



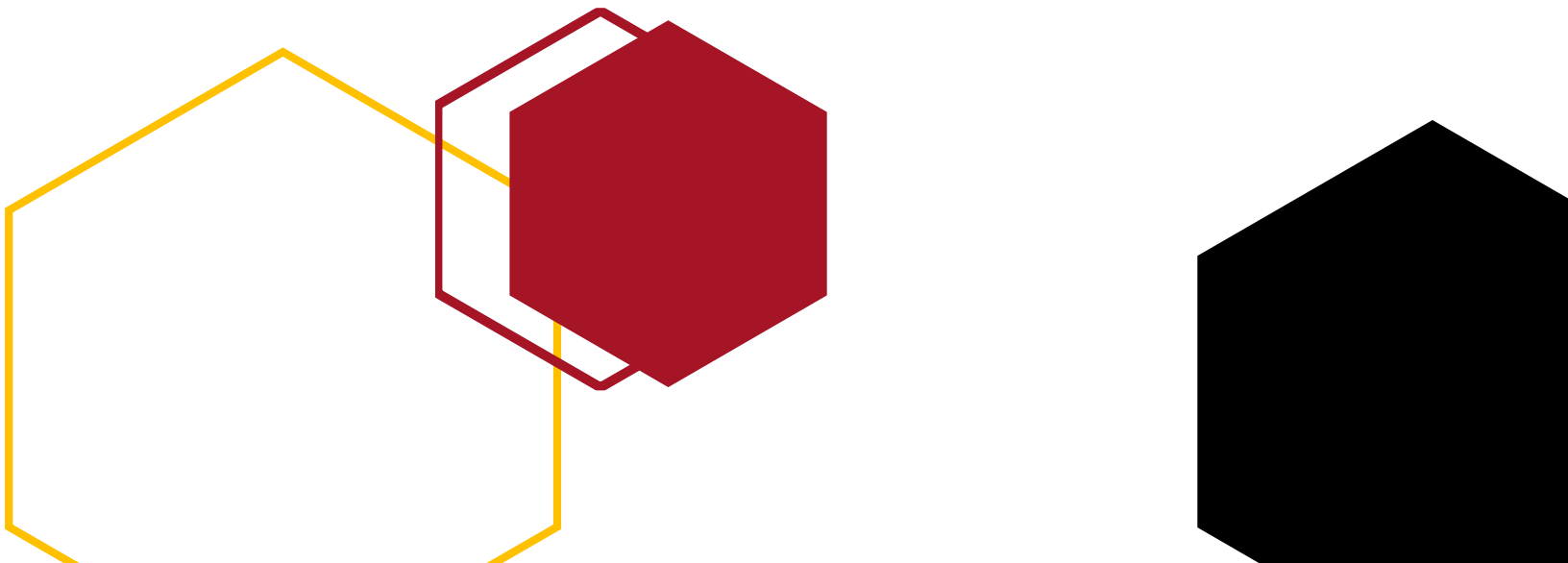
2021 Prevention through Design Workshop: Prevention through Design as We Move into the Post-COVID Era

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Available at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

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1. Introduction

This document describes the 2021 Prevention through Design (PtD) Workshop. This second PtD annual workshop event was hosted virtually by Arizona State University on May 26 and 27, 2021. The theme of the 2021 Workshop was “Prevention through Design as We Move into the Post-COVID Era.” The current COVID-19 pandemic has impacted the world, specifically the response to the disease by industries such as construction. COVID-19 has changed the way industries approach protecting workers’ safety, and PtD holds the promise to reduce workers’ exposure to health hazards. This second workshop focused on what we have learned in the past year that can be translated to improvements in PtD moving into the post-COVID Era. The event brought together representatives from 38 construction industry organizations as well as 16 universities to exchange and leverage their experiences and expertise on PtD practices by interacting with professionals worldwide.

The Purpose of the 2021 PtD Workshop was to focus on what we have learned in the past year that can be translated to improvements in PtD moving into the post-COVID Era.

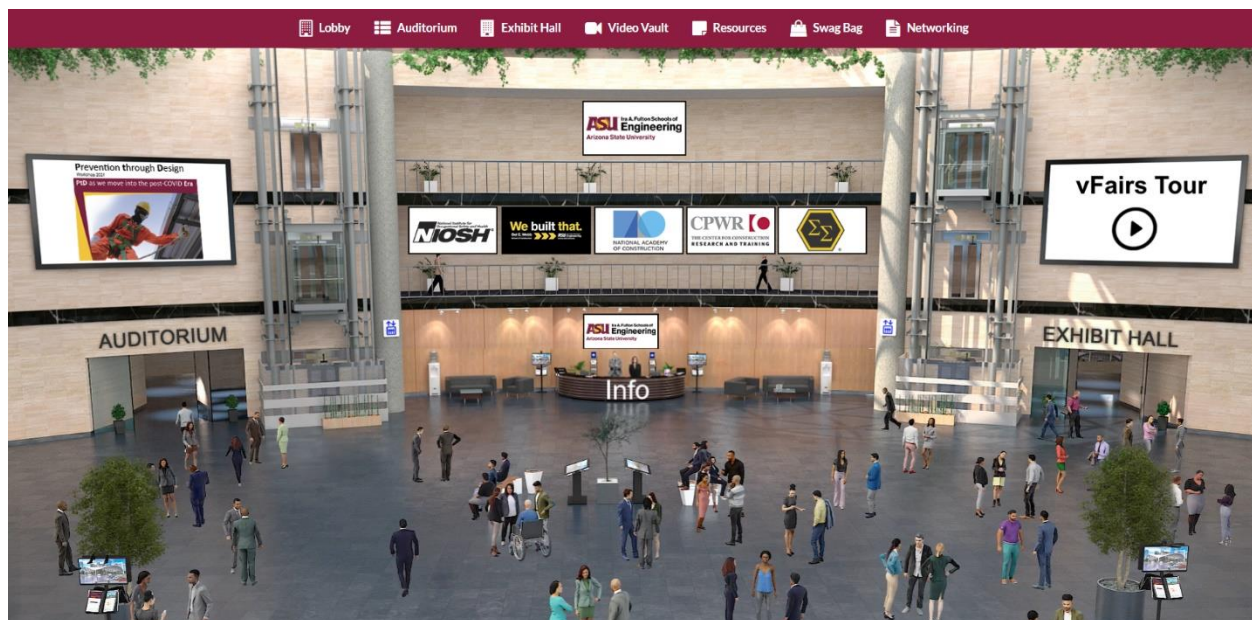
Due to the COVID-19 pandemic and following the United States Centers for Disease Control and Prevention (CDC) guidelines to practice social distancing to limit virus transmission—as well as to reach global audiences—the Steering Committee¹ decided to use a virtual events platform to host the second PtD workshop. For this purpose, vFAIRS² was selected because of its best-in-class virtual environment, stunning 3D designs, self-selected animated avatars, immersive lobby, auditoriums, and interactive exhibit booths. In addition, the platform allows audiences the opportunity to connect, network, and interactively participate during sessions.

The 2021 PtD Workshop occurred over two consecutive half-days with three sessions per day. Each session had pre-recorded videos and a live Question and Answer or Panel at the end of each session, in which keynote speakers and panelists addressed the attendees' questions in real time. Moreover, with the vFAIRS platform, networking breaks between each session provided an excellent opportunity for attendees to network and build new connections with PtD experts.

¹ The Steering Committee is listed in Appendix D.

² The vFAIRS platform’s features can be found in Appendix H.

Finally, at the end of each day, there were concurrent Virtual Meet and Greet Sessions, where attendees met keynote speakers,³ moderators,⁴ panelists,⁵ and other attendees through Zoom.



vFAIRS Virtual Lobby

In total, 102 attendees⁶ engaged with the PtD Workshop. Ten keynote speakers and nine panelists with educational and industry backgrounds provided a baseline for PtD improvement by exploring lessons learned from online collaboration, regulatory guidance, modularization, artificial intelligence, worksite ventilation, building design, and prevention through design processes. The workshop agenda is provided in Appendix B.

The 2021 PtD Workshop is the second instance within a PtD 5-year Initiative of five workshops funded by the National Institute of Occupational Safety and Health (NIOSH)⁷.

This PtD Initiative is described in Appendix C and aims to:

- Drive the implementation of PtD within large industry organizations.

³ Presenter bios can be found in Appendix E.

⁴ Moderator bios can be found in Appendix F.

⁵ Panelist bios can be found in Appendix G.

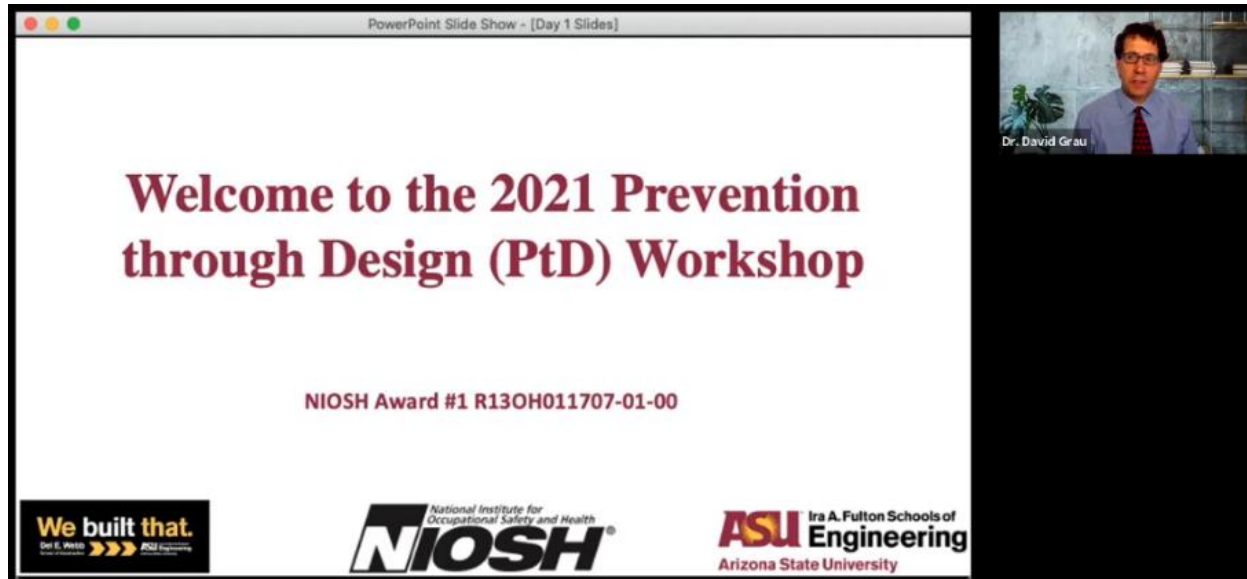
⁶ The list of attendees can be found in Appendix A.

⁷ PtD 2020 workshop's keynote presentations and report can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2020-neu/>

- Advance knowledge in PtD by collecting implementation guidelines and tools, as well as identifying case studies and business case models to effectively demonstrate concepts and strategies.
- Promote PtD instruction in construction management, construction engineering, architecture, and other engineering programs at US colleges and universities.

2. Day One

The 2021 Workshop's Co-Chair, Dr. David Grau (Arizona State University), opened the Workshop and welcomed the attendees. The first day consisted of three sessions followed by live Question and Answer or Panel discussions.



Dr. David Grau initiating the first session

Dr. Grau provided a summary of the 5-year PtD Initiative and its aims. He mentioned that the Workshop was envisioned as the second of at least five, focused on PtD and funded by the National Institute of Occupational Safety and Health (NIOSH). Next, Dr. Grau introduced the Steering Committee and Sponsors. Finally, he discussed the Workshop theme and daily structure.

The first session of day one focused on the Australian Construction Industry Experience with PtD and the importance of having PtD legislation and regulation. The second session consisted of three sequential presentations followed by a panel discussion focusing on PtD for infrastructure and airport design. The third and final session of the first day concentrated on collaboration within PtD during the COVID era and what can be translated from these principles to the future improvement of PtD.

1.1 Session 1. The Australian PtD Experience



Dr. Helen Lingard, Dr Payam Pirzadeh

Dr. Helen Lingard and Dr. Payam Pirzadeh of Royal Melbourne Institute of Technology (RMIT University) provided a keynote presentation for the first session describing how policy and legislation enabled PtD and its

adoption in the design and construction industry in Australia. In addition, they shared their insights and case studies from over ten years of research into PtD in the Australian construction industry to illustrate structural and cultural challenges. The two keynote speakers also provided examples of successful PtD implementation. In particular, the importance of communication, collaboration, and end-user participation in decision-making were highlighted as critical success factors for PtD in the construction industry. Their presentation provided a perfect kickoff to the Workshop⁸.

*Prevention through Design Workshop
May 26 – 27, 2021*

Specific duties for designers

- Additional duties for PCBUs that design plant, substances or structures
- In relation to structures, designers must ensure - so far as is reasonably practicable - that the structure is designed to be without risks to the health and safety of people who:
 - **use the structure** for a purpose for which it was designed,
 - **construct the structure** at a workplace,
 - carry out any reasonably foreseeable activity in relation to the **manufacture, assembly or use** of the structure or the proper **demolition or disposal** of the structure; or
 - **other people** who are at or in the vicinity of a workplace, who are exposed to the structure and whose health or safety may be affected.
- Designers also have responsibilities to give **adequate information** to each person who is provided with the design regarding the purpose for which a structure was designed, calculations and analysis related to the design and **conditions necessary** to ensure the structure is without risks to health and safety when used for the purpose for which it was designed.

Dr. Helen Lingard and Dr. Payam Pirzadeh's Presentation

⁸ Keynotes' presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

As previously stated, the presentation was followed by live Q&A. Dr. David Grau moderated the first Q&A part, and Dr. Helen Lingard and Dr. Payam Pirzadeh addressed the audience's questions. The Q&A specifically addressed the following topics:



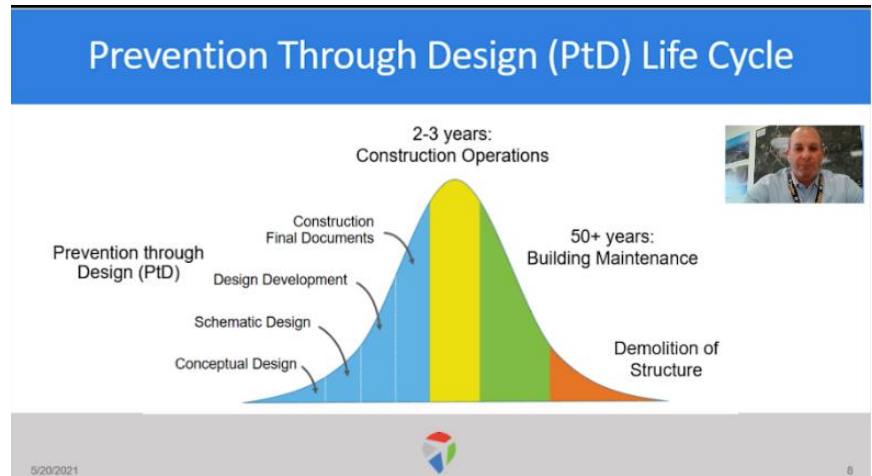
Q&A session. Moderator: Dr. David Grau, Speakers: Dr. Helen Lingard and Dr. Payam Pirzadeh

- 1) Effect of PtD legislation on the rate of accidents and fatalities in the Australian construction industry
- 2) Designers' responsibilities in PtD
- 3) The link between implementing PtD concepts/practices and the Australian legislation
- 4) Workers' and supervisors' involvement in the hazard recognition process during the design phase to identify potential hazards and minimize or eliminate them through design
- 5) Designers' legal protection/liability
- 6) Implementation of PtD through distinct project delivery methods

1.2 Session 2. PtD and Airport Design

The second session consisted of three keynote speakers followed by a panel discussion. Dr. John Gambatese of Oregon State University moderated the session.

Mr. Jason Timmerman from the Allegheny County Airport Authority gave an engaging presentation on the “Lessons Learned during COVID for Airport Design.” Mr. Timmerman explained that the Pittsburgh Airport implemented cutting-edge



Mr. Jason Timmerman's presentation

construction PtD concepts to design the 1.3-billion-dollar Allegheny County Airport Authority Terminal Modernization Project for the post-pandemic world. He outlined the lessons learned and shared how, in the middle of the pandemic, architects, designers, owners, and contractors worked together to use PtD concepts/activities to “Design Out” risks and hazards across all stages of a project’s lifecycle and keep workers safe from job site hazards⁹.

The second keynote speaker in this session was Mr. Chris Golden from Skanska USA Civil. Mr. Golden shared lessons learned and considerations for implementing PtD on a large design-build



Mr. Chris Golden's Presentation

project, the LaGuardia Terminal B renovation. He addressed the importance of establishing clear objectives early in concept design. Mr. Golden outlined the key considerations for ensuring that safety in design interventions is

⁹ Keynote’s presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

carried out through the project execution process¹⁰.

The final keynote presentation of the second session was given by Ms. Kate McGee, Director of Health and Safety at Pennoni Associates Inc. She discussed the role of health and safety professionals in facilitating PtD. Ms. McGee detailed the opportunities



Ms. Kate McGee

and challenges of health and safety experts in introducing and guiding a safety prevention aspect in the engineering design process. In addition, she shared the lessons learned and captured during COVID¹¹.



Panel Discussion. Moderator: Dr. John Gambatese, Panelist: Mr. Jason Timmerman, Mr. Chris Golden, and Ms. Kate McGee

Dr. John Gambatese also moderated the panel discussion that followed the presentations. Mr. Jason Timmerman, Mr. Chris Golden, and Ms. Kate McGee served as the panelists. Attendees' questions were answered, and the following topics were discussed:

- 1) End-user engagement in the design process during the airport project
- 2) Impact of PtD practices on airport design
- 3) Examples of changes in design and construction that were driven by COVID and will most likely continue in the post-COVID Era

^{10, 11} Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

- 4) Safety as a driver in the design and not as a result of other design decisions
- 5) Early involvement of the general contractor in the design process

1.3 Session 3. Collaboration to Achieve Excellent PtD Results in the COVID Era

The third and the final session focused on achieving new heights in safety during the COVID era. Ms. Anette Balestrand from Erland Construction gave a presentation that emphasized the relationship between building design and the



Ms. Anette Balestrand

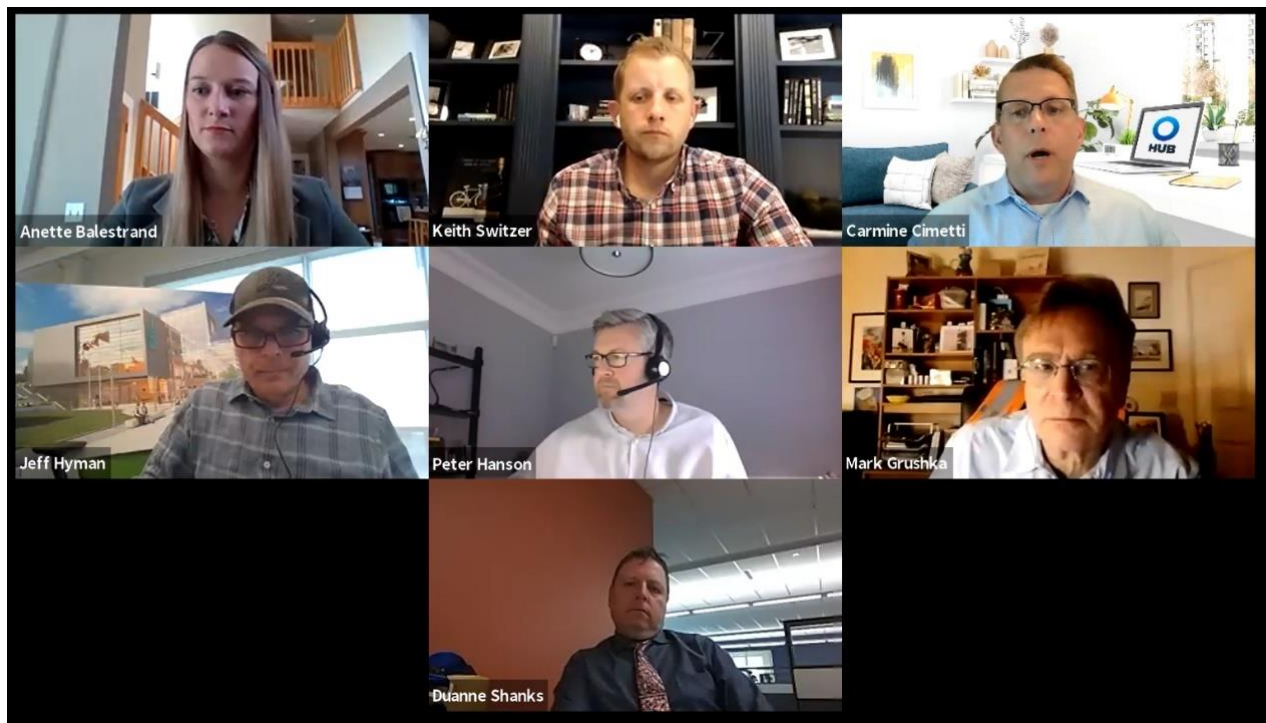
potential for occupational injuries, illnesses, and fatalities, then discussed how a collaborative PtD process was achieved during the pandemic¹².

Prevention Through Design					
Legend					
StP = Safety through Planning					
PtD = Prevention through Design					
#	Review	Category	Item	Mitigation	Applied
1	Foundations	PtD	Building Location in relationship to electrical farm and Sagamore	Moved building by 63' to minimize earth retention and underpinning	Y
2	Foundations	StP	Timely Ingress/Egress following steel erection	Sequencing steel erection in a manner that allow permanent stairs to be utilized as construction egress at the beginning of the project. Will result in only one temporary stair tower instead of two	Y
3	Foundations	StP	Rebar Delivery	Rebar delivered to the site in 2 week supply	Y
4	Foundations	StP	22' Foundation wall Formwork	Pre-assemble rebar/formwork on the ground and erect with crane. Reduces the amount of work being done at elevation	Y
5	Foundations	PtD	Checkerboard slab	Reduce slab "checkerboarding" – does not fully eliminate, but reduces number of pours/tripping hazard. Submit suggested slab pours to LeMessurier. Will need to review with floor finishes and discuss potential cracking	Y
6	Foundations	PtD	Diamonds at columns	Can diamonds be eliminated or reduced? Need to review with floor finishes and discuss potential cracking	Y
7	Foundations	PtD	SOG Return Bars	Drill & epoxy return bars @ SOG	Y
8	Foundations	PtD	Foundation Wall Utility Penetrations	Coordinate openings/sleeve penetrations. Minimize coring/saw cutting	Y
9	Foundations	PtD	Slab and mat foundation top reinforcing steel spacing	Review space slab and mat foundation top reinforcing steel at no more than 6" on center each way to provide safe walking surface	Y
10	Foundations	PtD	Top of Foundation wall Rebar	Design reinforcing steel at top of foundation walls to be turned down	Y
11	Foundations	PtD	Sequencing of backfill at E-Line wall	Backfill behind E-Line wall, added grade beams to provide structural support allowing wall to be backfilled to approx. halfway point. This reduces the size of the hole on site behind this wall by months. Still will be a 10'+ hole, but reduced from 22'.	Y
12	Foundations	StP	Anchor Bolts	Drilled and epoxied at the Sagamore Connector	
	Foundations	PtD	Rebar Lengths	Cut rebar to length ahead of delivery	Y
13	Steel	PtD	Lanyards and tie offs	Design floor perimeter beams and beams above floor openings to support lanyards beam clamps	Y

Figure 1. Ms. Anette Balestrand's Presentation, Identified Prevention through Design Items

¹² Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

Ms. Balestrand introduced the EMD Serono’s New Heights Project as a case study on how the design team “designed out” hazards and risks to protect the subcontractors during construction, the end-users during occupancy, the operations team during operations and maintenance, and the owner during the project life cycle. As shown in Figure 1, Ms. Balestrand shared many examples of incident prevention using design interventions that had been identified and implemented by the project team through a collaborative approach. Moreover, all identified PtD items were accessible to attendees through the Prevention through Design Initiative booth in vFAIRS. Finally, Ms. Balestrand explained critical steps for successful PtD implementation.



Panel Discussion. Moderator: Mr. Mark Grushka, Panelists: Ms. Anette Balestrand, Mr. Jeff Hyman, Mr. Peter Hanson, Mr. Keith Switzer, Mr. Duane Shanks, and Mr. Carmine Cimetti

Mr. Mark Grushka from MJGrushka Consulting moderated the panel after the presentation. Ms. Anette Balestrand from Erland Construction, Mr. Jeff Hyman from EMD Serono, Mr. Peter Hanson from PM Group, Mr. Keith Switzer from INTEC Group, Mr. Duane Shanks from OSCO Construction Group, and Mr. Carmine Cimetti from HUB International served as the panelists.

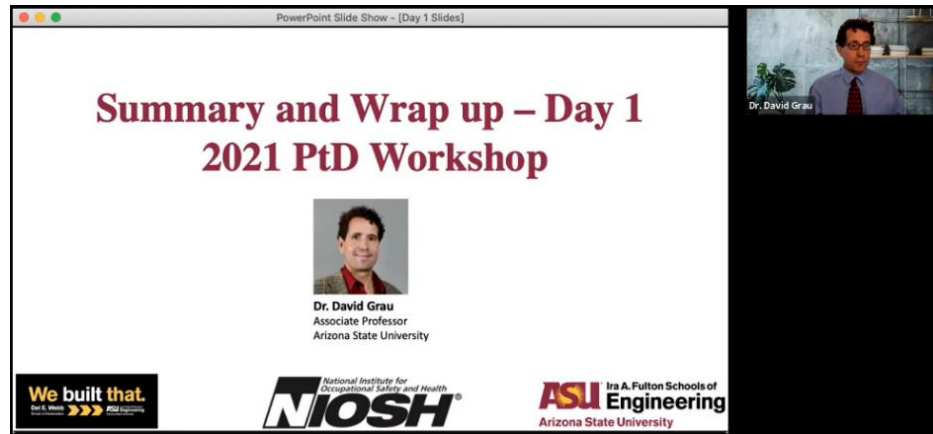
The panelists answered the attendees' questions and discussed the following topics:

- 1) The direct benefits of PtD
- 2) Project stakeholders’ commitment to PtD implementation
- 3) Project contracts and successful PtD implementation

- 4) Subcontractor engagement in the PtD process
- 5) PtD regulation and legislation
- 6) Challenges and difficulties in implementing PtD
- 7) The owner's perspective and its effect on PtD implementation
- 8) The importance of PtD support from professional groups such as AIA
- 9) The importance of educating on PtD at the university and practitioner level
- 10) Cost/benefit of PtD implementation
- 11) The relationship between the PtD effort and project size and type
- 12) PtD and insurance

1.4 Summary Day One

Dr. David Grau wrapped up the first day with a summary of key thoughts and learnings of the day. The summary included:



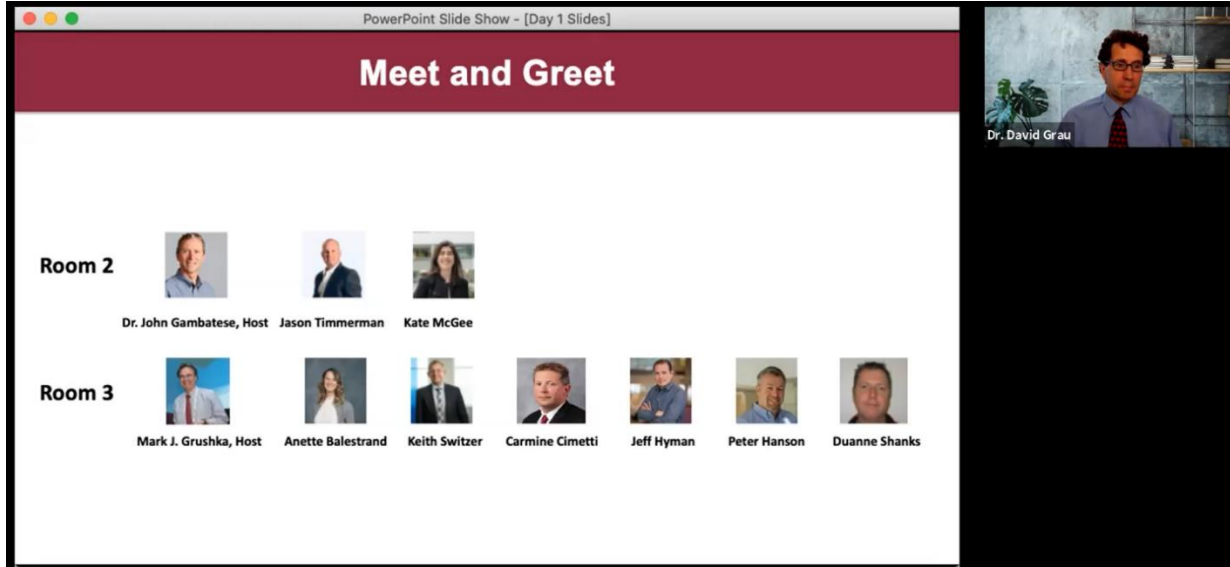
Dr. David Grau wrapping up the first day

- PtD can be enabled through policy and legislative mechanisms and requires the involvement of all stakeholders such as the government, regulators, unions, and industry groups.
- PtD regulation must consider how to protect the designers and the design liability aspect associated with prevention through design.
- The PtD adoption in Australia shows positive patterns of decreasing accidents and fatalities, which highlights that policy legislation is a measure for protecting worker wellness and safety.
- Contractually prescribed PtD in the project contract documents provides an important incentive for contractors and subcontractors to engage with PtD early in the project, often ahead of the design.
- Adoption of PtD policy and legislation should be regarded as a natural response to the human right to a safe workplace.
- PtD has a positive impact on life cycle costs.
- Anticipating safety maintenance during design facilitates maintenance and makes it more durable, cost-effective, and safe.
- Optimizing the location of equipment provides a safe and efficient mechanism for maintenance during the project's life cycle.
- PtD has a positive impact on change orders, project completion time, and project delays.

- The need to engage end-users in the design process is paramount to PtD. End-user engagement in the design process is also important to enhance the health and wellness of airport travelers.
- A lack of hazards avoidance still permeates the planning and design for operations, maintenance, and demolition.
- PtD cannot happen without collaboration among the owner, design team, design consultants, contractors, subcontractor team, end-users, and workers.
- The design process is ineffective without collaboration; however, it is still a complex, iterative, and multidisciplinary process. Project roles heavily influence safety hazard perceptions.
- Engaging all key stakeholders as early as possible with PtD gives the ability to exert a maximum influence on the built product.
- Implementing safety control gates through the design can ensure that PtD is addressed.

1.5 Meet and Greet Day One

At the end of the first day, attendees met the keynote speakers, moderators, panelists, and attendees in virtual Zoom rooms. More than 25 attendees joined each room.



Meet and Greet Session Day One

1.6 Efficacy of the Workshop's First Day

Workshop attendees were asked to fill out an evaluation survey at the end of the day. A number of questions were asked using a Likert Scale of 1 to 5, 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=35)

Questions	Average Rating
Workshop content quality	4.37
Format and organization	3.97
Applicability to your present or future assignments	4.09
Overall Workshop rating	4.20

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

Table 2. Workshop Attendee Subject Evaluation of Overall Value (n=35)

Questions	Yes %	No %
Would you recommend a future similar Workshop to others?	97.1	2.9
Did the Workshop improve your understanding of how to implement PtD?	94.3	5.7
Was this Workshop worth the time that you spent attending?	97.1	2.9
Did the Workshop improve your overall understanding of PtD?	82.9	17.1

Additional suggestions for future content were also received, and these will be used as a basis for crafting the next Workshop. The Steering Committee will use these results to improve the next Workshop.

2. Day Two

The 2021 Workshop's Co-Chair, Dr. G Edward Gibson (Arizona State University), opened the second day and welcomed the attendees. Dr. Gibson introduced the Steering Committee and thanked them for their support. After announcing the 2021 Workshop sponsors, he discussed the Workshop theme and Workshop daily structure. Dr. Gibson summarized the first day of the Workshop according to the following key themes:



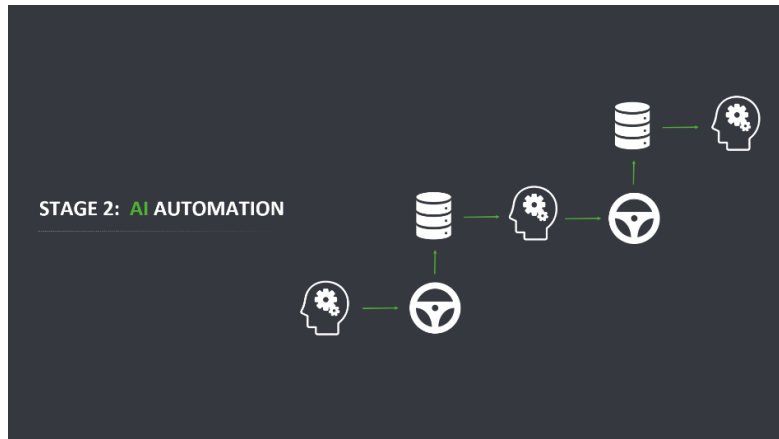
Dr. G. Edward Gibson Initiating the Second Day

- 1) Collaboration
- 2) Early planning for safety
- 3) Involvement of stakeholders in the early planning stages
- 4) Legislation and regulation impact on the safety and PtD in the Australian construction sector
- 5) Changes brought about by COVID
- 6) PtD methods and techniques

Dr. Gibson explained that the second day of the Workshop consisted of three sessions followed by live Question and Answer or Panel discussions. The first session of day two focused on autonomous trucks with a strong machine learning and artificial intelligence aspect. The second presentation concentrated on the impact of modularization on safety. The final session consisted of two sequential presentations on occupational health risks, including PtD solutions and ventilation on the job site for the construction workers.

2.1 Session 1. Autonomous Vehicles and Machine Learning

Ms. Qian Chu from TuSimple was the opening keynote speaker on the second day. Her presentation provided an overview of TuSimple's operations and autonomous systems development for heavy-duty trucks used in long-haul freight distribution. First, she outlined autonomous technologies



Qian Chu's Presentation

used for Level 4 (L4) driverless, heavy-duty truck operations to ensure safe autonomous and virtual trucking operations. Next, she discussed the challenges of autonomous heavy truck operations and demonstrated operational L4 scenarios. She then discussed the use of sensor networks, data fusion, machine learning, and artificial intelligence applied to PtD. Finally, Ms. Qian discussed the future and planned developments at TuSimple¹³.

The presentation was followed by a live Q&A. Dr. Gibson moderated the Q&A session, and Ms. Qian Chu addressed the questions through the following topics:

- 1) Scenarios that TuSimple is planning to handle in the future
- 2) The importance of data in autonomous driving
- 3) Application of autonomous driving in construction zone sites
- 4) Application of Minimum Risk Condition (MRC) in autonomous driving



Q&A Session. Moderator: Dr. G. Edward Gibson, Speaker: Qian Chu

¹³ Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

2.2 Session 2. Modularization as a Driver of PtD

Mr. Mike Flowers moderated this session and, as such, introduced Mr. Brian Bennett from ExxonMobil Global Projects as the second keynote speaker. Mr. Bennett's presentation emphasized the potential for reduction of safety risk during construction operations through modular design. A brief overview of pre-assembly and modularization applications to heavy industrial projects preceded a case study on a large-scale modularization project. He discussed the key activities that can be shifted from a construction site to a fabrication yard or facility and the potential benefits from a safety perspective. In addition, efficiency and the safety-related benefits of completing the project with fewer overall work hours were highlighted and exemplified¹⁴.

Potential safety benefits

Working at Height

- Reduced work hours at height - permanent & semi-permanent work platforms & stair towers vs. erection of largescale temp scaffolding

Slips/Trips/Falls

- Stable (often-paved) work surface vs. uneven soil or mud
- Often better-organized with purpose-built laydown & access ways and less clutter (trip hazards)

Short Service Workers

- Established, skilled permanent workforce that is familiar with the facility, equipment and work processes

ExxonMobil



Mr. Brian Bennett's Presentation

Mr. Mike Flowers moderated the panel discussion that followed the presentation. Mr. Brian Bennett, Mr. Mike Walker, Mr. Chet Zabik, and Mr. Jim Steele from ExxonMobil Global Projects, and Mr. Jack Toellner from Toellner Consulting LLC, served as the panelists. Panelists answered the questions posed by attendees, and the following topics were discussed:

- 1) The link between modularization and safety
- 2) The financial impact of modularization

¹⁴ Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

- 3) Specialized labor needs in modularization
- 4) Short- and long-term effects of COVID on modularization
- 5) Early involvement of operations and maintenance workers in modularization
- 6) Application of 3D laser scanning to modularization
- 7) Insurance costs in modular projects



Panel Discussion Session. Moderator: Mr. Mike Flowers, Panelists: Mr. Brian Bennett, Mr. Mike Walker, Mr. Chet Zabik, Mr. Jim Steele and Mr. Jack Toellner

2.3 Session 3. The Role of PtD in Health

The third and last session of the second day consisted of two sequential keynote speakers followed by a panel discussion. Dr. Babak Memarian from The Center for Construction Research and Training (CPWR) moderated the session and introduced the keynote speakers.

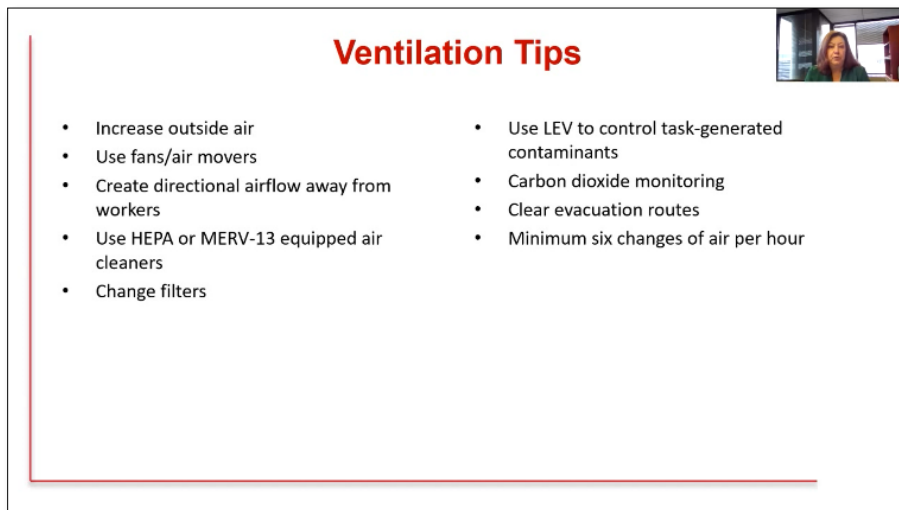
The first speaker of the final session was Ms. Chris Trahan Cain, Executive Director at CPWR. Ms. Cain provided the attendees with the CPWR's resources and information on COVID-19 to help the construction industry protect workers against the pandemic.



Chris Trahan Cain's Presentation

In addition, she discussed

practices toward ventilating spaces without operational HVAC systems that were implemented



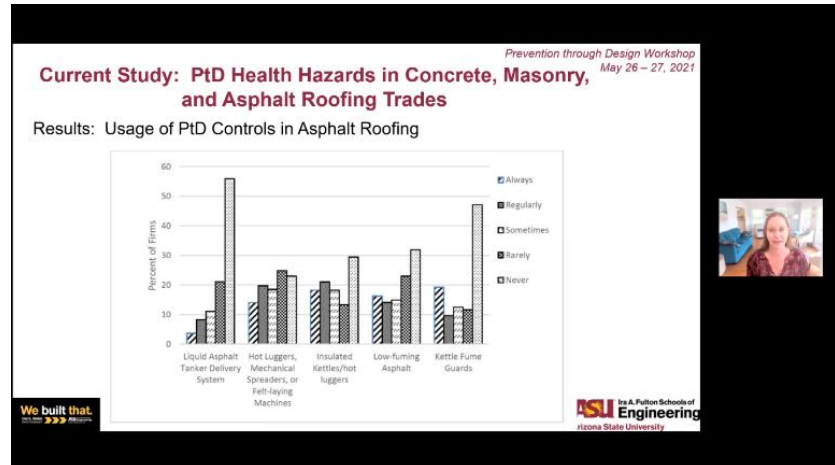
Chris Trahan Cain's Presentation

and advanced during COVID-19 to protect worker health and mitigate the spread of the virus. Finally, Ms. Cain illustrated and discussed examples of ventilating solutions¹⁵.

Dr. Deborah E. Dickerson from Virginia Tech served as the second keynote speaker. First, Dr. Dickerson introduced the findings of a study to improve PtD solutions for controlling occupational health hazards in the construction trades of asphalt roofing, concrete, masonry, and welding. Next,

¹⁵ Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

the effectiveness of PtD solutions such as tanker systems, insulated hot luggers, mechanical asphalt spreaders, fume-suppressing asphalt, and local exhaust ventilation systems was discussed. In addition, Dr. Dickerson described an intervention strategy to improve industry



Dr. Deborah E. Dickerson's Presentation

adoption and use. Finally, she presented preliminary results of an experiment to test the effectiveness of the intervention¹⁶.

Dr. Babak Memarian moderated the panel session that followed the presentations. Ms. Chris Trahan Cain and Dr. Deborah E. Dickerson, as the panelist, discussed the following topics:



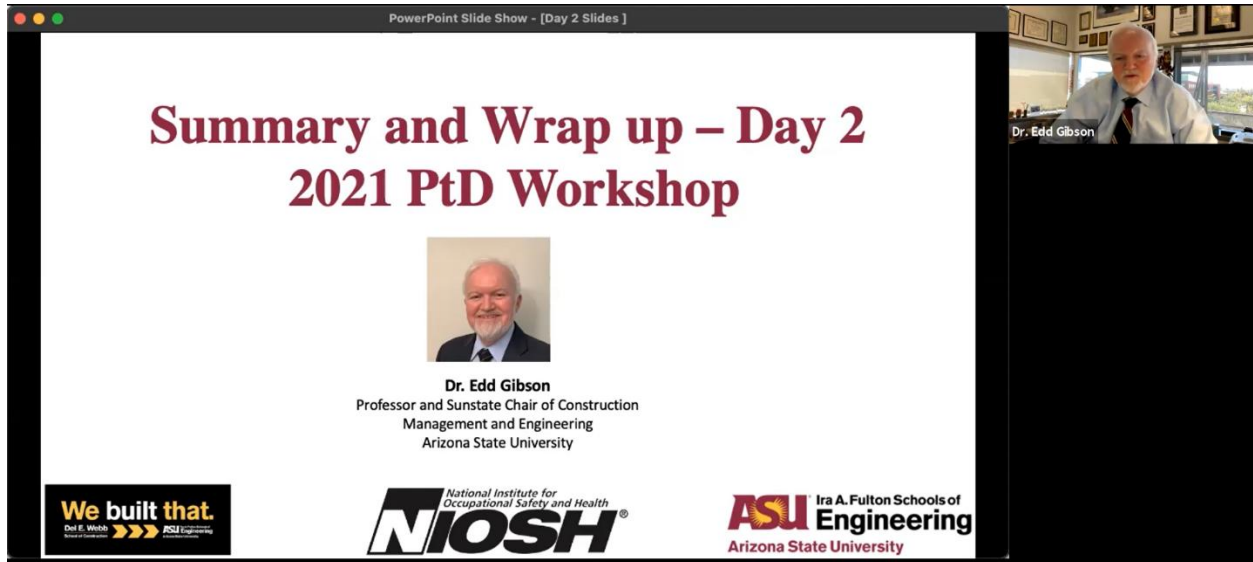
Panel Discussion Session. Moderator: Dr. Babak Memarian, Panelists: Chris Trahan Cain and Dr. Deborah E. Dickerson

- 1) PtD solutions to protect construction worker's health
- 2) Longevity and quality of a product when looking at product substitution
- 3) Application of Building Information Modeling (BIM) to PtD
- 4) Effect of the COVID-19 pandemic situation on applying the modular system in physical health hazard management

¹⁶ Keynote's presentation can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2021-neu/>

2.4 Summary Day Two

Dr. George Gibson wrapped up the second day and the 2021 Workshop with a summary of key thoughts and themes, which included:



The image shows a screenshot of a PowerPoint presentation. The main slide is titled "Summary and Wrap up – Day 2 2021 PtD Workshop" in a large, bold, red font. Below the title is a portrait of Dr. Edd Gibson, a man with white hair and a beard, wearing a suit and tie. Underneath the portrait, his name and title are listed: "Dr. Edd Gibson, Professor and Sunstate Chair of Construction Management and Engineering, Arizona State University". At the bottom of the slide, there are three logos: "We built that." on the left, the "NIOSH" logo in the center, and the "ASU Ira A. Fulton Schools of Engineering" logo on the right. The presentation window title bar at the top reads "PowerPoint Slide Show - [Day 2 Slides]". On the right side of the screenshot, there is a small video feed of Dr. Edd Gibson speaking.

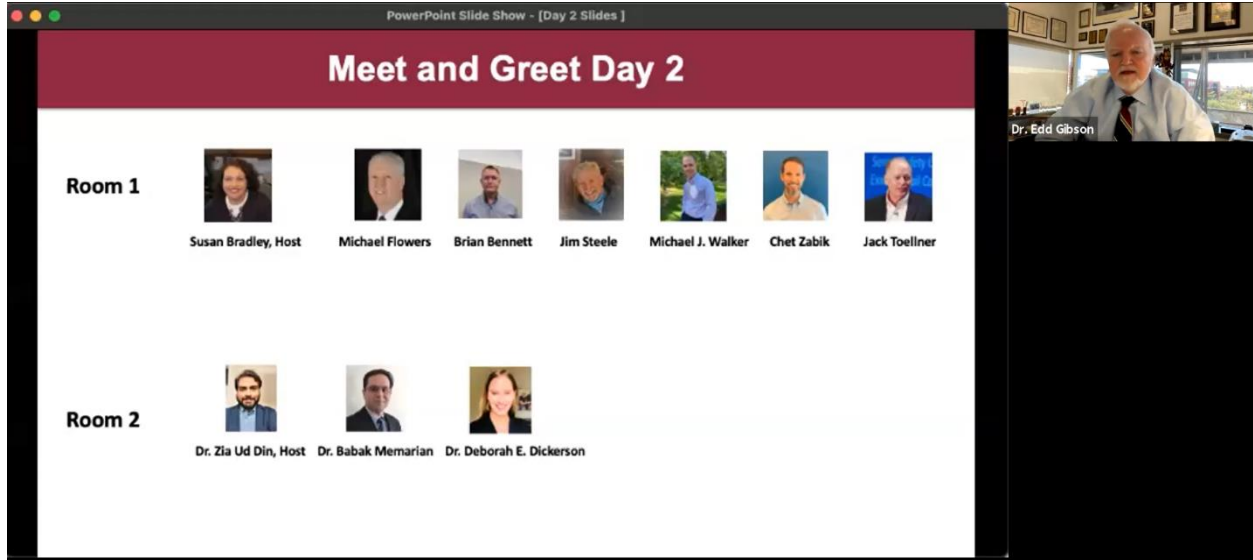
Dr. G. Edward Gibson wrapping up the second day

- Policy & Legislation
 - PtD can be enabled through policy and legislative mechanisms
 - Contractually prescribed PtD can help
- Owner role in PtD
- Holistic PtD life cycle vision
 - Positive impact on life cycle costs
 - Positive impact on project delays and change orders
- Importance of collaboration, including:
 - Perception and communication challenges
 - Early engagement of key stakeholders
 - Engagement of end users
 - Incorporation of construction knowledge to make informed decisions regarding health and safety
- Importance to standardize, implement, and maintain safety incorporation into the design process, including training and education
- The promise of Artificial intelligence (AI) and Machine Learning (ML) on PtD

- Automation and hazard mitigation
- Impact of pre-fabrication and modularization on safety
- Ventilation design decisions on construction site workers' health

2.5 Meet and Greet Day Two

At the end of the first day, attendees met the keynote speakers, moderators, panelists, and attendees in virtual Zoom rooms. More than 25 attendees joined each room.



Meet and Greet Session Day 2

2.6 Efficacy of the Workshop's Second Day

Workshop attendees were asked to fill out an evaluation survey at the end of the day. A number of questions were asked using a Likert Scale of 1 to 5, with 1 being poor and 5 being excellent. The weighted average of each question is given in Table 3.

Table 3. Workshop Attendee Subject Evaluation of Contents (n=35)

Questions	Average Rating
How would you rate today's (Day 2) Workshop content quality?	4.17
How would you rate today's (Day 2) Workshop overall?	4.29
How would you rate vFAIRS, the technology provider?	4.03
How would you rate the applicability of today's (Day 2) content to your present or future assignments?	4.11
How would you rate the format and organization of today's (Day 2) Workshop?	4.34

A number of yes/no questions were asked to gauge the overall value of the Workshop. The percentage of yes/no answers for each of the questions is given in Table 4.

Table 4. Workshop Attendee Subject Evaluation of Overall Value (n=35)

Questions	Yes %	No %
Did today's (Day 2) Workshop improve your understanding of how to implement PtD?	85.71	14.29
Would you recommend a future similar Workshop to others?	97.14	2.86
Was this Workshop worth the time that you spent attending?	97.14	2.86
Did today's (Day 2) Workshop improve your overall understanding of PtD?	82.86	17.14

Additional suggestions for future content were also received, and these will be used as a basis for crafting the next Workshop. The Steering Committee will take these, and additional comments, and use them to improve the next Workshop.

3. vFAIRS Platform as a Mechanism for Virtual Conferencing

The vFAIRS platform featured a 3D lobby, avatars, and exhibitor booths, giving visitors something as close to a physical show experience as possible. This chapter reviews the key features that were used in the 2021 PtD Workshop.

3.1 Networking

Developing connections and relationships is the fundamental part of each PtD Workshop. vFAIRS, with its user-friendly virtual networking and chat features, provided this opportunity for attendees to connect and build connections with PtD experts. As shown in Figure 2, attendees actively visited the networking tab during the networking break and interacted with speakers, panelists, and other attendees, building connections with PtD experts. This 2021 PtD Workshop brought together architects, engineers, contractors, construction companies, project owners, academics, and other PtD professionals representing 38 construction industry organizations and 16 universities to collaborate, network, learn and share success stories and challenges.

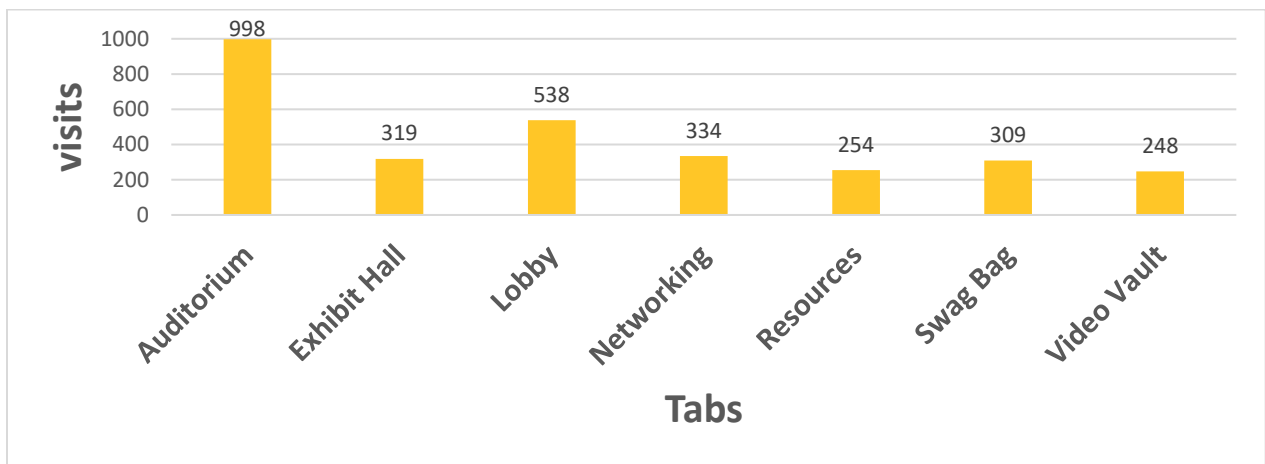


Figure 2. Hall Navigation Report

3.2 Exhibition Hall:

The Prevention through Design Initiative, CPWR—the Center for Construction Research and Training, the Del E. Webb School of Construction, the International System Safety Society, and the National Academy of Construction each hosted a booth in the Exhibition Hall. During the Workshop, 319 audience members visited the exhibitors’ booths through the exhibition hall area (Figure 2). Each booth provided attendees with documents, videos, and other PtD resources. Attendees could add such resources in a virtual “Swag Bag.” Attendees could download or email

the content of the Swag Bag (Figure 2 and Figure 3). Furthermore, attendees had access to documents, videos, and resources in the booths, and also all Workshop content, through a “Video Vault” tab. The tab listed and consolidated all videos and documents (Figure 2). In addition, attendees had access to the past 2020 PtD Workshop resources and content through the Prevention through Design Initiative booth. As shown in Figure 4, the 2020 PtD Workshop report and its keynote presentations’ slides by Mr. Jonathan A. Bach, Dr. John Gambatese, Mr. TJ Lyons, Mr. Michael Flowers, and Dr. Michael Toole were downloaded more than 15 times.

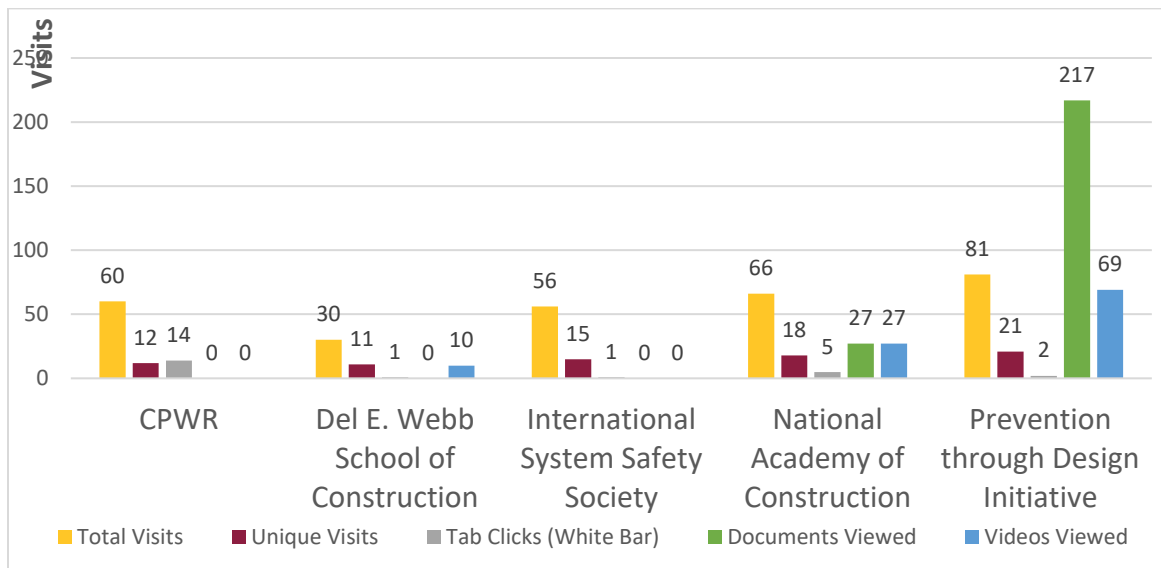


Figure 3. Booths Report

Furthermore, attendees interacted with booth admins via group and private chats.

3.3 On-Demand

All the sessions, which had been recorded, and other content were accessible through vFAIRS until June 25, 2021, in asynchronous mode. During one month of On-Demand viewing, more than 23 attendees logged into vFAIRS to take advantage of the platform’s features. Asynchronous attendees watched the sessions, visited the exhibition booths, and downloaded the documents and videos of the booths. It is worth mentioning that the 2020 PtD Workshop’s documents and videos were among the most downloaded content.

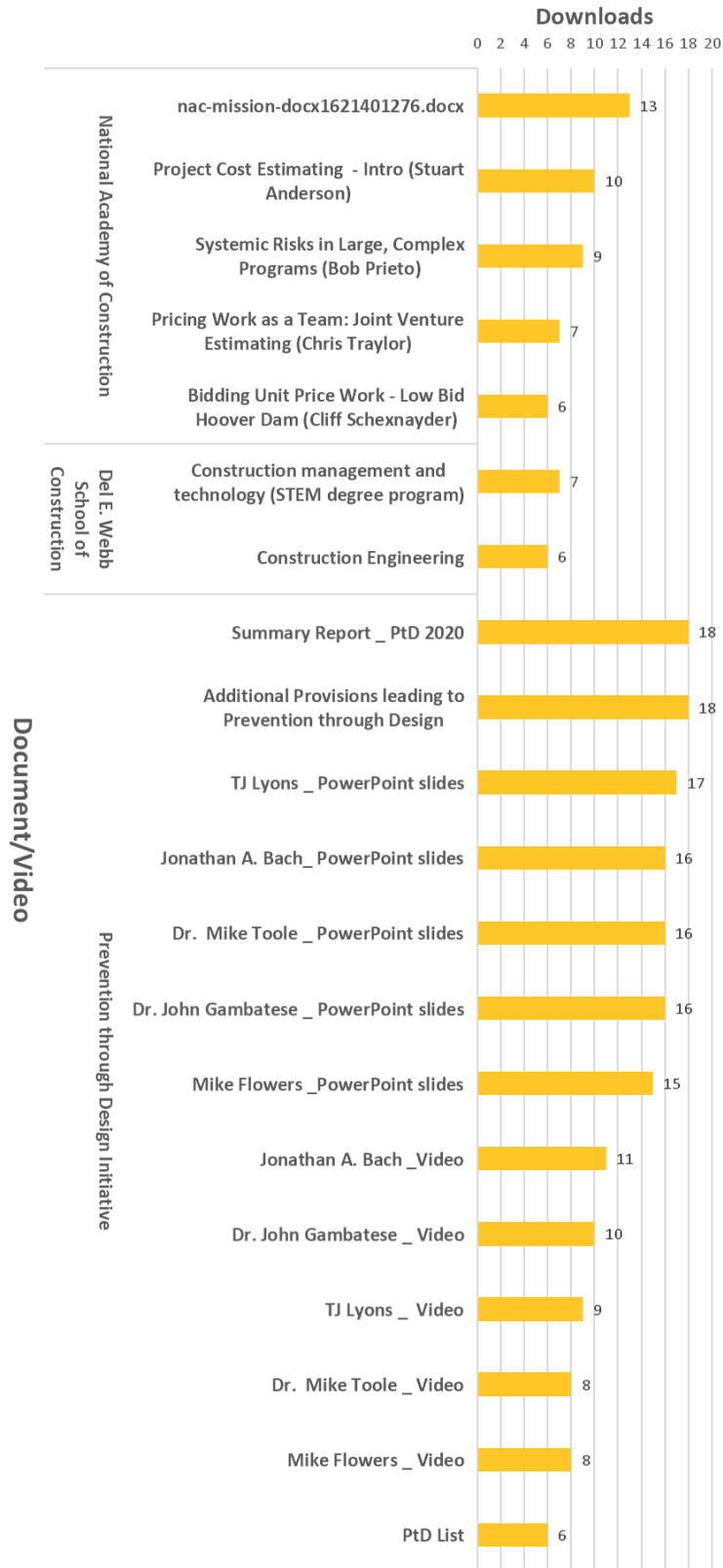


Figure 4. Swag Bag Report

Appendix A. Attendees

Full Name	Company/Organization
Abdulaziz Alotaibi	Oregon State University
Abdullah Alsharif	North Carolina State University
Luis Amigo	Webber, LLC
Vartenie Aramali	Arizona State University
Anette Balestrand	Erland Construction, Inc.
Jane Beaudry	Jacobs
Brian Bennett	ExxonMobil
Robbie Berryman	American Contractors Insurance Group
Bernie Blakely	Ocean Steel & Construction Ltd.
Susan Bradley	ExxonMobil
Christine Branche	NIOSH
Christina Cain	CPWR
David Campos	Raytheon
Philip Casto	HUB International
Mayda Castro	Raytheon
Raghuvaran Chakkravarthy	Gilbane Building Company
Sergio Chinchilla	Netflix
Qian Chu	TuSimple
Carmine Cimetti	Hub International
Dan Cobb	Columbia Construction
Matthew Combs	Erland Construction, Inc.
Ryan Curry	Raytheon
Ken Daigle	CITADEL EHS
Rafael De Luna III	Arizona State University
Sairahul Deepak	Arizona State University
Deborah Dickerson	Virginia Tech
Zia Din	University of Houston
Steve Duff	DPR Construction
Vincent Duffy	Purdue University
Scott Earnest	NIOSH
Pedram Liam Esmailzadeh	Arizona State University
Jerry Eyink	Anheuser-Busch Inc. (retired)
Michael Flowers	American Bridge Company
Reese Fortin	Sundt Construction, Inc.

Randy Fox	NiSource
John Gambatese	Oregon State University
Gaines Gibson	Aerojet
George Gibson	Arizona State University
Chris Golden	Skanska USA Civil
David Grau	Arizona State University
Mark Grushka	MJGrushka Consulting
Brent Hancock, CSP	Raytheon
Peter Hanson	PMGROUP
Sogand Hasanzadeh	Purdue University
Richard Hislop	Richard Hislop and Associates
Charles Hoes	Hoes Engineering, Inc
Gayla Hurson	Gayla
Jeff Hyman	EMD Serono, Inc.
Seth Jeannotte	Facility Management Consultants
Mitkumar Khunt	Arizona State University
Jiwon Kim	Chungang University
Jonathan Klane	BioRAFT
Stan Klonowski	Arizona State University
Chien-Ho Ko	University of Kansas
Richard Korman	Engineering News-Record
Wei-Hsuen Lee	Oregon State University
Beidi Li	Aarhus University
George Lima	EMD Serono, Inc.
Helen Lingard	RMIT University
Joseph Lisiewski	Arizona State University
Sarah McCraren	McCraren Compliance
Kate McGee	Pennonni Associates Inc.
Tony Meenaghan	EMD Serono, Inc.
Daniel Mehrabi	Arizona State University
Babak Memarian	CPWR
Serey Moeung	Oregon State University
Martin Moon	ASI LLC
Chris Nesman	EMD Serono, Inc.
Elif Oguz Erkal	University of Colorado Boulder
Kelly Ormsby	INTEC Group
Mayank Patel	University Of Houston

Ram Pendyala	Arizona State University
Payam Pirzadeh	RMIT University
Irtaza Rabbani	-
Rick Rinehart	CPWR
Tammy Rossomando	Health and Safety Ergomedic
Craig Sandles	Raytheon Missiles & Defense
Shalaka Sawant	Arizona State University
Carol Schmeidler	University at Buffalo
Rama Krishna Seethiraju	Arizona State University
Harsh Shah	University of Houston
Ishit Shah	University of Houston
Umair Shakeel	vFAIRS
Duanne Shanks	Ocean Steel
Mona Stanton	ECi MarkSystems Users Group
Jim Steele	ExxonMobil
Keith Switzer	INTEC Group, Inc.
Craig Tappel	HUB International
Jochen Teizer	Aarhus University
Jason Timmerman	Allegheny County Airport Authority
Jack Toellner	Toellner Consulting LLC
Mike Toole	University of Toledo
Todd Troutman	Mars Wrigley
Evangelitsa Tsoulofta	Cyprus University of Technology
Nicholas Tymvios	Bucknell University
Tim Van Wieren	Parkland
Naaga Viswanath Vedula	Arizona State University
Michael Walker	ExxonMobil
Bill Wright	CPWR
Yiye Xu	Oregon State University
Chet Zabik	ExxonMobil
Yang Zhan	University of Arizona

Appendix B. 2021 PtD Workshop Agenda

May 26 and 27, 2021 Prevention Through Design Workshop

Theme: PtD as We Move into the Post-COVID Era

Online

Pacific Daylight Time (GMT-7)

May 26

- 8:00-8:15 Welcome and Introduction
Dr. David Grau (Arizona State University)
- 8:15-8:45 *Prevention Through Design – The Australian Construction Industry Experience*
Dr. Helen Lingard and Dr. Payam Pirzadeh (RMIT University)
- 8:45-9:00 Q&A (Moderator: Dr. David Grau)
- 9:00-9:15 *Networking Break*
- 9:15-9:35 *Lessons Learned during COVID for Airport Design – A Case Study*
Jason Timmerman (Allegheny County Airport Authority)
- 9:35-9:40 *PtD Considerations for Managing Design on Large Projects*
Chris Golden (Skanska USA Civil)
- 9:40-9:45 *Potential Applications of Safety by Design in Civil Engineering*
Kate McGee (Pennoni Associates Inc.)
- 9:45-10:20 Panel
Moderator: Dr. John Gambatese (Oregon State University)
Panelists: Jason Timmerman; Chris Golden; Kate McGee
- 10:20-10:35 *Networking Break*
- 10:35-11:00 *Achieving New Heights in Safety during the COVID Era*
Anette Balestrand (Erland Construction)
- 11:00-11:45 Panel
Moderator: Mark Grushka (MJGrushka Consulting)
Panelists: Anette Balestrand; Jeff Hyman (EMD Serono); Peter Hanson (PM Group); Keith Switzer (Intec Group); Duanne Shanks (Ocean Steel); Carmine Cimetti (HUB)
- 11:45 – 11:55 Summary and wrap-up
Dr. David Grau
- 11:55-12:05 *Networking Break*
- 12:05 – 13:00 Virtual Speaker Rooms with moderators

May 27

- 8:00-8:15 Welcome and Introduction
Dr. Edd Gibson (Arizona State University)
- 8:15-8:45 *Autonomous Trucks – The Pursuit of Safer, More Efficient Logistics with Artificial Intelligence and Machine Learning*
Qian Chu (TuSimple)
- 8:45-9:00 Q&A
Moderator: Dr. Edd Gibson
- 9:00-9:15 *Networking Break*
- 9:15-9:40 *Modularization in Safety*
Brian Bennett (ExxonMobil)
- 9:40-10:25 Panel
Moderator: Mike Flowers (American Bridge Company, retd.);
Panelists: Brian Bennett, Jack Toellner (Toellner Consulting LLC), Mike Walker (ExxonMobil), Chet Zabik (ExxonMobil), Jim Steele (ExxonMobil)
- 10:25-10:40 *Networking Break*
- 10:40-11:00 *CPWR COVID-19 Resources and Reducing Risk Through Ventilation*
Chris Trahan Cain (CPWR)
- 11:00-11:20 *Prevention through Design Solutions for Occupational Health Risks*
Dr. Deborah Dickerson (Virginia Tech)
- 11:20-11:45 Q&A
Moderator: Dr. Babak Memarian (CPWR);
Speakers: Chris Trahan Cain and Dr. Deborah Dickerson
- 11:45 – 11:55 Day 2 Summary and wrap-up
Dr. Edd Gibson
- 11:55-12:10 *Networking Break*
- 12:10 – 13:00 Virtual Speaker Rooms with moderators

Appendix C. Prevention Through Design Workshop 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 2020¹⁷ 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.

Path Forward

A workshop on PtD will be offered annually until 2024. Each future workshop theme will be decided with the input from the Steering Committee and based on the accumulated outcomes from past workshops. Potential themes include the advancement of PtD through innovative technologies, PtD in training and higher education, incentives, barriers, and liability, or life-cycle benefits.

¹⁷ PtD 2020 workshop's keynote presentations and report can be found at: <https://ptd.engineering.asu.edu/ptd-workshop-2020-neu/>

Appendix D. Steering Committee

Name	Organization
Anette Balestrand	Erland Construction
Rob Berryman	American Contractors Insurance Group (ACIG)
Susan Bradley	ExxonMobil
Dr. Deborah Dickerson	Virginia Tech
Scott Earnest	NIOSH
Mike Flowers	American Bridge Co.(ret)
Dr. John Gambatese	Oregon State Univ.
Mark Grushka	MJGrushka Consulting
Charlie Hoes	Hoes Engineering, Inc
TJ Lyons	Total Facility Solutions
Dr. Babak Memarian	CPWR
Jack Toellner	Toellner Consulting LLC
Dr. Mike Toole	University of Toledo
Dr. Zia Ud Din	University of Houston
Russ Mitchell	Base2 Solutions
Dr. David Grau	Arizona State University
Dr. Edd Gibson	Arizona State University

Appendix E. Keynote Bios

Helen Lingard is Distinguished Professor at RMIT University. Helen started her career working for a contracting organisation in the civil engineering/construction sector in Hong Kong. Since moving to Australia, Helen has worked as a consultant to organisations in the mining, construction and telecommunications industries. Helen has undertaken extensive applied in the areas of workplace safety, workers' health and wellbeing and work-family interaction in the construction industry. Her work has been funded by private and public sector construction organisations. Recent projects include an examination of client initiatives in driving work health and safety improvements in the planning, design and construction of major transport infrastructure construction projects, and an analysis of the cultural, organisational and job design factors that impact construction workers' physical and mental health. Helen is currently working with government and industry leaders in a Construction Industry Culture Taskforce focused on improving work hours, gender diversity and health in the Australian construction industry.

Payam Pirzadeh is a researcher at RMIT University, Australia. He holds a Bachelor of Civil Engineering followed by 4 years of experience in planning and control of industrial and infrastructure construction projects. He is a member of the Institute of Engineers Australia. He also holds a Master Degree in Project Management and a PhD in Construction Management from RMIT University. His doctoral research on design decision-making and its impact on construction workers' health and safety has led to him receiving two prestigious research awards in 2019, the RMIT Prize for Research Excellence (HDR-Design) and the Chartered Institute of Building (CIOB) Research Award.

Jason Timmerman is Vice President of Environmental and Workplace Safety at Allegheny County Airport Authority. Jason is responsible for strategy, leadership, and execution of the environmental and safety programs at both the Pittsburgh International and Allegheny County Airports, as well acting as directing Environmental, Health and Safety for the future 1.2 billion dollar Pittsburgh International Airport Terminal Modernization Program, which will break ground in 2021. Jason has worked in the Environmental, Health and Safety (EHS) space for 25 years. He has worked in the construction industry serving as the EHS Director of several large general

contractors and commercial developers. Jason is a Certified Safety Professional (CSP) and has a BS in Education and an MS in Safety and Environmental Management from West Virginia University.

Kate McGee is a Certified Safety Professional with more than 14 years of experience in occupational health and safety program management and environmental consulting. Ms. McGee is the Director of Health and Safety for Pennoni, a professional engineering services firm with more than 1200 employees throughout the eastern United States, specializing in civil, municipal, structural, transportation, and environmental engineering. Prior to her role at Pennoni, she was an environmental consultant specializing in due diligence and industrial hygiene. Ms. McGee currently serves as the President-elect of the Philadelphia Chapter of the American Society of Safety Professionals (ASSP), a member of the executive committee for the Mid-Atlantic Construction Safety Council (MACSC), and a member of the American Society of Civil Engineers (ASCE) – Safety Committee.

Chris Golden is a Project Manager with Skanska USA Civil in Los Angeles, California. Most recently, Chris spent 6 years on Skanska USA's \$4 billion public-private partnership to replace LaGuardia Airport's Central Terminal Building in key safety and operational roles. Chris is a Certified Safety Professional and Project Management Professional. Chris has degrees from Indiana University of Pennsylvania and Columbia University.

Anette Balestrand is an Assistant Project Manager at Erland Construction, Inc. She currently serves as a PtD Coordinator on a new 149K SF mixed-use office and lab pharmaceutical building. Since the project kickoff in 2019, she has assisted with forming 100+ prevention considerations being implemented into the building's design and construction. Ms. Balestrand holds a Master's in Architecture from Wentworth Institute of Technology. She is an active member of the National Association of Women in Construction and recently served as the Correspondence Secretary for the Boston Chapter. Ms. Balestrand also sits on the NIOSH-funded PtD Steering Committee.

Qian Chu is an Algorithm Project Manager lead at TuSimple where she oversees the program management of the autonomous driving systems. In her role, she leads the TuSimple team dedicated to the project management of technology development, testing and integration. As one of TuSimple's earliest employees, Qian has played a major role in identifying and resolving

technical and procedural hurdles, enabling the sophisticated development of TuSimple's technology.

Brian D. Bennett is a Principal Engineer of Project Engineering Management with the ExxonMobil Global Projects Company. He has 23 years of experience in oil and gas project management, spanning project team leadership, project execution planning and technical advisory roles. Brian's current role is in the Project Engineering Management Center of Excellence, which provides tools and innovation, project support, and people and skill development to the ExxonMobil project management community. He received his Bachelor of Science degree in Chemical Engineering from Florida State University.

Chris Trahan Cain is CPWR's Executive Director and leads its construction research, training, and service programs funded by federal agreements, grants, and contracts. She partners with CPWR's external partners in the government, construction and non-construction unions, and the larger construction safety and health community. She leads CPWR staff in finding synergies among functional areas in order to capitalize on programs funded by different federal grants. She also serves as the director of safety and health for North America's Building Trades Unions (NABTU), the umbrella organization also known as the Building and Construction Trades Department, AFL-CIO. NABTU is comprised of 14 national and international unions collectively representing over three million workers.

Deborah E. Dickerson is an Associate Professor of Human Factors and Safety Engineering in the Grado Department of Industrial and Systems Engineering at Virginia Tech. She is the Director of the Health Work Design Lab, which researches ways to improve the health of workers through design of work, management systems, and the physical and psychosocial work environment. As a faculty member, she has established an integrated research, instructional, and service program emphasizing innovative design solutions to occupational risks; and, intervention strategies to improve stakeholder willingness to adopt those innovations. Certified as a Safety Professional and Industrial Hygienist, Deborah entered her current academic career with over ten years of professional experience conducting health hazard exposure assessment and designing control strategies to reduce worker exposure to occupational health hazards. These prior experiences directly inform her current scholarly pursuits; in that the importance of eliminating hazards at the

design-stage of equipment and materials, rather than attempting to control exposures during work operations, became quite evident.

Appendix F. Moderator Bios

Michael D. Flowers is the retired President and CEO of American Bridge Company. He received his Bachelor of Science in Civil Engineering from West Virginia University and his Master of Science Degree from the University of Pittsburgh. Flowers has worked over 44 years in the engineering and construction of high-rise buildings and complex bridges. He oversaw several notable bridge projects in his career, including the rehabilitation of the Williamsburg Bridge in New York City, the Lions Gate Bridge in Vancouver, the historic Wheeling Suspension Bridge in West Virginia, the retrofit of the Tagus River Bridge in Lisbon, Portugal, and the Woodrow Wilson Bridge in Alexandria, VA. Mike is the recipient of multiple awards, including the prestigious Golden Beaver Award for his work on the new Bay Bridge, and ASCE's Roebling Award for outstanding leadership in construction of the most challenging bridge projects ever attempted in the modern era. Mike is an active member of the National Academy of Construction, ASCE, the West Virginia Academy of Civil Engineers, serves with an advisory capacity at both West Virginia University and the University of Pittsburgh, and is a trustee at Berea College in Kentucky.

John Gambatese is a Professor at Oregon State University. His educational background includes Bachelor and Master of Science degrees in Civil Engineering from the University of California at Berkeley, and a PhD in Civil Engineering from the University of Washington. He has worked in industry for six years as a structural engineer in San Francisco and for one year as a project engineer for a construction management firm in Seattle. Dr. Gambatese's expertise is in the broad areas of construction engineering and management, and structural engineering. He has performed research and published numerous articles on construction worker safety, work zone design and safety, prevention through design, risk management, sustainability, constructability, innovation, and construction contracting. He is a member of the American Society of Civil Engineers (ASCE) and American Society of Safety Professionals (ASSP). He is a licensed Professional Civil Engineer in California.

George Edward Gibson is currently a Professor and holds the Sunstate Chair in Construction Management and Engineering in the School of Sustainable Engineering and the Built Environment (SSEBE) at Arizona State University. From 2010 to 2018, he served as SSEBE School Director, overseeing significant growth in its programs and rankings. In addition to ASU, he served on the faculty of North Carolina State, the University of Texas at Austin, the University of Alabama,

Tuscaloosa and Auburn University. His educational background includes a B.S. and Ph.D. in Civil Engineering from Auburn University and an M.B.A. from the University of Dallas. Dr. Gibson has been PI or co-PI on over \$10.8 million worth of funded research in his career with research and teaching interests that include front end planning, safety leadership and systems, prevention through design, organizational change, asset management, alternative dispute resolution, knowledge management, earned value management systems, and risk management among others. Dr. Gibson has several years of industry experience, served as an Army officer, and is a licensed professional engineer in Texas. He is an elected member of the National Academy of Construction (NAC) in 2005 and a Distinguished Member of ASCE in 2020. He was awarded the 2016 ASCE R. L. Peurifoy Award for outstanding research and the 2020 Richard L. Tucker Service Award from NAC; he served as a Visiting Academic Fellow at Cambridge University in spring 2019.

David Grau is an assistant professor in the School of Sustainable Engineering and the Built Environment at Arizona State University. Grau graduated with both a Master's degree and doctorate 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 in Spain. Previous to his affiliation with ASU, he taught at the University of Alabama as an assistant professor for four years. During his academic career, Grau 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 more than 10 years inclusive of positions such as program manager for heavy industrial projects and director of a large engineering design department. He has led large interdisciplinary and multicultural teams to deliver numerous capital projects in South America, Africa and Europe. Grau is a member of ASCE and ASEE professional societies and holds a professional license as an Industrial Engineer in Spain.

Mark J. Grushka is the Principal Consultant and Owner of MJGrushka Consulting in Tucson, Arizona. He has been assisting organizations achieve high levels of measurable safety, health and environmental performance for over 30 years. He has held a number of technical and managerial positions in both the private and public sectors, including the University of Arizona, BHP Copper, the Biosphere 2 Project and Tucson Medical Center. He holds a Master of Science Degree in Safety

Management from Northern Illinois University and is a Board-Certified Safety Professional. In addition, he holds a postgraduate certification in environmental management from Arizona State University.

Babak Memarian is the Director of Exposure Control Technologies Research at CPWR – The Center for Construction Research and Training and the co-chair of the NIOSH/CPWR Engineering Controls Workgroup. He currently leads a NIOSH-funded project titled “Prevention through Augmented Pre-Task Planning.” He holds a Ph.D. in Construction Management from Arizona State University and a M.S. in Civil Engineering with a concentration in Construction Engineering & Project Management from Oklahoma State University. His research interest involves development of high reliability production systems with a focus on safety & health, production improvement, and error management. He is an active member of the American Society of Safety Professionals. Dr. Memarian is also a Certified Safety Professional (CSP) and Construction Health and Safety Technician (CHST).

Appendix G. Panelist Bios

Carmine Cimetti is Vice President at HUB International, New England. Carmine brings over twenty-five years of experience in construction risk management, operations, planning and project logistics to HUB International New England. His collaborative approach to construction health and safety has been associated with some of the largest regionally recognized projects in the heavy infrastructure, transportation, education and healthcare/life sciences sectors. He presently holds CSP (Certified Safety Professional) and CRIS (Construction Risk Insurance Specialist) credentials and he is an OSHA 500 Certified Construction Outreach Instructor. Carmine has a Bachelor of Science in Construction Management from Wentworth Institute of Technology, plus an Associate of Science in Building Construction.

Peter Hanson is a subject matter expert in process architecture and an Associate Director at the PM Group. He has worked in the bio pharmaceutical industry for over 25 years. He has led design teams on numerous major pharmaceutical projects across the globe; his work in the industry has spanned from China to the USA to Europe and Australia. He has completed front-end and concept designs together with site master planning on some of the world's largest projects for companies including Pfizer, Thermo Fisher, Teva, and EMD Serono. Peter is the project sponsor for the EMD Serono New Heights project and has been a key resource on the project from inception all the way through construction. Making safety a priority throughout his career, he has been an advocate for Erland's PtD initiative.

Jeff Hyman is an environmental health & safety professional with more than 35 years of practical experience in compliance with federal, state, and local regulations in support of Biotechnology, Pharmaceutical operations, facilities operations, and construction projects. Jeff manages a diverse team of occupational health, laboratory operations, and logistics professionals supporting a combined base of 1,400 R&D, Commercial, and Clinical Development employees with locations in Massachusetts, Washington, DC, and Miami, Florida. Jeff has significant experience with environmental compliance and has built a robust culture of leadership in sustainable operations, achieving and maintaining ISO 14001 certification, multiple Platinum and Gold LEED certifications, and WELL Gold certification from the International WELL Building Institute. Jeff maintains zero-poison pest control and monitoring programs, zero campus irrigation protocols,

and recently received Gold Wildlife Habitat Council (WHC) certification for its “Pollinator Friendly Campus” in Massachusetts.

Duanne Shanks is Safety Manager of the NB/PEI Division at OSCO Construction Group. He joined the OSCO Construction Group in 2008 starting as the corporate trainer. He has 12 years’ experience in the construction sector as a Safety Professional. In 2016 he took on the role as a Safety Manager for various sections of the company, including electrical, precast concrete fabrication, rebar services, steel fabrication, steel erection and concrete ready mix. He has received his National Construction Safety Officer Designation and has also completed a Certification in Occupational Health and Safety from University of New Brunswick.

Jim Steele is a Construction Advisor with the ExxonMobil Global Projects Company, providing project support. He has 20 years of experience in oil & gas offshore construction site management and project engineer roles primarily on FLNG, LNG Carrier and FPSO projects in Asia, Europe and Africa. Prior to joining ExxonMobil, Jim served 24 years in the U.S. Navy, serving on six ships and retiring as a Commander. He received his Bachelor of Science degree from the U.S. Naval Academy and Master of Science degrees from the U.S. Naval Postgraduate School and the University of Madras, India.

Keith Switzer is the President/CEO of INTEC Group, Inc., a full-service firm offering architecture, interior design and furniture procurement services with offices in Fairfax, VA, Charlotte, NC and Washington, DC. As both a registered architect (RA) and certified designer by the National Council for Interior Design Qualification (NCIDQ), Keith leads his team with a well-rounded, diverse background and more than 20+ years of commercial design experience. He is motivated by his firm’s corporate vision, “to enhance the human condition,” along with their mission—“to create an inspiring experience through the built environment that uniquely enhances the lives of our clients, our employees and our community.” Keith believes PtD practices are a natural complement to his team’s project approach and delivery; he is passionate about sharing this knowledge and having the opportunity to further elevate the well-being of his clients to a level that remains unrivaled by competitors in the industry.

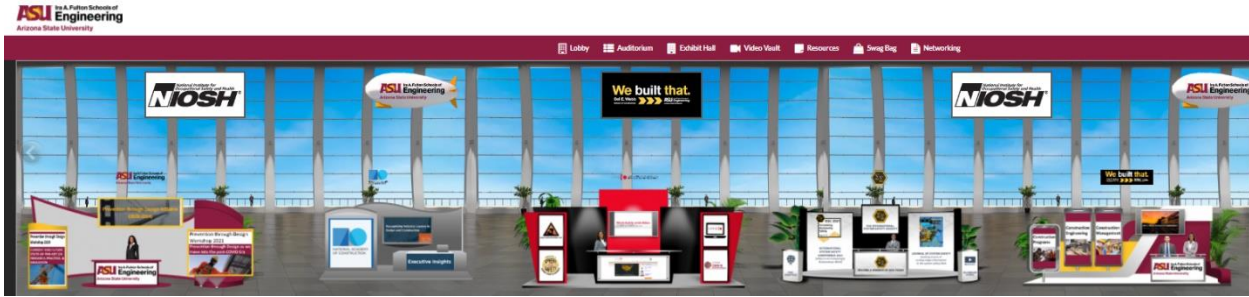
Jack Toellner is a professional engineer at Toellner Consulting LLC. He is a recognized expert in safety management planning/execution and public speaking. He has worked in 30+ countries

with 100+ clients, including multiple government agencies. Jack is a Graduate of Texas A&M University with a degree in Civil Engineering. He also holds a graduate degree from Tulane University in Occupational and Safety Management. He has diversified experience in construction, engineering, SH&E, and management; and is a retired executive with ExxonMobil with 38+ years of service. He is Registered Professional Engineer (P.E.) with the State of Texas and Certified Safety Professional (CSP). He was the recipient of the American Society of Safety Engineers Charles V. Culbertson Outstanding Volunteer Service Award.

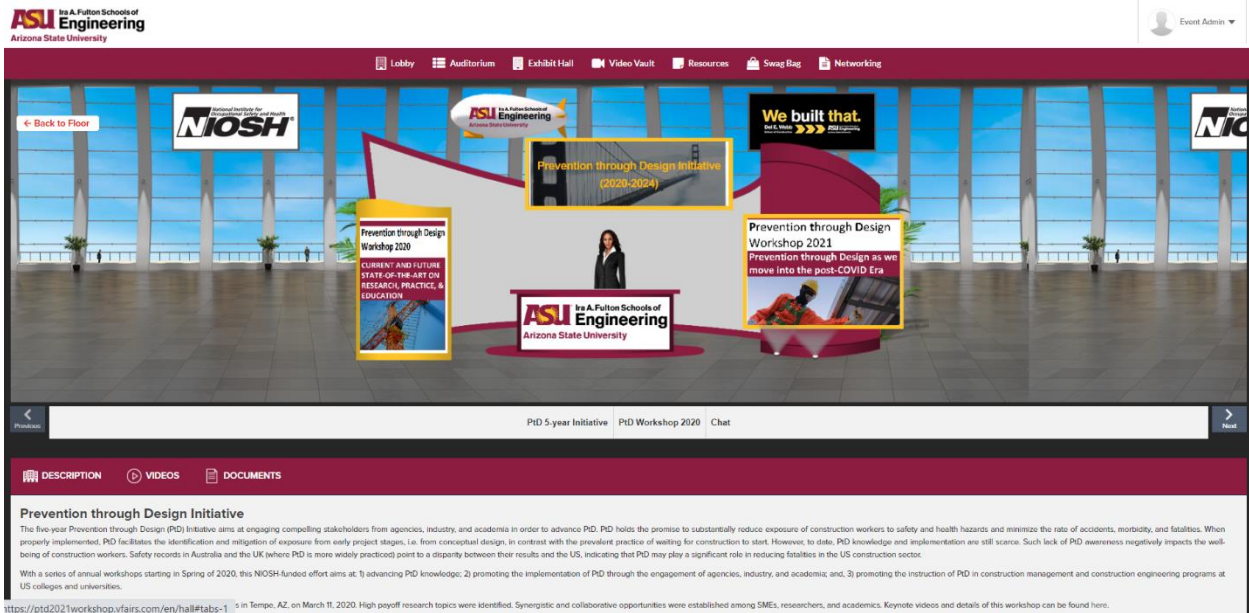
Michael J. Walker, Principal Construction Engineer, provides construction advisement and support for the ExxonMobil Global Projects Company. With 27 years of oil and gas experience, Mike has performed project management, engineering management, and construction management in upstream production (onshore and offshore) and downstream refining. Mike graduated in 1994 from the Georgia Institute of Technology with a Bachelor's Degree in Mechanical Engineering.

Chet Zabik is the Module Center of Excellence Lead within the ExxonMobil Global Projects Company. Chet has 16 years of experience in oil & gas construction for primarily international onshore and offshore projects in the execution phase. His current role is targeted at early strategy development for projects to evaluate stick-built construction vs. the degree of modularization, as well as fabrication strategies. Prior to joining ExxonMobil, Chet worked along the U.S. Gulf Coast in the industrial construction market with a focus on project management of civil repair and strengthening projects. He received his Bachelor of Science and Master's degrees in Civil Engineering from the University of Florida.

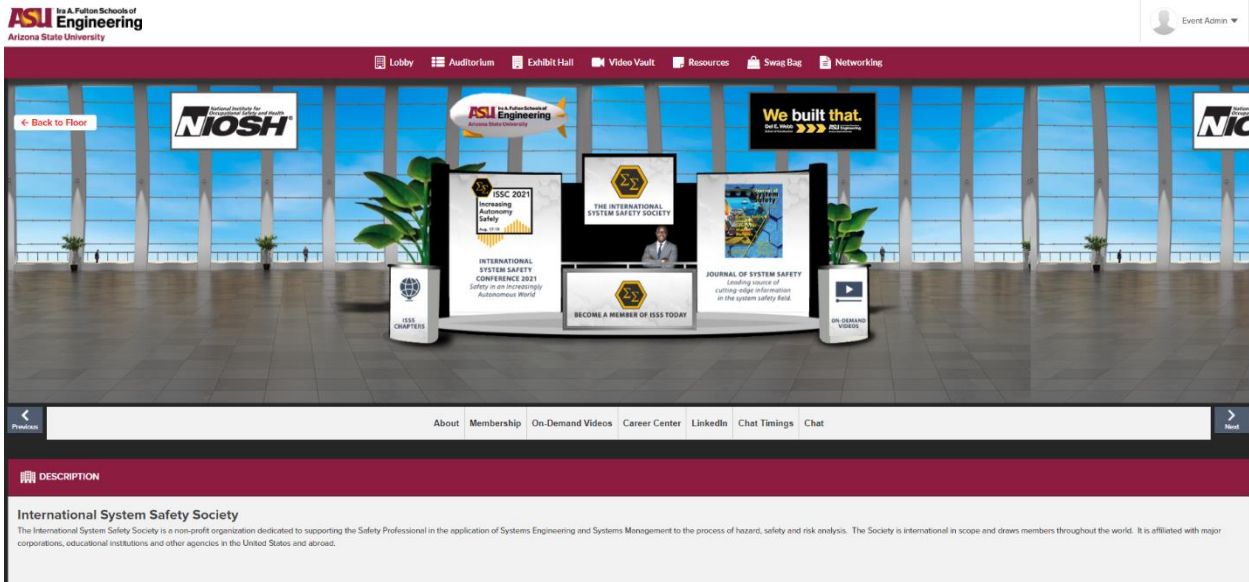
Appendix H. vFAIRS' Features



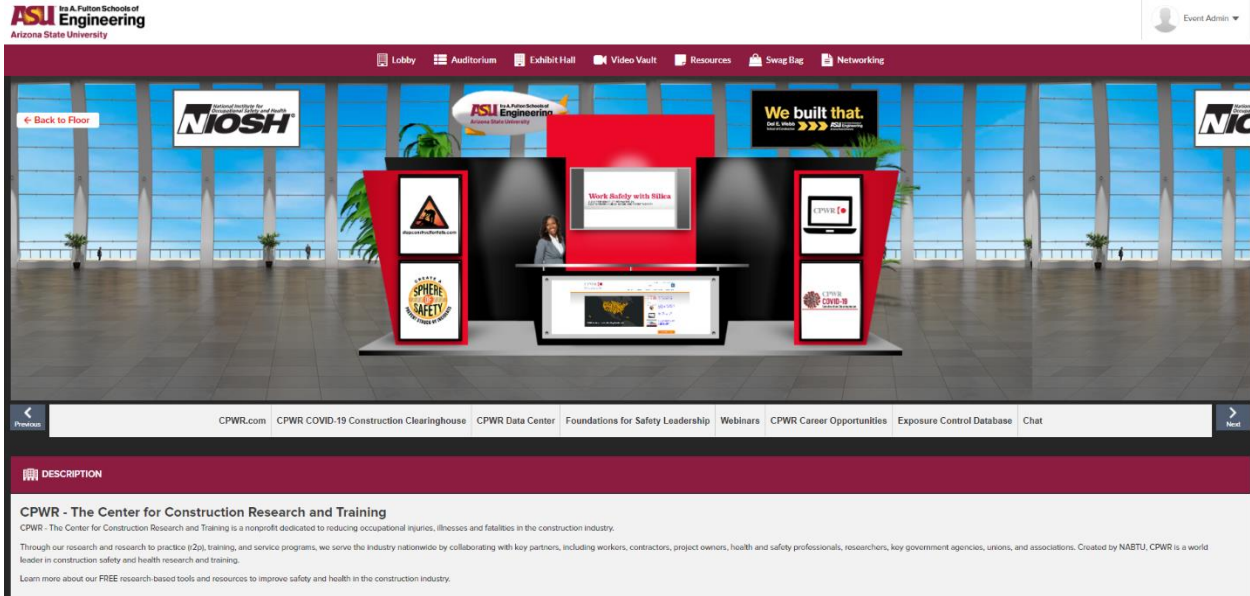
2021 PtD Workshop Exhibition Hall



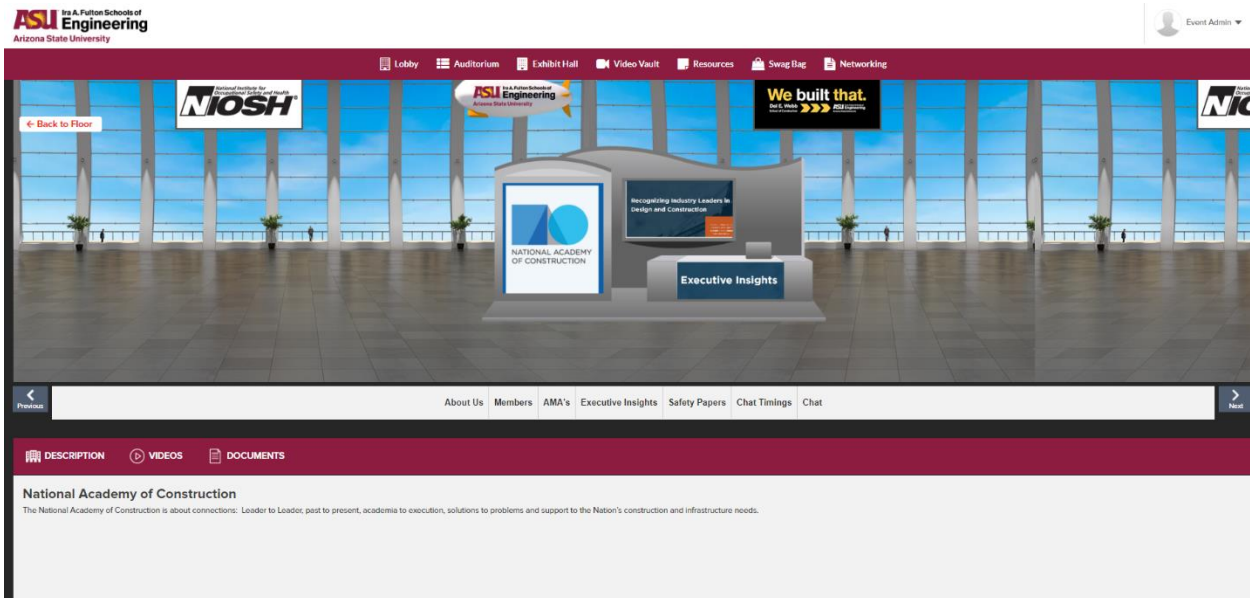
Prevention through Design Initiative Booth



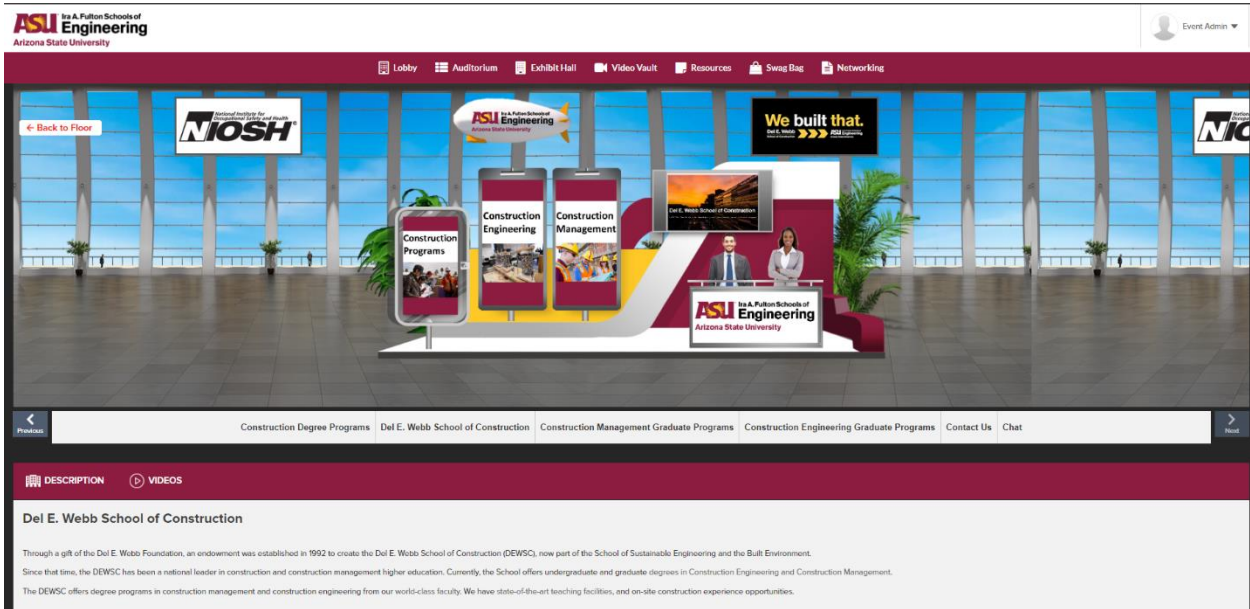
International System Safety Society Booth



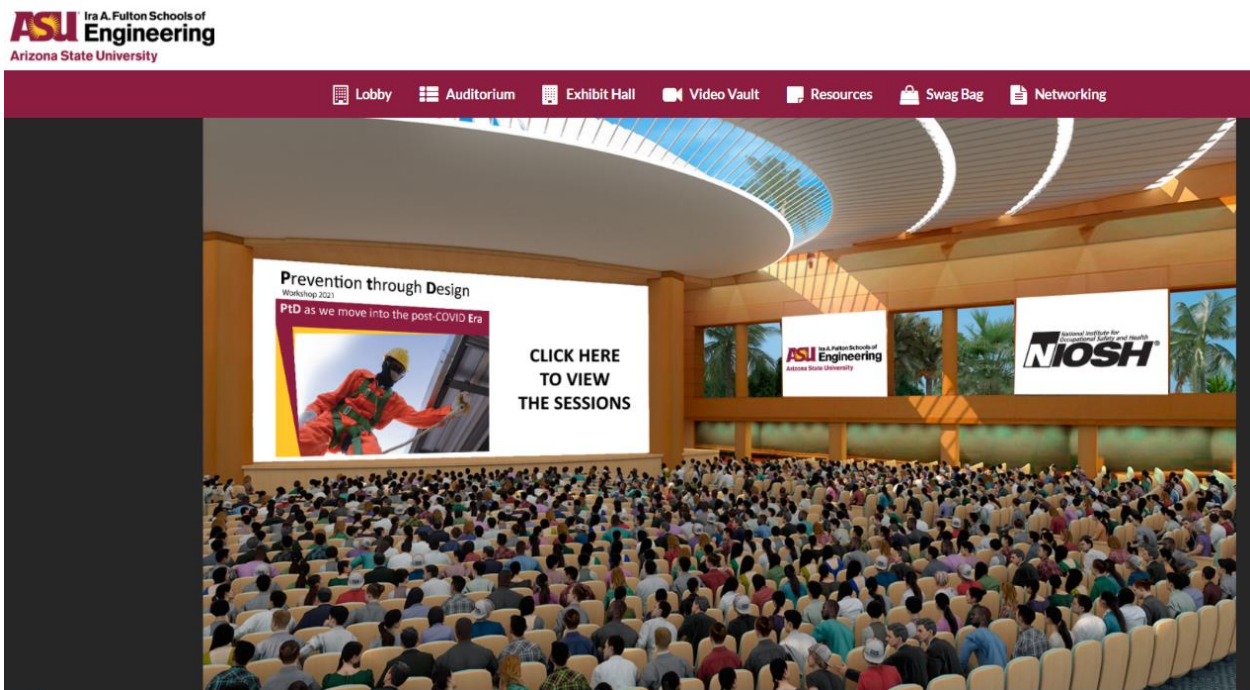
CPWR Booth



National Academy of Construction's Booth



Del E. Webb School of Construction's Booth



PtD 2021 Workshop Auditorium on vFAIRS Platform

MAY 26TH

Welcome and Introduction

Play



Dr. David Grau, PE, Ph.D.



Dr. George Edward Gibson, Jr., Ph.D., PE, NAC, Dist.MASCE

Prevention Through Design – The Australian Construction Industry Experience

This session has ended



Dr. Helen Lingard, Ph.D.



Dr. Payam Pirzadeh, Ph.D., M.Sc., MIEAust

Prevention through Design forms a key component of Australian policy and legislation. The Australian Work Health and Safety Strategy 2012-22 (the Strategy) establishes the elimination/minimisation of hazards by design as a priority action area and identifies construction as an industry warranting particular attention. The Strategy frames PtD broadly, referencing the design of structures, plant, substances, work, work processes and systems of work as falling within the scope of this priority action area. The principal occupational health and safety (OHS) Act in each Australian State and Territory also establishes requirements for PtD. Notwithstanding the established and widely accepted importance of PtD in the Australian construction industry, practical challenges to its effective implementation remain. Design work, particularly in construction, is heterogeneous and ascribing decision-making responsibility to the occupant of an abstract socio-technical role, i.e. ‘the designer’ is problematic. In practice, design decision-making is socially and technically complex, involves multiple stakeholders whose interests may not always be aligned and decisions that reflect trade-offs between different interests and priorities. The optimisation of OHS in this context can be challenging. Drawing on findings from over 10 years of research into PtD in the Australian construction industry, the presenters use case studies to illustrate some of the structural and cultural challenges experienced and provide examples of successful PtD implementation. In particular, the importance of communication, collaboration and end user participation in decision-making are highlighted as critical success factors for PtD in the construction industry.

 Dr. Helen Lingard and Dr. Payam Pirzadeh_ Prevention Through Design – The Australian Construction Industry Experience_ PtD 2021

PtD 2021 Workshop's Agenda