2023 Prevention through Design Workshop

Continuing the Journey – Proven Strategies for Design & Execution

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Acknowledgements

Thanks to the National Institute for Occupational Safety and Health (NIOSH) for their financial support in making the 2023 Prevention through Design (PtD) Workshop a reality. We extend our gratitude to our keynote speakers, Mr. Jonathan Bach, Mr. Manuel Tender, Ms. Donna Heidel, and Mr. Bob Moser, and panelists, Mr. Corey Wallace and Mr. Daniel Lavoie, for sharing their expertise and contribution to creating a fantastic event. We also extend our gratitude to Dr. Scott Earnest, Mr. Daniel Lavoie, and Mr. TJ Lyons for moderating the sessions. Special thanks go to Liberty Mutual Insurance for hosting this event in downtown Boston, MA. Also, we want to thank MJGrushka Consulting, Toellner Consulting, the National Academy of Construction (NAC), CPWR, Gilbane Building Company, and the Del E. Webb School of Construction at Arizona State University for their sponsorships. We want to express our appreciation to the Steering Committee of the 5-year PtD initiative for their excellent guidance in designing and implementing the fourth PtD annual workshop. Lastly, our heartfelt thanks also go to Daniel Mehrabi and Lisa Hogle and her team for their invaluable 'behind the scenes' efforts in making the 2023 workshop possible.

Citation:

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Report also available at: https://ptd.engineering.asu.edu/ptd-workshop-2023/

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1. Introduction

This document summarizes the 2023 Prevention through Design (PtD) Workshop, the fourth in the sequence of annual workshops under the 5-year PtD initiative funded by the National Institute for Occupational Safety and Health (NIOSH). The workshop, graciously hosted by Liberty Mutual Insurance in Boston, Massachusetts, took place on September 21, 2023, and it was themed "Continuing the Journey – Proven Strategies for Design & Execution," reflecting a deepened commitment to advancing workplace safety through innovative design and execution. The workshop emphasized regulatory measures and innovative strategies with a tangible impact on improving worker safety and project outcomes.

The 2023 PtD Workshop emphasized regulatory measures and innovative strategies with a tangible impact on enhancing worker safety.

A collective of 35 attendees[1], representing 17 organizations and academic institutions, attended this year's workshop. Participants engaged in discussions to further the integration of PtD principles across research, industry practices, and education, with the ultimate goal of elevating safety through prevention and design initiatives.

Building upon the accumulated wisdom of the previous workshops, the 2023 workshop concentrated on elucidating the design ('what)' and execution ('how') of PtD, steering discussions toward actionable outcomes. The workshop's objective remained consistent with previous years: accelerating the adoption of PtD across industry sectors; deepening the PtD knowledge pool with guidelines, tools, and case studies; and, enhancing PtD instruction within the curricula of U.S. colleges and universities. The intent was to energize conversations surrounding PtD, stimulate research, refine implementation tactics, and strengthen educational momentum for improving workplace safety.

The workshop was a one-day event encompassing dynamic sessions with informative keynote presentations, each complemented by interactive question and answer (Q&A) sessions. In between the sessions, attendees enjoyed networking and fostered connections with peers and PtD

[1] The list of attendees can be found in Appendix B.

specialists. The workshop also included two facilitated breakout sessions; the first addressed the intricacies of legislation, scrutinizing its benefits, drawbacks, and adoption hurdles. The second breakout session turned the focus inwards, questioning what barriers exist against the progress of PtD and seeking solutions to overcome such barriers. The event balanced educational content with collaborative discussions and culminated with strategies for the advancement of PtD. Insights from each presentation and breakout session are detailed in the following sections. The workshop agenda is included in Appendix B.

Dr. David Grau, Sundt Professor at Arizona State University and Chair of the PtD Workshop, gave the official start to the 2023 workshop. He welcomed the participants and outlined the objectives of the 5-year PtD Initiative[2]. Dr. Grau recognized the Steering Committee's contributions and sponsors' contributions and set the stage for the day's proceedings by detailing the workshop's theme and agenda.

Dr. David Grau during the opening speech.

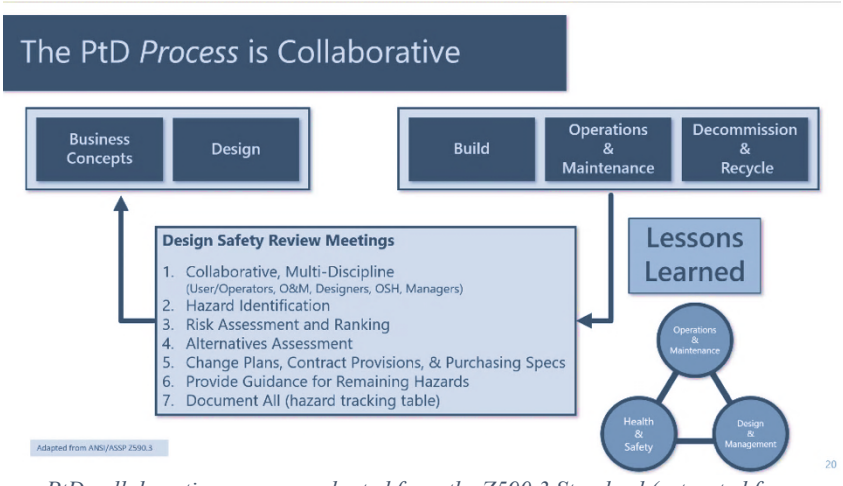
[2] The PtD Initiative can be found in Appendix F.

2. NIOSH Prevention through Design Program

Jonathan Bach during his presentation

Mr. Jonathan Bach[3], Safety Engineer at NIOSH, led the opening keynote speech by detailing the scope and recent advancements of NIOSH's PtD program. His presentation was initiated with examples of PtD throughout history, including the industrial revolution efforts by engineers who saw worker danger on-site and altered their designs accordingly to improve safety and reduce costs. Mr. Bach highlighted the ongoing relevance of PtD, pointing to the key role of the United Kingdom's Construction Design and Management (CDM) regulation towards the reduction of accident and fatality rates in construction.

Throughout his presentation, he underscored the life-saving potential of PtD, substantiating his statements with statistical evidence indicating that the United Kingdom's successful application of PtD principles has significantly reduced fatalities compared to other countries without PtD regulation. He concluded his session with a compelling anecdote from his visit to Edinburgh Castle, where discussions with local professionals further confirmed the positive impact of PtD regulation and practices. His



PtD collaboration process, adapted from the Z590.3 Standard (extracted from Jonathan Bach's Presentation)

[3] Keynote speakers and panelist bios can be found in Appendix C.

presentation sought to answer the critical question "So What?" setting the stage for a day of presentations focused on the real-world application and associated benefits.

Dr. Scott Earnest, Associate Director for Construction at NIOSH, moderated an engaging Q&A during which attendees delved deeper into NIOSH's PtD program details and its impact on various industry sectors. During Q&A the following topics were discussed:

Q&A session moderated by Dr. Scott Earnest (left) and Jonathan Bach (right)

- Application of PtD across all sectors with a special focus on high-risk industries like agriculture, forestry, and fishing.
- Challenges faced in the US due to educational gaps and absence of legislation, particularly compared to countries such as the UK and Australia, where PtD is legally mandated.
- Initiatives to include PtD in educational programs, highlighted by a dedicated course at the Occupational Safety and Health Administration (OSHA) Training Institute, which aims to educate a wide array of industry participants.
- Growing interest from OSHA in incorporating PtD principles into their regulatory framework and the creation of briefings to introduce PtD into various OSHA directorates.
- Efforts to integrate PtD into academic curricula, including textbooks and courses at both undergraduate and graduate levels, particularly in construction and engineering.

3. Central Repository to Monitor the Status of BIM Implementation for Occupational Safety and Health

Manuel Tender, an Adjunct Professor in Civil Engineering and Occupational Safety and Health (OSH) at the Instituto Politécnico de Gestão e Tecnologia in Porto, Portugal, presented an overview of the applied research initiative Digital4OSH. This collaborative Portugal-UK industry and academic research effort aims to study and promote the use of digital technologies, especially Building Information Modeling (BIM), to improve OSH in construction.

Mr. Tender's presentation highlighted that while BIM is being widely adopted for structural, mechanical, and electrical modeling, its use in Occupational Safety and Health (OSH) is far from prominent. He delved into how BIM can improve OSH practices by offering a range of benefits, from document and contractual management to risk assessment and training. He shared insights from the UK's experience with BIM standards for safety information sharing and outlined how BIM contributes to planning and executing construction projects safely. Through BIM, stakeholders can visualize potential hazards and plan effectively, reducing accidents and improving safety training.

The Digital4OSH Team

The presentation reflected the promise of digital technologies to transform OSH outcomes and the need for continued research and collaboration to ensure effective adoption within the construction industry. The presentation concluded with the introduction of the BIM4OSH Observatory, a platform to benchmark progress and propagate best practices. With a focus on future technologies like digital twins and the Internet of Things, Mr. Tender positioned Digital4OSH as a pioneering step toward a more automated, smart, and connected future in construction safety.

Mr. Daniel Lavoie, Technical Director of Construction & Energy within Risk Control Services at Liberty Mutual Insurance, moderated an engaging Q&A session. The following topics were discussed:

- Varied maturity levels of BIM usage across countries.
- BIM implementation in small projects.
- The role of safety coordinators in European design teams.
- Importance safety managers training on BIM tools and use .
- Time investment as a key challenge against BI< training.

The Q&A session with Manuel Tender (left), moderated by Daniel Lavoie (right)

4. Breakout 1: Positives and Negatives of Legislation

The above presentations were followed by an interactive breakout session where all participants were divided into three groups, each led by a facilitator: Mr. TJ Lyons, Dr. David Grau, and Mr. Daniel Mehrabi. The discussions across the rooms delved into the multifaceted impact of PtD-related legislation, debating its positive influences and potential drawbacks and exploring the challenges encountered in its adoption and implementation. Once the breakout groups had thoroughly discussed the topics, the attendees regrouped for a plenary session where each group's representative summarized their group's deliberations and findings.

The groups delved into the positive impacts of legislation, such as mitigating risks through proactive safety planning and fostering innovation. However, they also addressed drawbacks, like the financial strain of new laws and the vagueness or over-specificity that can hinder effectiveness. The enforcement of laws and regulations from different government agencies poses additional implementation challenges. The breakout groups emphasized the importance of a strong safety culture and the need for legislation to level the playing field between large and small employers, promoting consistency and training. They pointed out the importance of adopting legislation that promotes the incorporation of advanced technologies and practices.

Participants highlighted that the positives of legislation typically outweigh the negatives, with laws intended to benefit the community. They mentioned local legislative successes, such as Jackie's Law in Massachusetts, which has had tangible benefits on public safety. Nevertheless, participants also acknowledged the downsides, including the cost to small businesses, the lengthy process of legislation, and the potential for unintended consequences.

The session concluded with reflections on the complex layers of legislation at national, state, and local levels, the challenges of enforcement, and the importance of education and rewards to foster compliance and encourage adherence to prevention principles.

The key takeaways from the breakout session follow:

Positives of legislation:

1. Mitigates safety risks through proactive planning and budgeting.
2. Fosters innovation by protecting workers and stakeholders.
3. Levels the playing field between large and small employers.
4. Promotes training and consistency in safety standards.
5. Updates old and non-existing regulations and should account for advanced technologies.

Representatives from each of the three breakout groups reporting during the plenary discussion

Negatives of legislation:

1. Financial burden, especially on small businesses.
2. Vagueness or over-specificity hindering effectiveness.
3. Enforcement complexities across different governments and their legislative layers.
4. New legislation or its constant evolution hindering consistent application.
5. Potential to lose employees reluctant to comply with new rules.

Challenges in the adoption and implementation of legislation:

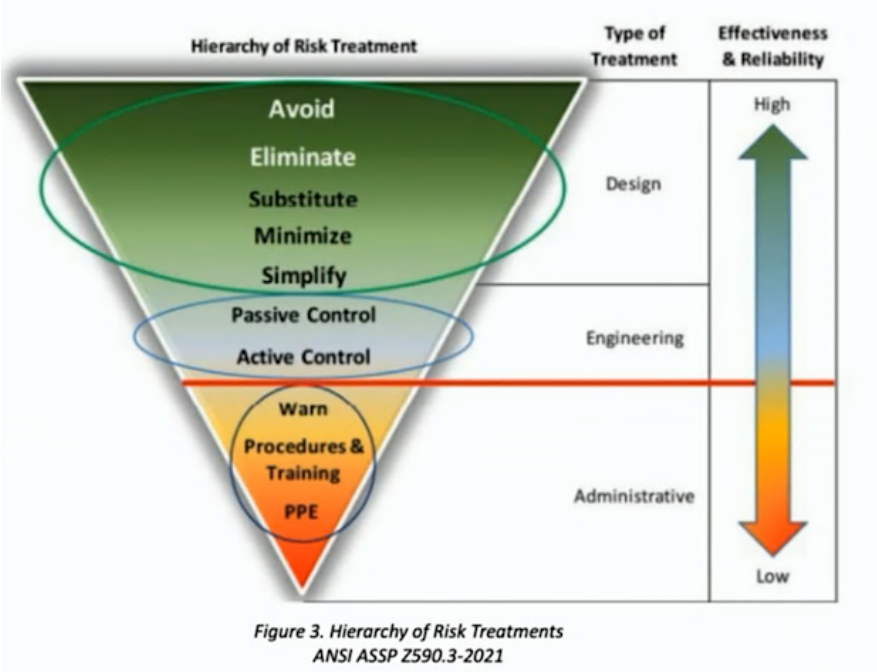
1. Lengthy legislative process with potential for unintended consequences.
2. Ensuring understanding among regulatory bodies before passing laws.
3. Navigating national, state, and local legislative layers.
4. Tailoring laws for broad applicability vs. local needs.
5. Building enforcement, supervision, and compliance mechanisms.
6. Education and training rollout to teach new legislative requirements.
7. Incentivizing the adoption of legislation across industry stakeholders.

5. Applying PtD Concepts to Industrial Hygiene Hazards

Donna S. Heidel, Principal Industrial Hygiene Risk Manager at Amazon, gave an insightful presentation on expanding PtD concepts beyond conventional safety topics to encompass industrial hygiene hazards like noise and chemical exposures.

Donna Heidel during her presentation

Ms. Heidel's presentation covered the multifaceted aspects of risk control, stressing the critical importance of integrating exposure mitigation controls during the design and redesign stages. She focused on noise control, underlining the need to comprehend noise exposure limits, identify sources, conduct surveys, and conduct octave band frequency analysis towards noise prevention for the selection of effective control measures.



Hierarchy of Risk Treatment from Z590.3 Standard (Ms. Donna Heidel's presentation)

Ms. Heidel emphasized that the key to PtD in industrial hygiene is in the adoption during the early stages of the design process, when industrial hygienists collaborate with designers to eliminate hazards.

During her presentation, Ms. Heidel underscored the importance of integrating PtD principles into industrial hygiene from the early stages of the design process in order to reach the top of the hierarchy of risks. She emphasized the necessity of collaboration between industrial hygienists and designers at project inception to allow for a comprehensive assessment of health risks and the implementation of elimination solutions and engineering interventions to manage exposures systematically. Her presentation highlighted practical gaps and proposed solutions for broadening the PtD approach to enhance health and occupational well-being -in addition to safety.

6. Safety and Health in Design

Bob Moser during his presentation

Mr. Bob Moser, Manager of Health and Safety by Design at Jacobs, delivered an insightful presentation on proactively integrating safety and health considerations during design. He emphasized the application of PtD principles across all stages of a capital asset's lifecycle, including construction, maintenance, and decommissioning, to benefit both people and the environment.Mr. Moser highlighted practical strategies for considering safety in design, such as fostering an open, collaborative environment for inputs on safety innovations from all project stakeholders; utilizing BIM models for visualization to identify safety elements like tie-off points and ergonomic considerations; encouraging the use of hazard wheels to spur multidisciplinary conversations on risk mitigation priorities; and emphasizing inherent safety through priority controls, including elimination and substitution of risks.

Modular Safety in Design – Case study from Mr. Bob Moser's Presentation

Mr. Moser presented a case study on modular construction as an effective PtD approach. Safety was improved through controlled fabrication environments, reduced onsite work density, and minimized work at height.

Finally, the presentation reflected how leading firms champion worker-centric philosophies through hands-on collaboration, financial incentives tying safety and design, and imbibing best practices. Mr. Moser highlighted that such a culture shift holds tremendous promise for moving the needle on PtD.

7. Project Stakeholder Influence on PtD

The 2023 PtD Workshop featured an insightful panel discussion with subject matter experts from diverse stakeholder roles and industry sectors, including representatives from owner, contractor, subcontractor, and insurance organizations. Subject matter experts were Ms. Donna Heidel (owner representative, Amazon), Mr. Bob Moser (contractor representative, Jacobs), Mr. Corey Wallace (subcontractor representative and Principal Engineer at Southland Industries), and Mr. Daniel Lavoie (insurance representative at Liberty Mutual Insurance). Mr. TJ Lyons, Safety Director at Gilbane Building Company, moderated the engaging panel discussion and Q&A. The panel discussed perspectives on overcoming barriers and propagating PtD principles more widely across the industry with the ultimate goal to improve safety.

The panel being moderated by TJ Lyons (standing), and the panelists (left to right) Bob Moser, Donna Heidel, Corey Wallace, and Daniel Lavoie.

By convening influential safety practitioners spanning perspectives like workplace health, process engineering, risk management, and worker engagement, the panel discussion provided a 360-degree view into gaps and emerging solutions for the implementation of PtD principles and practices. The panel provided a comprehensive overview of the challenges and evolving solutions for embedding PtD principles into the practices of owner organizations, design firms, contractors, and subcontractors, ultimately reflecting a multidimensional approach to workplace health,

process engineering, risk management, and worker engagement. The discussion concluded with actionable insights, setting the stage for industry-wide progress on PtD initiatives.

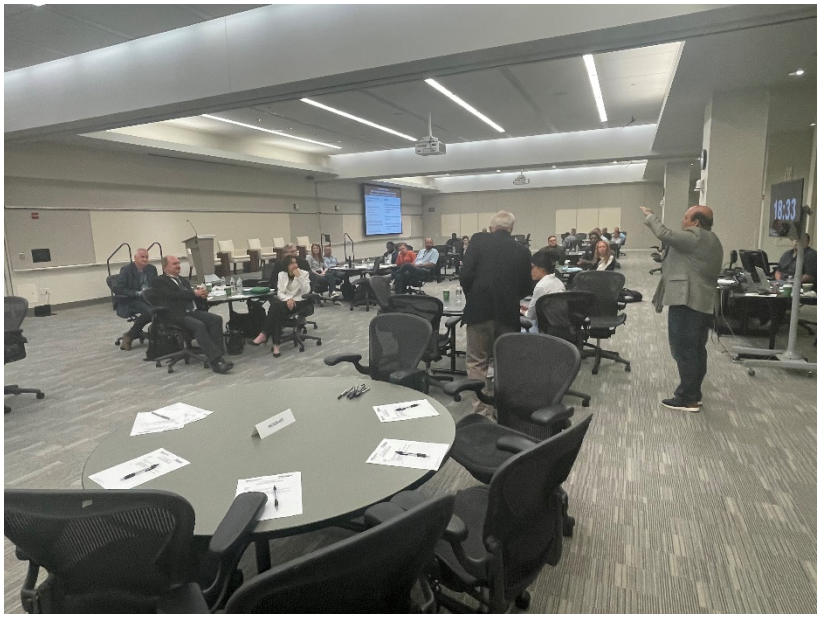
The key takeaways from the panel discussion follow:

1. **Offsite, modular construction.** Offsite construction is driven by contractors who obtain benefits like safety, schedule, and cost performances, and labor optimization. However, its perceived impact of reducing onsite jobs needs sensitive communication and worker awareness.
2. **Business case and return on investment.** Returns quantifying financial gains are crucial for engaging industry leadership. Returns include direct and indirect project cost savings but also lower insurance expenses, better schedule, quality adherence, quicker facility commissioning, and eased operation and maintenance over an asset's lifetime.
3. **Cross-functional and early collaboration.** Early involvement of diverse project stakeholders enables valuable interdisciplinary perspectives and opportunities that may not be available later in the project. Examples include designers seeking safety guidance from contractors or operators for inputs on operation and maintenance. Coordination brings upfront technical expertise together for a holistic and timely safety evaluation.
4. **Comprehensive incorporation of occupants' needs.** Specific health and safety needs and gaps like those of children and seniors were exemplified to highlight unaddressed risks. For instance, research indicates that most smoke alarms are ineffective at awakening sleeping children. Such type of gaps offer significant opportunities for improvement through inclusive design thinking.
5. **Health prevention during PtD.** While construction safety is the focus of PtD, workplace health hazards require similar prevention strategies. That chemical exposures prevention and elimination was achieved in the pharmaceutical industry exemplifies the PtD applicability towards health hazard prevention through intentional design choices.

The panel highlighted that a multifaceted approach spanning training, education, regulation, and financial incentives is essential to influence organizational behavior and safety cultures.

8. Breakout 2: What is Holding us Back from moving Forward, and What Do We Need to Move Forward?

The panel was followed by a second breakout session where attendees were divided into three groups, each facilitated by Mr. TJ Lyons, Dr. David Grau, and Mr. Daniel Mehrabi. This collaborative forum delved into the current barriers impeding the advancement of PtD. The discussions were robust and explored ground-level challenges in awareness and education and systemic issues in research and implementation. Breakout discussions examined how existing perceptions within the industry could be transformed through strategic initiatives and enlightened leadership. The dialogue extended into academia, highlighting the need for applied research addressing the realities of construction sites, influencing educational curriculums, and, subsequently, industry practices. Central to the discussions was the emphasis on a collaborative approach integrating PtD principles not merely as guidelines but as an established culture.



Discussion during the breakout session

The second breakout session focused on three themes:

What is holding us back from advancing the awareness/education/research/implementation of PtD?

1. Lack of knowledge and awareness about PtD.
2. Insufficient laws and regulations supporting PtD.

3. Difficulty in accessing information at local level.
4. Misunderstandings about the cost implications of PtD.
5. Unclear definitions and guidelines around PtD.

What do we need to do to move forward?

1. Development and sharing of case studies on PtD financial value and benefits.
2. Emphasis on legal cases to highlight their importance towards worker safety.
3. Follow-through type of contractual clauses that ensure contractual integrity on PtD.
4. Education on PtD.
5. PtD interventions to influence organizational behavior.
6. Leveraging BIM and virtual reality technologies to visualize and identify hazards.
7. Mirror regulations that have succeeded, such as those from the UK and Australia.
8. Knowledge sharing through working groups of PtD experts.
9. Need for PtD checklists and resources, especially for smaller contractors.

Topics of high interest and impact proposed for the 2024 PtD workshop:

1. Applied research to understand barriers to adopting PtD and developing structured implementation strategies.
2. Dissemination of lessons learned, recommendations, and success stories.
3. Contractual requirements that encourage PtD adoption.
4. Evaluation methods beyond the lowest bid to include best value of PtD designs and considerations.
5. Top-down vs. bottom-up approaches to implementing PtD.
6. Leveling the competitive playing field with regulation/guidelines on PtD requirements.
7. Workforce development and education.
8. Investment in research to identify and mitigate barriers.
9. Use of social media to communicate and generate awareness.
10. Incorporating PtD considerations into the design of educational facilities and residential construction.

9. Summary

Dr. David Grau wrapped up the 2023 PtD Workshop with a summary of the insights from presentations and discussions. Insights included legislation and regulation; the PtD potential to drive process re-engineering in construction through increased use of prefabrication and off-site fabrication; the cultural shift needed for PtD adoption; and the need for safety to be a mandated outcome in ABET accreditation criteria.

The attendees to the 2023 PtD Workshop

Also, insights included the hurdles in passing and enforcing PtD legislation, especially for small contractors, and how regulation could encourage industry-wide adoption. A consensus was achieved on the importance of early, collaborative, multidisciplinary engagement in design processes to identify risks and determine appropriate mitigation strategies. It was noted that while PtD typically focuses on safety hazards, worker exposure to health hazards such as noise, silica dust, welding fumes, and ergonomic issues also warrant further attention. Ideas for the 2024 workshop included engagement of small businesses, occupational health, incentivization of PtD, business value, integration with BIM, and incorporation in higher education.

The conclusion highlighted the human impact of PtD by preventing fatalities and injuries, preserving quality of life, and reuniting workers with their families. Overall, it reflected the diversity of perspectives shared and the energy around elevating PtD.

10.Efficacy of the Workshop's Day

Workshop attendees were asked to fill out an evaluation survey at the end of the day. An answer to each question was requested using a 5-point Likert scale, with 1 being poor and 5 being excellent. The weighted average of each question is given in Table 1.

Table 1. Workshop Attendee Subject Evaluation of Contents (n=27)

Question	Average Rating
Workshop content quality	4.41
Format and organization	4.62
Applicability to your present or future assignments	4.22
Networking opportunities	4.30
Overall Workshop rating	4.46

A number of yes/no questions were asked to gauge the overall value of the Workshop. The percentage of yes/no answers for each question is given in Table 2.

Table 2. Workshop Attendee Subject Evaluation of Overall Value (n=27)

Question	Yes (%)	No (%)
Would you recommend a future similar Workshop to others?	100	0
Did the Workshop improve your understanding of how to implement PtD?	92.6	7.4
Was this Workshop worth the time that you spent attending?	92.6	7.4
Did the Workshop improve your overall understanding of PtD?	92.6	7.4

Additional suggestions for future content were received and will be used as a basis for crafting the next Workshop.

Appendix A. Workshop Agenda
September 21, 2023

7:00 – 8:00 Check in
Light refreshments, coffee

8:00 – 8:10 Welcome and Introduction

8:10 – 8:40 **NIOSH Prevention through Design (PtD) program**
Jonathan Bach (NIOSH)

8:40 – 9:00 Q&A (Moderator: Dr. Scott Earnest)

9:00 – 9:30 Central Repository to Monitor the Status of BIM Implementation for OSH
Dr. Manuel Tender (ISLA/Polytechnic of Porto)

9:30 – 9:50 Q&A (Moderator: Daniel Lavoie)

9:50 – 10:15 *Networking break*

10:15 – 11:30 **Facilitated Breakout**
Positives and negatives of legislation.

11:30 – 12:30 *Networking Lunch*

12:30 – 1:00 **Applying PtD Concepts to Industrial Hygiene Hazards**
Donna S. Heidel (Amazon)

1:00 – 1:20 **Safety and Health in Design**
Bob Moser (Jacobs)

1:20 – 2:05 **Panel – Stakeholder influence on PtD**
Moderator: TJ Lyons; Panelist: Donna Heidel (Amazon - owner), Bob Moser (Jacobs - contractor), Corey Wallace (Southland Industries - mechanical contractor), Daniel Lavoie (Liberty Mutual - insurance)

2:05 – 2:15 Q&A (Moderator: TJ Lyons)

2:15 – 3:30 **Facilitated Breakout**
What is holding us back from moving forward; and what do we need to move forward (2024 workshop).

3:30 – 3:50 *Networking Break*
3:50 – 4:00 Summary and wrap-up, path forward

Appendix B. List of Attendees

Name	Company/Organization
Ahmed Albayati	Lawrence Tech. University
Shiva Arabi	Arizona State University
Jonathan Bach	CDC NIOSH
Timothy Bergeron	Astrus Insurance Solutions
Juilia DaCosta	Liberty Mutual
Scott Earnest	NIOSH
James Fayiah	Liberty Mutual
Dennis Ferrier	Liberty Mutual
Nicholas Genovese	Liberty Mutual
David Grau	Arizona State University
Paul Anoop Raj Gummadi	Northeastern University
Donna Heidel	Amazon
Brenna Hoar	Gilbane Building Company
Timothy Irving	US DOL/OSHA
Erik Johnson	Zurich Insurance Group
Joe Knapik	NuCycle Energy
Brian Lane	Railroad Construction Company, Inc.
Daniel Lavoie	Liberty Mutual
Thomas Lyons	Gilbane Building Company
Franco Magliozzi	Sompo International
Jacob Martineau	Gilbane Building Company
Daniel Mehrabi Moezabadi	Arizona State University
Bob More	Liberty Mutual
Robert Moser	Jacobs Engineering
Glen O'Connor	Sompo International
Andrew Quainoo	Next 150 Construction
Hala Sanboskani	Arizona State University
Jesse Starnino	Gilbane Building Company
Shannon Sturtz	Gilbane Building Company
Manuel Tender	Digital4OSH
Ron Thompson	Gilbane Building Company
Gerardo Torres	Next150 Construction
Douglas Trout	CDC/NIOSH
Corey Wallace	Southland Industries
Erika Wentz	Gilbane Building Company

Appendix C. Keynote Speakers and Panelists' Bios

Jonathan A. Bach is a professional engineer serving at the National Institute for Occupational Safety and Health, as the coordinator for the Prevention through Design program. He is certified in industrial hygiene and safety. After gaining his engineering degree at Syracuse University, Mr. Bach served as an active-duty Bioenvironmental Engineering officer with the U.S. Air Force in Colorado, Turkey, Italy, and Pennsylvania. In 2002 he became a regional industrial hygiene manager for Naval Healthcare New England. In 2004 Mr. Bach moved to Germany to serve with the U.S. Army Corps of Engineers as an environmental project manager and the industrial hygienist for European operations. In 2007, Mr. Bach became the overall Health and Safety Manager for the Army Corps of Engineers in Europe. From 2014 to this date, Mr. Bach's work has focused on PtD with NIOSH.

Manuel Tender has Ph.D. in Civil Engineering, Post-Doctoral Researcher in BIM for Occupational Safety and Health; Post-Graduations in Safety Engineering and BIM. Safety and Health Construction Coordinator in major projects, Adjunct Invited Professor at ISLA-Polytechnic Institute of Management and Technology and ISEP Polytechnic of Porto – School of Engineering, and Lead Researcher of Digital4OSH. Has 25 years of experience in the sector of Safety Management and Coordination. Coordinator of the Task Force "Safety and Health" of Technical Commission 197 (BIM). Senior and Specialist Member (Safety at Construction Work) of the Engineers Association. Published two books, 20 book chapters, and 30 papers in journals and conferences.

Donna S. Heidel is the Principal Industrial Hygiene Risk Manager for Amazon. In her role, she supports the design of building mechanical systems and the specification, installation, and operation of equipment to ensure that worker exposures to industrial hygiene hazards are controlled to acceptable levels of risk. Prior to her employment with Amazon, she served as the IH practice leader for a consulting company, coordinated the Prevention through Design program at the National Institute for Occupational Safety and Health, and directed IH and occupational toxicology at a major pharmaceutical company. She holds an MS in Industrial Hygiene, is certified by the American Board of Industrial Hygiene (CIH), and is an AIHA fellow. She also serves on the AIHA board of directors as Past President.

Bob Moser is a Manager and Subject Matter Expert (SME) with Jacobs' People and Places business, one of the largest professional services providers to the electronics, life sciences, and specialized manufacturing markets. Mr. Moser is a chemical engineer with 30 years' experience in creating and leading environmental, safety and risk control programs and products within the electronics, energy, general manufacturing, chemical, refining, and pharmaceutical industries. His background also includes technical and staff management, consulting, project management, personnel training, and engineering standards development. Whether master planning a new site, modernizing facilities to increase compliance, debottlenecking existing facilities to increase profitability, or troubleshooting a unit operation to solve a technical issue, clients turn to Mr. Moser for his technical leadership and proven ability to deliver high-value results.

Panelists:

Daniel P. Lavoie is currently a Technical Director of Construction & Energy for Risk Control Services at Liberty Mutual Insurance, is a Certified Safety Professional and Associate in Risk Management. After graduating from the University of Lowell (UMASS – Lowell) with a Bachelor of Science in Industrial Technology, he joined Liberty Mutual. Mr. Lavoie is currently responsible for providing safety consulting services to various insured customers and supporting underwriting in evaluating and selecting profitable business. Mr. Lavoie was a key developer of a PtD Toolkit at Liberty Mutual for both customers and internal partners. Mr. Lavoie was a vice-chair of the ASSP A.10.100 – 2018 Technical Report: Prevention through Design – A Life Cycle Approach to Safety & Health in the Construction Industry and continues to be a contributing member of this subcommittee.

Corey Wallace is the Principal Engineer at Southland Industries, Las Vegas, NV, with over 22 years of expertise in fire protection engineering. A licensed Professional Engineer and contractor in over 20 states, Wallace holds a B.S. in Mechanical Engineering, a Master's in Engineering Management, and a NICET Level 4 certification in Water-Based Systems Layout. With 16 years at Southland, his experience spans both consulting engineering and design-build contracting across various sectors, including Hotel/Casino, Industrial, Aircraft Hangars, Commercial, Data Centers, Educational, and Residential facilities. His wide-ranging proficiency covers the design and direction of multiple system types such as Wet, Dry, Pre-Action, ESFR, Deluge, Rack Storage,

High Expansion Foam, Clean Agents, Water Storage Tanks, Standpipes, Freezer Storage Protection, Clean Room Suppression, Underground Fire Protection Loops, and Plumbing systems, demonstrating his versatility and commitment to innovative fire protection solutions.

Appendix D. Moderators' Bios

TJ Lyons is a safety professional working for Gilbane Building Company. He supports field teams and operations in the United States from Malta, New York. Board-certified as an Occupational Health and Safety Technologist and Certified Safety Professional, he is proud to have taken some of these skills to his local community. A past assistant chief, New York adjutant fire instructor (hazardous materials), emergency medical technician, and still a volunteer firefighter, he sees the need to bring safety from the field to the home as often as possible. His safety passion is focused on working with people and the idea of preventing incidents through the smarter design of the structure being built and the way the building is built. Rather than install roof anchors on a flat roof and hope everyone will remember to attach their fall protection, build common parapets around the roof to eliminate the fall itself, implementing simple steps that he calls "design intervention.

Scott Earnest is the Associate Director for Construction Safety and Health at the National Institute for Occupational Safety and Health. Prior to joining the Office of Construction Safety and Health, Scott was Engineering Branch Chief in the NIOSH, Division of Applied Research and Technology from 2005-2015. Scott has over 70 peer reviewed publications and technical reports. He began his career as an active duty commissioned officer in the U.S. Army, Corps of Engineers. He is a registered Professional Engineer (PE) and Certified Safety Professional (CSP) with M.S. and Ph.D. degrees in industrial and mechanical engineering.

Appendix E. Chair's Bios

Dr. David Grau is an Associate and Sundt Professor at the Del E. Webb School of Construction within the School of Sustainable Engineering and the Built Environment at Arizona State University. Dr. Grau graduated with both Master and doctorate degrees in civil, architectural, and environmental engineering from the University of Texas at Austin, and with an industrial engineering degree from the Universitat Politècnica de Catalunya. Before his affiliation with ASU, he taught at the University of Alabama. During his academic career, he has received numerous teaching and research awards, including the Distinguished Professor Award by the Construction Industry Institute and the Celebration of Engineering & Technology Innovation (CETI) award by FIATECH. Complementing his academic career, he has worked in the private industry for about ten years, including positions such as program manager for heavy industrial projects and director of a large engineering department. He has led large interdisciplinary and multicultural teams to deliver numerous capital projects in South America, Africa, and Europe. Dr. Grau is a member of ASCE and AACE professional societies and holds a professional license as an Industrial Engineer.

Appendix F. 5-Year Prevention through Design Initiative

Construction hazard PtD holds the promise to eventually reduce construction workers' exposure to safety and health hazards, and hence minimize accidents, morbidity, and fatalities. PtD aims to proactively identify and mitigate hazard exposure(s) through the design function, i.e., conceptual and detailed design, in contrast to the prevalent industry practice of waiting for construction in order to assess hazards. Hence, there is a critical need to advance PtD knowledge and disseminate and engage influencing stakeholders who are in the position to lead and advocate for implementing a holistic PtD approach. In order to address these gaps, highly influential stakeholders in client//owner, designer, and contractor organizations will be engaged with this PtD Workshop Initiative. With a kickoff Workshop in March 2020 and a second Workshop in May 2021 (this report), the aims of the 5-year PtD initiative follows:

Aim 1: To drive PtD implementation within large industry organizations. We will inform and engage highly influential stakeholders in large client/owner, designer, and contractor organizations. We will measure the cumulative engagement of these organizations with PtD during the 5-year effort.

Aim 2: To advance knowledge in PtD. We will collect implementation guidelines and tools, as well as identify case studies and business case models to effectively demonstrate concepts and strategies. We will query stakeholder participants, for example, on PtD drivers, benefits, and barriers. We will also identify and analyze information gaps, and propose a high-payoff research agenda. We will evaluate the number, quality, and broader impacts of knowledge contributions.

Aim 3: To promote PtD instruction in construction management and construction engineering programs at US colleges and universities. We will design and proactively disseminate six graduate instruction modules around PtD Workshop themes. We will cumulatively track academics and programs that are including the PtD approach in their curriculum.

Appendix G. Steering Committee

Name	Organization
Dr. Edd Gibson	National Academy of Construction
Dr. Scott Earnest	NIOSH
Mike Flowers	American Bridge Company (retired)
Dr. John Gambatese	Oregon State University
Mark Grushka	MJGrushka Consulting
Charlie Hoes	Hoes Engineering, Inc
TJ Lyons	Gilbane Building Company
Dr. Babak Memarian	CPWR
Jack Toellner	Toellner Consulting LLC
Dr. Zia Ud Din	University of Houston
Dr. David Grau	Arizona State University

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