COMPARISONS OF PTD/DFS APPROACHES BETWEEN US vs UK CONSTRUCTION SECTORS: AN OVERVIEW

NIOSH/NORA CONSTRUCTION SECTOR COUNCIL MEETING

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UNIVERSITY OF WISCONSIN WHITEWATER

PtD Prevention through Design

Source: NIOSH PtD

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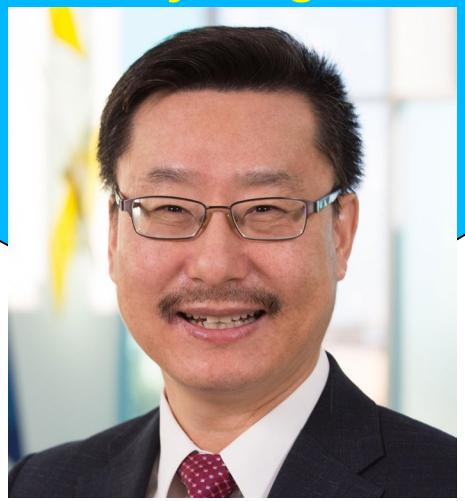

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OUTLINE

- Introduction
- Purpose
- What is Prevention through Design (PtD)?
- PtD in Europe (UK)
- PtD in United States
  - DoD – Standard Practice (Mil-Std-882)
  - Army Safety Program (AR-385-10)
  - Army Corps of Engineers (EM 385 1-1)
- Possible Reasons
- Construction "Focus Four" Hazards
- Discussion/Future Direction
- Acknowledgements
- References
- Q & A

Source: OSHA. https://www.osha.gov/training/outreach/construction/focusfour

INTRODUCTION

- In 2010, UK's All Industry Fatality Rate was 1/3 the US All Industry Fatality Rate and UK's Construction Fatality Rate was ¼ US Construction Fatality Rate.
  - Mendeloff and Staetsky (2014) found lower rates were associated with:
    - ✓ ***High-level management*** attention to safety issues,
    - ✓ In-house preparation of ***"risk assessments"***

- In 2019, US had 5,333 Fatal Work Injuries (i.e. 100+ per week) and Construction had 1,061 Fatalities (BLS, 2020). This was 40% increase from 2011 when there were 761 Construction Fatalities (Brown et al, 2021)

- The UK consistently shows one of the lowest rates of fatal injury compared to countries across the EU.
  - In 2018, the UK standardized rate, at 0.61 per 100,000 employees, was amongst the lowest of all European countries (HSE, 2022).

Why is Construction Work in UK (and the EU) Safer than in the US?

How can the Differences be Explained?

PURPOSE

- **To explore and discuss the Prevention through Design (PtD) / Design for Safety (DfS) approaches/initiatives of the U.S. vs U.K. etc. and their effectiveness in controlling work site injuries and fatalities.**

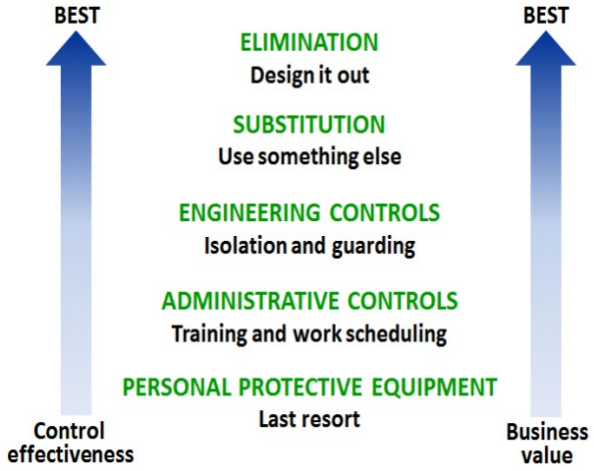
  - *The findings can help better understand the PtD challenges and opportunities for the US construction industry, stakeholders and possible safety policy or regulation initiatives, etc.*

PREVENTION THROUGH DESIGN (PTD)

❑ History and What is PtD?

- ❖ In 2007, the U.S. National Institute for Occupational Health and Safety (NIOSH) began its National Initiative on Prevention through Design with the goal of promoting prevention through design philosophy, practice, and policy.

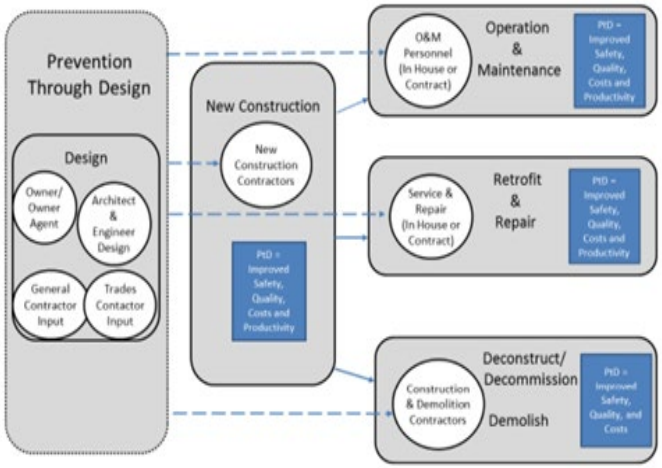
- ❖ Integrating into product design, machine design, plant layout, condition of premises, selection and specification of materials, production planning, and duties of managers and employees (NIOSH, 2013).



Hierarchy of Hazard Controls
(Ref: ASSE 2017)

❑ PtD in the Construction Industry

- ❑ PtD is a ***"life cycle design"*** approach to building construction with the aim of mitigating or preventing injuries, illness, and fatalities through-out the entire process including operation, maintenance, retrofit and demolition (ANSI ASSP_A10_100_TR, 2018).



PtD Life Cycle Approach
(Ref: ANISI ASSP_A10_100_TR, p. 11)

Source: ANSI/ASSP A10 Committee for Construction and Demolition Operations (2014-present), ASSP TR-A10.100-2018 Technical Report (TR): Prevention through Design – A Life Cycle Approach to Safety and Health in the Construction Industry (published June 2018)

PTD IN AUSTRALIA AND EUROPE (UK)

❑PtD/DfS in Australia

- ❖ Australian National Coroners' Information System
  - ➢ **Design** is a significant contributor to 37% (*and additional suggestive design issues to 14%*) of work-related fatalities (Driscoll et al., 2008).
- ❖ The successful implementation of prevention through design concepts can have substantial positive impacts on worker health and safety.

❑PtD/DfS in Europe (UK)

- ❖ "Designers*" are legally bound to "design out" health and safety risks during design development to reduce or eliminate hazards in the construction and end use phases via the Mobile Worksite Directive (also known as - *Construction Design and Management (CDM) regulations* in the UK.

***CDM (2015) - Legal duties to:**

- ✓ Client
  - ❑ "Appoint the right people at the right time"
- ✓ Principal designer (>1)
  - ❑ Plan, manage and coordinate the planning and design work
- ✓ Principal contractor (>1)
  - ❑ Plan, manage and coordinate the construction work

PTD IN UNITED STATES

Source: USGBC (2022). https://www.usgbc.org/leed

❑ PtD and NIOSH

- ❖ Through NIOSH efforts, the U.S. Green Building Council posted new PtD credits or PtD pilot credit available for ***Leadership in Energy and Environmental Design (LEED)*** certification for construction.

- ❖ The NIOSH "***Buy Quiet***" ***initiative*** uses elements of prevention through design to encourage companies to buy quieter machinery, thereby reducing occupational hearing loss for their workers (NIOSH, 2017)

Source: NIOSH (2013). Prevention through Design. https://www.cdc.gov/niosh/topics/ptd/default.html

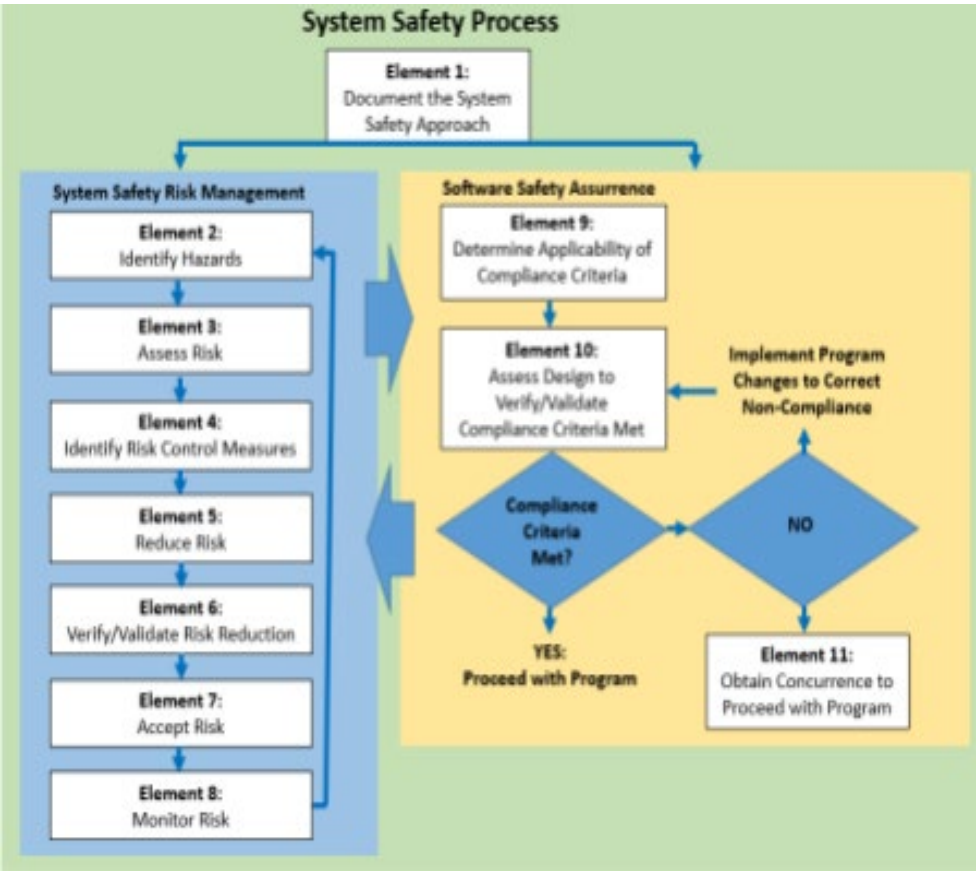
❑ PtD National Initiatives (NIOSH)

- ❖ Collaborates with business, labor, trade unions, professional organizations, academia (Bach, 2021).
- ❖ The educational curriculum focuses on ***"designing out"*** workplace hazards and threats in order to avoid sickness, injury, and death (NIOSH, 2014).
- ❖ PtD goals and processes in collaborative design and renovation of facilities, work processes, equipment, and resources (Din & Gibson, 2019).

DoD - STANDARD PRACTICE

SAFETY SYSTEM

MIL-STD-882F (TBD).
SUPERSEDES MIL-STD-882E (2012)



ARMY SAFETY PROGRAM
SAFETY MANAGEMENT SYSTEM
AR 385-10 (FEB 2017)

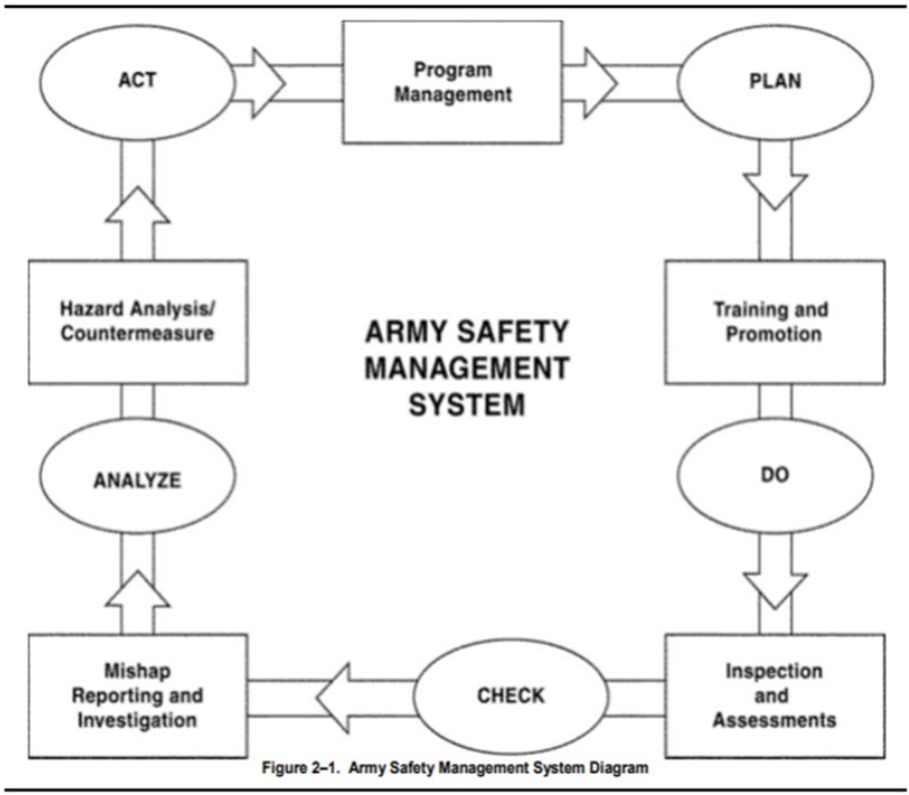


Figure 2–1. Army Safety Management System Diagram

US ARMY CORP. OF ENGINEERS

SAFETY AND HEALTH REQUIREMENTS

EM 385 1-1 (2014)

- **Applicability**: Extends to occupational exposures for missions under the command of the Chief of Engineers **whether accomplished by military, civilians or contractor personnel.**

MINIMUM BASIC OUTLINE – ACCIDENT PREVENT PLANS EM 385 1-1 (2014)

Minimum Basic Outline for Accident Prevention Plans

1. Accident Prevention Plan (APP) - General. An APP is a safety and health policy and program document that is contract- or job- specific. It is an integral part of the planning process. > See Section 01 and 01.A.12.

a. The APP shall interface with the employer's overall safety and health program. Any portions of the overall safety and health program that are referenced in the APP shall be included as appropriate.

b. The APP shall be submitted to the GDA for acceptance prior to work starting.

(1) Understanding that the APP is submitted prior to work starting and that some project-specific information is not yet known (e.g., subcontractors to be used, type of fall protection to be used at a certain point in time, specific cranes or other load handling equipment (LHE) to be brought on site, etc.), the known information shall be provided and additional information added at each preparatory phase/meeting along with the appropriate Activity Hazard Analyses (AHAs).

(2) A copy of the contractor's project-specific, accepted APP shall be available on the work site. > See ANSI/ASSE A10.38 for programmatic issues.

2. Abbreviated APP. In lieu of a fully-developed APP, for Limited-Scope Service, Supply and R&D Contracts (e.g. grass mowing, park attendant, rest room cleaning, etc.), the Contracting Officer (KO) and local Safety and Occupational Health Office (SOHO) may allow an Abbreviated APP to be developed and submitted for acceptance.

a. The non-mandatory Abbreviated APP Form, Form A-1 (or similar) may be used to insure each area of required information has been provided.

ACTIVITY HAZARD ANALYSIS (AHA) EM 385 1-1 (2014)

Activity Hazard Analysis (AHA)

Activity/Work Task:	Overall Risk Assessment Code (RAC) (Use highest code)					
Project Location:	Risk Assessment Code (RAC) Matrix					
Contract Number:	Severity	Probability				
Date Prepared: __/__/____		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by (Name/Title):	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
Reviewed by (Name/Title):	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
Notes: (Field Notes, Review Comments, etc.)	Step 1: Review each "Hazard" with identified safety "Controls". Determine RAC (See above)					
	Probability: likelihood the activity will cause a Mishap (near miss, incident or accident). Identify as Frequent, Likely, Occasional, Seldom or Unlikely.	RAC Chart				
	Severity: the outcome if a mishap occurred. Identify as Catastrophic, Critical, Marginal, or Negligible	E = Extremely High Risk				
		H = High Risk				
	Step 2: Identify the RAC (probability vs. severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.	M = Moderate Risk				
		L = Low Risk				

Job Steps	Hazards	Controls	RAC
1. 2.	1. 2.	1. 2.	1. 2.
Equipment to be Used	Training Requirements & Competent or Qualified Personnel name(s)	Inspection Requirements	

Possible Reasons?

UK vs US – Different PtD Approach

- **PtD** – Since 1990's, Prevention through Design approach has gained acceptance globally because it demonstrated risk reduction/removal during design and execution phases of construction projects.

- European States added National Legislation impetus (Aires and Gamez, 2015)
  - ✓ Britain added rules i.e. Construction Design & Management Regulations (CDM, 2015)
  - ✓ Obligates Designers and Architects to include Safety in all Project Phases:
  - ✓ Establishs Sensible Work Plan which Manages Risks from Start to Finish,
  - ✓ Has Right People for the Right Job at the Right Time,
  - ✓ Coordinates All Worksite Work,
  - ✓ Provides Risk and Mitigation Information,
  - ✓ Communicates these Effectively to all Workers Involved.

Additional Possible Reasons?

UK vs US – Industry Differences

(Mitrefinch, 2021; Van Green, 2022; Phillips, 2022; Schneider, 2014)

- UK's construction industry has been and is more Unionized than US Industries:
  - In 1995, Britain's Construction Sector was 32.4% unionized and in 2018 it was 11.3%.
  - In 1983, US Construction Sector was 20% and in 2021, it was 10.3%.
  - UK's construction workforce:
    - ✓ More Stable,
    - ✓ More Experienced,
    - ✓ Less Risk Taking,
    - ✓ Tougher Fall Protection Rules,
    - ✓ More Government-Funded Projects which are safer because more closely follows Regulation (e.g. 2012 London's Olympic Park).

PTD AND OSHA "FOCUS FOUR"

❑ Falls and PtD/DfS Examples

Potential Hazard	Design Risk	Proposed PtD/DfS Control
No or inadequate skylight fall protection systems	Falling through the opening during installation or maintenance. ***e.g., Falling through a roof skylight after he tripped while carrying solar panel.*** *Source: The California Fatality Assessment and Control Evaluation (CA/FACE) program*	**Engineering Control:** Adding a load-bearing mesh cover over the skylight **Action By: Architect**
Unsafe Vegetated or Green Roof *Source: Behm, M., & Boughton, C.. Architectural Design and Construction. Education Module. 2013. CDC/NIOSH.*	Falling off the open edges during construction or maintenance, etc. **Action By: Architect** *Source: The Institution of Engineers, www.ies.org.sg/Publication/Technical-Resources. Singapore.*	**Substitution** (maintenance work) • Auto-irrigation system **Engineering Control** • Design edge protection (guardrails and toe boards) **Action By: Architect**

PTD AND OSHA "FOCUS FOUR" (CONT'D)

❑ Caught-In- or –Between and PtD/DfS Examples

Potential Hazard	Risk	Proposed PtD/DfS Control
No proper machine guarding of the moving/rotating parts of the lift machine	Worker injured or trapped by moving parts. *Source: The Institution of Engineers, Singapore (https://www.ies.org.sg/Publication/Technical-Resources)*	Design proper machine guarding to prevent contact with moving/rotating parts
Inadequate shoring system. No cave-in protection at the open end of the trench box	Unsafe egress. Employee egressing from trench had no choice but to have help to get out safely. Foreman is the person with the red hard hat helping out employee egressing. *Source: Oregon OSHA osha.oregon.gov/OSHAPubs/2174.pdf*	*"Before You Dig It, Plan It!"*

Source: NIOSH (2022). Trenching and Excavation https://www.cdc.gov/niosh/topics/trenching/default.html

PTD AND OSHA "FOCUS FOUR" (CONT'D)

❑ Struck-By and PtD/DfS Examples

Potential Hazard	Design Risk	Proposed PtD/DfS Control
• The façade of the building requires vertical aluminum fins to be manually installed on site. • Long protruding vertical fins that need to be installed manually by workers on a gondola	• The presence of a façade with long protruding aluminum vertical fins that need to be installed manually by workers on the gondola. • Increases the likelihood of workers falling from height and falling objects during construction.	**Elimination** Remove the fin design, if possible. **Substitution** 1. Design the fins to be part of the precast wall (see Figure). 2. Reduce the number and size of fins, if possible. **Action By: Architect, C&S Engineer**

Source: Goh et al.. (2021). IES-NUS Design for Safety (DfS) Library for Designers: Construction and Maintenance Design Risks.

PTD AND OSHA "FOCUS FOUR" (CONT'D)

❑ Electrocution and PtD Examples

Potential Hazard	Risk	Proposed PtD/DfS Control
- Prox. to energized power lines - Lack of lone/remote worker safety assessment - Lack of hazard identification/ situational awareness - Non-typical job task - Lack of safety standard operating procedures - Lack of appropriate PPE - Lack of training	"Electrocution" • Power line had arced, burnt through, and landed on the ground. • Electric maintenance worker had signs of electrical burns on his right shoulder, hand, and clothing. *Position of bucket truck in cul-de-sac at the time of the incident. (Photo courtesy of the City)*	**Employers should:** • Determine safety distances • Develop, implement, and train on hazards, communication plans • Provide competent and qualified person training • Implement pre-work hazard identification • Develop periodic and regular testing, inspection/maintenance • Train and evaluate employees on the selection, inspection, and safe operation • Identify and establish safe work practices such as lockout/tagout (LOTO) procedures

Source: City Electric Maintenance Worker Electrocuted While Installing Lines for Security Cameras Ohio (FACE 201901)

DISCUSSION:
ON-GOING/FUTURE DIRECTION

- **Produce succinct, actionable PtD guides & checklists** for small companies & their insurers, and publications of local government codebooks.
  - *Why are there no requirements for construction safety in current building codes?*
- Increase PtD practice by **disseminating case studies of real-world PtD solutions** empowering stakeholders to implement & share them, and encourage businesses, trade unions, governments, academic institutions, and consensus standards organizations (e.g. ANSI) to use PtD in policy revisions.
- **Increase PtD awareness, knowledge and implementation** among stakeholders from agencies, industry, and academia to advance PtD.
- Identify and analyze the disparities between safety records in **"Global Comparatives and Perspectives in PtD/DfS/DfCS"** in the UK, South Korea, Singapore, Australia and the U.S. Construction Sectors.
- Potential **industry specific guidance** (e.g., PtD in "Focus Four" hazards) to help narrow the disparity between U.S. and other countries' construction fatality rates.

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Questions or Comments