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Rapporteur's Report Construction Sector

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1. Introduction

Construction is a large, dynamic, and complex industry sector that plays an important role in the U.S. economy. Construction workers and employers build our roads, houses, and workplaces and repair and maintain our nation's physical infrastructure. Construction work can involve building of new structures, which may include activities involved with subdividing land for sale as building sites or preparation of sites for new construction. Construction work also includes renovations involving additions, alterations, or maintenance and repair of buildings or engineering projects such as highways or utility systems.

The occupational fatalities in the construction sector have long been disproportionate relative to the number of employees in the business. For example, in 2004 the construction industry employed 7% of the workforce, yet accounted for 23% of all work-related fatalities in the United States (Bureau of Labor Statistics, 2004; NIOSH, 2004). In addition to fatal injuries, workers in these industries are at risk of injury or illness due to 'contact with' objects, falls to a lower or same level, overexertion and excessive noise. Prevention through Design (PtD) has been recognized and implemented internationally as a feasible method to reduce construction worker risk (HMSO, 1994; WorkCover, 2001); however, its implementation in the United States is commonly limited to those situations where design and engineering are closely partnered to construction activities through procurement, contract, and firm type. Contractors are committed to safety on the jobsite, and their efforts have improved worker safety significantly over the years. There is great potential, however,

in engaging the design community to participate in devising risk-free processes from the start, as suggested by the safety hierarchy of controls.

2. Most Compelling Idea/Recommendation to Come Out of the Discussions

Many large engineering/construction firms have developed internal-specific processes and programs to initiate and implement PtD for the benefit of construction workers. Numerous large firms discussed their programs and practices during the PtD construction breakout session. Among these were Jacobs Engineering, Bechtel, Washington Group, BE&K, Southern Company, Haskell, and Parsons. While these firms are clearly leaders in PtD, there remains an obvious lack of widespread adoption and implementation in the broader United States construction industry. Moreover, as will be discussed in the Practice and Research Sections, these larger firms have developed a variety of systems, practices, and methods, all of which are quite unique. In addition, few, if any, case studies have been developed and evaluated with a systematic research design. One case study from the Washington Group, Inc., has been reviewed and accepted by the Occupational Safety and Health Administration and is posted on their Alliance webpage.

The most compelling idea from the construction sector discussion was to gather, combine, and share (i.e., create a repository) PtD programs, checklists, best practices, etc., in a manner that is customized by type of construction and firm size. Without this initial step, the group felt that subsequent ideas and recommendations would not be as effective.

3. Practice (Needs, Challenges, Opportunities)

In addition to the idea of creating a PtD repository, several practice recommendations came out of the construction sector

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discussions. These recommendations are multi-faceted in that they also have implications for policy, research, and education. In terms of PtD practice, several standardized tools are utilized, such as the Construction Industry Institute (CII) Design for Construction Safety Toolbox and variations of the Construction Hazard Assessment Implication Review (CHAIR) process developed in Australia. Additionally, firm-specific design reviews, constructability reviews, checklists, and risk assessment processes were presented.

3.1. Liability

One of the most pertinent issues is to clarify designers' liability issues with insurers and attorneys. This was emphasized by counterparts from the United Kingdom and Australia (due to legislative requirements, liability is not an issue in these countries). A large majority of the attendees and presenters were from large engineering/construction firms, who demonstrated that liability is not an issue when design and construction fall under one contract or firm. However, this is not the case for the vast majority of design professionals. This challenge was emphasized by an architect from an architectural services only company who spoke to the group. Industry standard contracts, which guide architect-owner and owner-contractor relationships, clearly state that site safety is the sole responsibility of the contractors. As a result, architects may not embrace the PtD concepts, since typical professional practice insurance does not cover claims arising from "means & methods." Architects are not trained and educated in PtD for construction. Any attempt, therefore, to "instruct" contractors on how to safely create their designs, would expose the architect to serious liability, as their insurance would not cover any claims arising from such an "instruction." Opportunities exist to work with some of the innovator design firms to understand how the liability issue may be overcome. Another option is to work with attorneys and insurance companies to demonstrate that safe design should, in fact, reduce exposure to claims. Insurance professionals may consider changing the conventions of professional practice insurance, or even reduce premiums for designers who design with proven PtD principles.

3.2. PtD Case Studies

To improve PtD practice, case studies must be developed and geared towards owners and designers. This idea bisects across practice and research. The presenters from the engineering/ construction firms have PtD process descriptions from past projects, and have developed these into case studies. However, these case studies may not be generalizable to design-only firms, and the methodology used to develop and evaluate the case studies may not meet the rigor of academic peer-review. A set of case studies from across the multi-faceted construction industry is needed, as is a prescribed methodology to incorporate PtD and measure its effectiveness.

3.3. Links with Sustainability

One of the most supported ideas to diffuse PtD in construction was to utilize the [United States Green Building Council's \(USGBC\) Leadership in Energy and Environmental Design \(LEED\) rating system](#) and the sustainability movement as a model. The concepts of sustainability and PtD were identified by the group as very congruent and able to co-exist. An architect who spoke to the group agreed that this could be a viable method for diffusion, but does not agree that construction worker safety fits as neatly within the LEED structure as the group's comments suggest. Several attendees referred to recent research highlighting the similarities between sustainability and PtD ([Gambatese et al., 2007](#)). Opportunities to partner with the USGBC should be sought.

3.4. Spreading the Word on PtD

Many key construction industry professional organizations are not aware of the PtD initiative. One architect stated that if not for his association with a National Institute for Occupational Safety and Health (NIOSH) researcher, he would have never heard of this concept. To help architects embrace the concept, he suggested making a "hot list" of design suggestions, developing direct designer benefits, and demonstrating ease of use. The most important of these suggestions might be to educate building owners and developers about the benefits of incorporating PtD and hiring capable design professionals who are knowledgeable about it. This will make architects eager to respond. A recommendation to collaborate with and educate key professional organizations, such as the American Institute of Architects, CII, and Construction Users Round Table, was agreed upon. These organizations educate and influence their members. Making these important players aware of PtD, and assigning it as a top priority, was viewed as necessary.

4. Policy (Needs, Challenges, Opportunities)

4.1. Defining PtD

With many different views of what PtD is, and questions about who should engage in it, and at what sequence in the construction life-cycle it should be put into practice, a great need exists for NIOSH to define PtD in the construction sector. Some of the many queries are: Is it design or is it redesign? Are all engineering controls considered under the umbrella of PtD? For example, if someone designs a better scaffold, is that PtD? Or is PtD about seeking methods to reduce work at heights through better project design? Or are both examples of PtD? For these reasons, one recommendation is that NIOSH, or some other consensus body (i.e., the American National Standard Institute (ANSI)), define PtD in the construction sector. Stemming from

whatever that definition is, a consensus PtD standard needs to be developed.

4.2. Legislation

The group felt strongly that governmental regulation of construction PtD is not a viable short-term strategy. There was agreement that governmental agencies should take a lead in PtD by making its incorporation a requirement on government projects utilizing changes in standard design services contracts.

5. Research (Needs, Challenges, Opportunities)

Many of the ideas and recommendations from the construction sector contained potential research opportunities. It was agreed that research was necessary to define the design professionals' liability of implementing PtD. Participants agreed that PtD research needs to be applied rather than theoretical, and should contain a component on measuring its effectiveness. Many participants found that measuring PtD effectiveness was difficult due to strong safety processes inherent within their firm. Often numerous safety processes are occurring simultaneously, making a specific PtD measurement hard to decipher. The larger construction firms highlighted the business case for PtD as one impetus for implementation. If the research can support the business case claim, then PtD becomes easier to promote and adopt among architects and design professionals. Each of the presenters had their own unique case studies and some have been documented, however, similar to the theme of the workshop, a satisfactory research effort must be designed properly. The research component in future PtD case study development must begin in the project's conceptual design stage and, for adequate measurement of success, follow through to construction completion. In the short-term, potential research efforts exist including: the link between PtD and the sustainability movement, the issues surrounding liability, and diffusion of the PtD innovation. The challenge for researchers is to be part of the PtD process from the beginning. Additionally, it must be noted that the workshop presenters were from large construction firms; research needs to focus on how good PtD practices can be diffused and incorporated by smaller construction and design firms.

6. Education (Needs, Challenges, Opportunities)

6.1. Continuing Education

The group agreed that creating PtD education workshops for Continuing Education Units (CEU), required for Professional Engineer (PE) and Registered Architect (RA) licensure renewals, is necessary to invigorate the concept among practicing architects and engineers. Challenges in this area include the state-by-state licensing structure, and developing

adequate educational materials for the various design and engineering specialties.

6.2. University Education

Incorporation of PtD into university engineering and design curricula was frequently brought up as an issue in the smaller breakout sessions. However, during the prioritization process, participants did not feel this action item should be listed as a high priority due to several factors. One of the most compelling factors was that entry-level architects and engineers will default to what their employers and clients want them to do (i.e., not utilize PtD). Given that practicing design professionals do not incorporate PtD in their design work, an educational effort aimed at colleges and universities may be ineffective until the industry standard changes to incorporate PtD in practice at some level.

7. Conclusions

There was much enthusiasm within the construction sector for PtD. However, numerous challenges exist and among those, the liability issue must be resolved at a national level. Additionally, a clearer definition of PtD must be agreed upon. If these two issues are not resolved, the construction sector will be limited in moving its PtD efforts forward to that of larger firms, where design and construction are closely tied. Because these firms are clearly implementing many innovative safety processes, the PtD effort will become masked in their larger corporate safety culture, and its true impact will not be realized on a national level. These issues are important from a research and educational perspective. Without a clear operational definition, individual researchers will create their own, which will circulate the literature possibly clouding the research-to-practice initiative. Lacking a clear understanding and agreement of the liability issue, researchers will be limited to dealing with the same large innovator firms, rather than expanding methods to diffuse PtD. Educators need a clear understanding of whether the PtD issue is of national importance or is a management system fad. Moreover, they need specific PtD tools and research from which to solidify the basis for educational efforts. The opportunities and future outlook for PtD in the construction sector are positive; momentum for construction PtD at a national level was gathered during the workshop.

In summary, the seven most pertinent recommendations and ideas to sustain PtD momentum are:

1. Gather, combine, and share PtD programs, checklists, best practices, etc., in a manner that is customized by type of construction and firm size;
2. Develop PtD case studies for owners and designers;
3. Clarify liability issues with insurers and attorneys; research real versus perceived liability;
4. Create PtD education for CEU's that are required for Professional Engineer and Registered Architect renewals in some states;

5. Develop consensus PtD standards (ANSI, building code, etc.). Define PtD and process;
6. Apply LEED/sustainability experiences to diffuse PtD;
7. Collaborate with and educate key professional organizations (American Institute of Architects, Construction Industry Institute, and Construction Users Roundtable).

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