Project Delivery (IPD) facilitates collaboration of design and construction professionals during design
  - Co-located
  - Processes and norms for candid feedback
  - Trust
  - Sufficient time
  - Life cycle costing criteria
  - Common success criteria

# CHOOSE YOUR PARTNERS WISELY

- PtD capability in designer RFP
- Designer interaction experience in GC RFP
- Consider Design-Builders with industrial and international project experience
- Collaborative culture and experiences
- Open to change

# PTD: AN OPPORTUNITY FOR YOU AND YOUR FIRM

- All organizational change starts with individual initiative
- Will you be a leader or a laggard?




www.healthknowledge.org.uk/public-health-textbook/disease-causation-diagnostic/2h-principles-health-promotion/prevention-paradox

# INITIATING PTD IN YOUR ORGANIZATION

- Leadership
- Sustainability
- Ethics
- Innovation
- Change management

# SUMMARY

- PtD is tied with sustainability, CSR, ethics
- Successful organizations have implemented PtD
- Keys to implementing PtD
  - Life cycle cost perspective and budgeting
  - Systems thinking
  - Contracts facilitate collaboration
- Three first steps to implementing PtD
  - Culture, Processes, Partners
- You can be a leader in implementing PtD in your organization

# THANK YOU FOR YOUR TIME!

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www.designforconstructionsafety.org