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Benchmarking and Advancing Construction Safety: An Owner's Perspective

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Abstract: Historically, owners have taken a "hands-off" approach when it comes to contractor safety, mainly due to the liability associated with the injury of construction workers. Today, with the lawsuits arising from construction accidents, owners could be held liable for the damages. Literature shows that involvement of owners in selecting, monitoring, and mentoring safe contractors significantly reduce recordable incidents on projects. This paper presents a research effort on benchmarking and advancing construction safety for The Pennsylvania State University's Office of Physical Plant. The goal of this study is to pilot the ability to profile the level of involvement of owners in project safety. The research effort involves two major activities: (1) benchmarking safety standards and practices for owners by an in-depth review of published literature on owner involvement in construction safety and review of safety programs of similar owners, and (2) profiling Penn State's safety practices, using documents from two case study projects. The outcomes demonstrate the ability to leverage the benchmarked safety approaches to inform current owner safety practices and suggest several opportunities to improve.

1. INTRODUCTION

For many years, construction safety has been in the hands of contractors. Limited work has been done on the role of owners in construction safety. Gambatese (2000b) suggests that involvement of owners in construction safety can improve project safety records. Huang and Hinze (2006) investigated the role of owners in construction safety by examining the relationship between project safety performance and the influence of owners. Both studies suggest that owners can positively influence project safety through involvement in selecting safe contractors, including safety requirements in the contract, and actively participating in safety during the construction phase.

Hallowell et al. (2013) investigated safety leading indicators that influence project safety performance. They introduced two types of safety leading indicators, passive and active. The former is utilized "before" construction and in planning steps to ensure a successful project; whereas the latter is implemented "during" construction to trigger adjustment. After reviewing past CII literature and brainstorming with the research team, they identified more than 100 potential safety indicators. After studying 19 projects, they found that only 20 of the identified active safety leading indicators, such as "owner safety walk" and "housekeeping" were implemented on any of the projects. They also found that very few active safety leading indicators were fully used by the industry, with significantly lower recordable incidents measured on the projects where the leading indicators were more thoroughly used.

The goal of this study is to benchmark owner construction safety practices through a review of the literature and publically available owner safety requirements of 15 university owners for comparison to Penn State's safety practices. The intent is to pilot the ability to compare and profile an owner agency's level of safety involvement.

2. OWNER CONSTRUCTION SAFETY PROGRAM

The American Society of Civil Engineers' (ASCE) Policy Statement 350 suggests owners "take an active role in project safety." With defined safety goal(s) and requirements in a "formal owner safety program" properly communicated to the project team, owners can positively affect safety on their jobsites (Gambatese, 2000a). Levitt and Samelson (1993) identify selecting safe contractors and subcontractors, monitoring contractor safety, and using wrap-up insurance as effective strategies that owners can utilize to reduce the number of construction accidents and therefore their liability exposure. Nelson and Haggard (1993) have identified the followings as the "high-impact, zero injury safety techniques" which owners and contractors can use:

- Pre-project/pre-task planning for safety
- Safety orientation and training
- Written safety incentive program
- Alcohol and substance abuse program
- Accident/incident investigations

Gambatese (2000a) developed a six-point safety program an owner can use to manage construction safety in their projects. The followings are the six major elements identified:

1. Establish a clear position on safety
2. Ensure that safety is addressed in project planning and design
3. Consider safety performance when selecting a constructor
4. Address safety in the construction contract
5. Assign safety responsibility during construction, and
6. Participate in project safety during construction.

Rajendran and Gambatese (2009) developed and validated a project safety evaluation tool called the Sustainable Construction Safety and Health (SCSH) rating system, which can be used to rate the level of safety "importance" and "implementation" on a project. The rating system is organized into 13 categories which carry a total of 50 safety and health elements. Inputs from owners, designers, and constructors are required to complete the rating system for a project. The rating system was implemented on 25 projects and was found to accurately represent the safety performance of large projects.

3. RESEARCH METHODOLOGY

This study has two major goals, (1) identifying safety standards and practices for owners and (2) piloting a benchmarking evaluation of owners' implementations by examining Penn State's safety requirements and practices on two recent construction projects.

In the first part of this study, literature was reviewed to identify the potential means by which owner involvement in construction safety has previously been measured. Safety practices of 15 owners in the Higher Education sector was then examined and compared by reviewing their publically available project team selection processes and project documents to identify owner's safety requirements and practices. This study is in line with the "six-point safety program" defined by Gambatese (2000a), targeting the following documents:

- Prequalification
- Team selection criteria
- RFP documents
- Professional Agreements
- Standard contracts
- Evaluation forms

In the second part of this study, two construction projects, one Construction Manager at Risk (CMR) and one Construction Manager Agency (CMA) with multiple prime contractors, on the University Park campus of The Pennsylvania State University were studied. One of the case study projects is recently completed, with the other nearing completion at the time of this study. The effort was to investigate the safety requirements and practices used in each project and compare them to identify typical and consistent safety practices employed by Penn State. Archival review of project documents, verified through conversations and email correspondence with project teams, were the main sources of data. Findings from this part of the study were compared to the identified owners' safety practices to determine the areas that Penn State differs from the benchmarked safety programs.

4. CONSTRUCTION SAFETY PRACTICES FOR OWNERS

The goal of this section is to collect the array of construction safety approaches and requirements from an owner's perspective. Published literature on owner involvement in construction safety as well as safety requirements and practices of 15 similar owners in Higher Education sector were reviewed to identify owner construction safety best-in-class practices. This section is presented in four subsections, (1) Safety Goals and Culture (2) Safety Qualification and Evaluation, (3) Safety Requirements in Design, (4) Safety during Construction, Planning and Execution.

4.1 Safety Goals and Culture

Gambatese (2000a) suggest that owners have a clear position on safety as the first step toward implementing a successful safety program. He states that an owner's emphasis on safety can influence the view of other project stakeholders toward project safety. He further suggests that owners have "genuine concern" toward safety so that the other project stakeholders learn from them.

Review of the 15 universities' statements, such as, Vision/Mission Statement, Values, and Guiding Principles, showed that 7 of 15 universities addressed safety in one of these. The remaining 8 universities do not mention Safety in their organizational statements. Table 1 lists the statements and frequencies in which safety was addressed. Penn State's Office of Physical Plant does mention safety in their Vision Statement and Guiding Principles, but is less specific than other universities.

4.2 Safety Prequalification and Evaluation

The purpose of a safety qualification process is to evaluate the safety performance of a prospective constructor. Selecting safe constructors is an "effective" and "simple" way of improving safety on construction sites (Levitt and Samelson, 1993). Levitt et al. (1981) showed that owners who prequalified and selected their constructors based on safety performance had fewer accidents. Levitt and Samelson (1993) suggest that, during safety prequalification process, owners review constructors' "past" and "current" safety performances, including Experience Modification Rates (EMRs), OSHA incident rates, client reference letters, safety orientation programs, safety training procedures and safety meetings. Hinze (1997) suggests that owners can also improve safety performance of subcontractors by requiring the general contractor to evaluate and select subcontractors based on safety performance measures, approving subcontractors based on their past safety performance, and requiring subcontractors to submit their project specific safety programs/plans to the owner.

The study revealed that 6 of 15 universities had their prequalification processes publically available. This means that the rest either did not have a prequalification process in place or it was not shared publically. Table 2 lists unique requirements found in the prequalification processes as well as the number of universities in each category. Of the six, two of the universities did not have any safety requirements in their prequalification processes. The most common safety requirements in the remaining 4 universities were (1) specific safety rules and regulations (2) safety metrics. The Office of Physical Plant (OPP) at Penn State does have an EMR requirement for prequalifying contractors, though in interviews with project managers they noted that it was notably above the national average.

Table 1: Summary of Safety Goals and Culture

Safety mentioned in the organization's	# of Universities
Mission	2
Values	3
Guiding Principles	1
Renovation program Goals	1
Not mentioned	8

Table 2: Summary of Safety Requirements in Prequalification Processes

Safety Requirements in Prequalification Process	# of Universities
Specific safety rules and regulations	4
Safety personnel and their qualifications	2
Safety metrics	3
Inspection history and correction action documents	3
Annual employee safety training plan	1
No safety prequalification requirements	2

4.3 Safety Requirements in Design

Traditionally, construction safety has not been the concern of Architects or Engineers. Design codes and standards currently used by design professionals in the United States only address end users safety. Design professionals are typically focused on the health and safety of end users, not construction workers (Gambatese, 2000a). Hinze (1994) showed that only 16% of designers addressed safety in their designs.

The ability to influence project safety significantly decreases while moving from the start of a project, conceptual design, toward the end, construction (Szymberski, 1997). Gambatese and Hinze (1999) showed that design professionals have significant influence on the safety of construction workers. They, to a large extent, dictate means and methods of the construction by specifying the design features and construction materials (Gambatese, 2000a). So, it is imperative to address construction safety early in the design phase before critical design decisions are made. This requires the design professionals to have knowledge of construction safety. Owners should insist that designers address construction safety in their designs by requesting or even requiring it in their contract (Gambatese, 2000a). Owners committed to safety can select their designers considering their experience in addressing workers safety in their design (Hinze, 1997). By selecting such design professionals, owners can proactively manage safety and eliminate or minimize hazards in the design phase at a much lower cost.

The result of the owner benchmarking process showed that 7 of 15 universities had their Professional Agreements publically available. The most common requirements found in the Professional Agreements were typical disclaimers of the A/E or/and CM related to their responsibilities toward safety (e.g. Indemnification Clause). One of the Universities, however, does required the A/Es to comply with the university's Drug Free Program. None of the universities reviewed, including Penn State, requires safety reviews during project design. Also, none of the universities had information shared regarding design for safety requirements or designer prequalification.

4.4 Safety during Construction Planning and Execution

4.4.1 Proposal and Planning Requirements

Involvement of owners in safety should be an ongoing effort and should not stop in the construction phase (Liska et al., 1993). The roles of owner in construction safety can be stated in the contract or a contractor safety program/policy. Table 3, in the left half, lists unique RFP requirements found as well as the number of universities in each category. The result found 7 of 15 universities had their RFP requirements publically available. Careful review of the RFPs revealed that 4 of the 7 universities did not have any proposal safety requirements. "Safety records" and "health and safety plan" were found to be the two common requirements in the RFP processes of the universities with defined safety requirements. Table 3, in the right half, further lists unique requirements found in the contractor safety programs. The study found that 9 of 15 universities had contractor safety programs in place that were publically available. The most common items identified in the programs were (1) Comprehensive contractor safety program, (2) Topic specific safety requirement(s), and (3) Project specific safety plan requirements.

Table 3: Summary of Safety Requirements in the Universities' RFPs & Contractor safety Requirements

Safety Requirements in RFP	# of Universities	Safety Requirements in Contractor Safety Program	# of Universities
Safety records	2	Comprehensive contractor safety program (from Owner)	5
Submit a Health and Safety Plan	2	Require project specific safety plan	4
Hazardous Materials	1	Topic specific safety requirement(s)	4
Safety as a selection criterion	1	Construction contractor safety recognition program	1
Compliance with specific safety regulations	1	Pre-construction safety inspection	1
No safety requirements in RFP	4	No contractor safety program	6

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4.4.2 Contract

In addition to the publically available prequalification, planning and proposal requirements regarding safety, standard or template contracts were reviewed for embedded requirements regarding safety. These build upon the previous section to clarify some of the requirements which owners had embedded in their contracts.

Site Specific Safety Plan

Constructors are often required to submit a site specific safety plan before they start the work. This document addresses the project's general and specific safety information, requirements and concerns. The purpose of such document is to eliminate or minimize accidents, injuries, and property damage. As noted above, 4 of 7 universities with their documents available require site specific safety plans. The detailed requirements for site specific safety plans were included in the construction safety requirements.

Safety Incentive Programs

There are two types of safety incentives, project level and individual level. At the project level, owners can award contractors for their good safety performance, while at the individual level, owners or contractors can award workers, supervisors, or superintendents for their good safety performance (Hinze, 1997). An example of a project level safety incentive is to fully reimburse the constructor(s) for all their safety costs (Levitt and Samelson, 1993). One of the universities had an individual level safety incentive called Safety Recognition Program which formally recognizes safe behavior by rewarding contractor employees for their outstanding safety practices. It is important to note that funding source can limit an owner's flexibility on offering safety incentives. Currently, OPP does not have any safety incentive programs in place. They have, however, used Owner-Controlled Insurance Program (OCIP) in one of their larger capital projects.

Safety Audits, Inspections, Reporting

The contracts consistently required the superintendent, or other designated site safety officer, to conduct weekly safety walks with contractors. In addition, the safety manager assigned to the job conducts monthly safety walks with the superintendent/assistant superintendent. A report containing positive and negative points is required to be submitted to the project manager, safety director, and or other designated representatives within a set time after the visit.

Incident/Accident Record Keeping, Reporting and Investigations

Owners should keep track of the safety performance of constructors (Levitt and Samelson, 1993). This requires the contractors to regularly submit project safety reports to the owner. These reports should contain information on "safety meeting minutes," site inspection results, and near misses, "a listing of all injuries," and "investigation of major accidents" (Gambatese, 2000a). Such information should be organized and stored in the owner's project or safety management database so that it can be used to analyze and rate the performance of the contractor(s) at any time. This can help the Owner to identify the contractor(s) that are not performing well on safety.

5. CASE STUDY OF PENN STATE'S OFFICE OF PHYSICAL PLANT PROJECTS

The Pennsylvania State University's Office of Physical Plant (OPP) at the University Park campus manages the daily operations and maintenance of over 700 buildings and the supporting infrastructure. As a diverse organization and owner, OPP is experienced with delivering projects using a CMR, CMA with multi-prime contractors, single prime contractors, Job Order Contracting (JOC), and some self-perform work for specific trades and scopes. In particular, CMR and CMA are the two primary project delivery methods frequently used in managing large capital projects by Penn State. In a CMR project, the owner holds separate contracts with the Construction Manager (CM) and the Architecture/Engineering (A/E) firm(s) while the CM is holding contracts with the specialty contractors. However, in a CMA project, the owner holds separate contracts, not only with the CM and the A/E firm(s), but also with a minimum of four Prime Contractors in accordance with state procurement requirements. This research represents a collaborative effort with OPP to study Penn State's approach for construction safety focusing primarily on their CMR and CMA delivery projects.

5.1 Case Study Project Selection

Two recent construction projects, one CMA and one CMR, on the main campus of The Pennsylvania State University were selected to study the owner safety requirements used during Prequalification, Design, Construction, and Evaluation phases. Table 4 shows some information about the selected projects.

5.2 Safety Prequalification and Evaluation:

5.2.1 Prequalification Requirements

In order for a construction manager to enter into a contract with Penn State, they must be qualified as a "General Contractor" with the University. This requires them to go through the prequalification process one of whose requirements is a State and Interstate EMR of less than 1.35 for the past three years. At the time of the qualification, both CMs for Projects A and B had a three-year average EMR of less than 0.90. Project A had seven Prime Contractors all of which had an average EMR of less than 1.0 for the past three years. For both projects, the CMs consulted with OPP's Contractor Liaison about the contractor prequalification process and criteria to ensure that they met the minimum requirements of the University.

Table 4- Description of Penn State case study projects

Project	Project Delivery Method	Area (SF)	Project Cost	Project Type
A	DBB w/ Multiple Primes	93,500	$48M	Administrative offices, research space and classrooms
B	CM at Risk	20,000	$23M	Research space and offices

5.2.2 Constructor Performance Evaluation

OPP utilizes quality control tools to evaluate the performance of design professionals and constructors. The result of such evaluations will determine whether or not the firm will be qualified for future projects. This section describes how OPP evaluates constructors on safety performance.

The Contractor Performance Evaluations (CPE) is a control tool that OPP utilizes to evaluate the performance of constructors. The purpose of the CPE is to improve the delivery and quality of projects, to promote better working relationships between constructors and OPP, and to remove poor performing constructors from Penn State's Pre-qualified Bidders List. Constructors are evaluated based on 9 performance categories one of which is Safety, which has a 10% weight. The safety performance of a constructor is evaluated based the following eight criteria with a five point scale of 0-100 with 0=unacceptable and 100=excellent:

a. Timely submission of site specific safety program
b. Knowledge of OSHA standards
c. Implementation of safety rules and regulations
d. Promotion and creation of safety awareness
e. Daily and overall housekeeping
f. Safety record
g. Response to safety concerns
h. Awareness of public safety

The constructor evaluation process is usually conducted after the close-out portion of the project; however, if there are problems early in the project or the Project Leader (PL) wants to be proactive, he/she conducts a "Preliminary" evaluation. Penn State reserves the right to remove constructors for unacceptable work/inappropriate conduct, such as, "serious safety issues." The evaluation team is usually selected by OPP's Project Leader. Once the evaluation is complete, it will be submitted to OPP's Contractor Liaison and stored in the OPP's Project Administration System. Firms receiving an unsatisfactory mark (below 50) will be considered for removal from the Pre-qualified Bidders List for a period of no less than six months. When discussing this capability with OPP project managers, none of them could cite an instance when they had used safety to remove a contractor. In a CMA project, prequalified prime contractors are selected based on the lowest bid, and if a contractor is prequalified and has the lowest bid, they will win the project despite their previous unsatisfactory performance. In a CM at Risk project, CM firms are provided information on the firms which have been prequalified by Penn State; however the process for selecting specialty contractors is relegated to the CM firm and can be based on their in-house prequalification standards.

5.3 Safety Requirements in Design

5.3.1 AE Agreement

Penn State uses two types of Forms of Agreement, long and short forms, when entering into a contract with an outside Design Professional. The long version is used when Penn State is seeking full design services; the short form is used when Penn State is seeking limited services, such as surveying or a geo-technical report. Careful review of the sample Agreements revealed that there is almost no mention of safety for the project stakeholders in this document. It is noted that the "Professional shall not be responsible … for safety precautions and programs in connection with the work. However, if the Professional has actual knowledge of safety violations, the Professional shall immediately alert the relevant Contractor or Subcontractor and shall give prompt written notice to the owner." Finally, under "Hazardous Material", this Agreement waives the responsibilities of the Professional and its consultants "… for the discovery, presence, handling, removal, or disposal of, or exposure of persons to hazardous materials." It is worthy to note that these sample Agreements could be modified for each project.

Penn State had three and four separate Forms of Agreement in place for projects A and B, respectively. The main design contract had the safety related items mentioned above, except that the Professional had no responsibility in either project for alerting the relevant constructor or the owner of actual safety

violations. Also, under, “Other Conditions or Services,” the Professional should furnish their design according to the Penn State Design and Construction Standards, one of which is “Environmental Health and Safety.” This section has five items that are all related to hazardous materials, i.e., Asbestos, Lead Paint, Mercury, PCB/Fluorescent Light Ballast, and Lamp Use and Disposal. No direct mention of construction safety was found in the other consultant contracts for this project.

5.3.2 RFP and Constructor Selection

OPP typically uses a two-stage process to select a CM. The first is a Letter of Interest request, followed by a Request for Proposal (RFP). In both projects, the RFPs were sent to 6-8 firms based on a down-select from the Letters of Interest. After reviewing the RFP documents, it was noted that there was no indication of the owner safety requirements and expectations specifically requested for either of the projects. Safety was not even mentioned in the RFP as an evaluation criterion for selecting the CM. During the CM interview, however, safety was among the evaluation criteria in both cases. The Constructors were evaluated based on five categories totaling 13 criteria, one of which was “Risk Management/Project Safety” with a weight of two percent.

5.4 Safety during Construction Planning and Execution

In both Projects A and B, managing safety was the sole responsibility of the CM firm.

CMA Project (Project A): Penn State held two contracts with the CM for this project, one for preconstruction and one for construction management. No mention of safety requirements was found in the Preconstruction Agreement; however under “Basic Services-Safety” of the Construction Management Contract, the Construction Manager was required to “… set up a written Job Safety Program and review the safety programs of each of the Trade Contractors and make appropriate recommendations.” The Construction Manager was also required to conduct “regular and complete inspections” to ensure that the contractors were in line with not only the project safety program but also “… all federal, state and local statutes, rules, regulations and orders applicable to the conduct of the Work”.

CMR Project (Project B): Penn State used Construction Manager Guaranteed Maximum Price Contract for this project. The Safety section of the contract listed the Construction Manager’s Services regarding safety during the Construction Phase, which was found to be identical to those of the CMA Contract. The major difference between the projects was in the General Conditions of the GMP Contract, where under “Access to and Inspection of the Work,” the owner reserves the right to inspect all the work under Contract; however they waive their right to enter into the Construction Manager’s responsibility for safety of persons and property. Moreover, under “Supervision” during Construction phase, the Construction Manager is recognized as the sole responsible party for safety of the work under this contract. Lastly, “Protection of Persons and Property” was addressed in the following six categories:

1- Compliance with OSHA regulations
2- Owner’s minimum safety requirements
3- Construction Manager’s role during Emergencies
4- Safety Precautions toward Employees, the Work, materials and equipment, and adjacent properties
5- Hazardous Material
6- Property damage repair

In addition, the owner requires 100% ANSI approved safety glasses for eye protection at project site.

5.4.1 Site Specific Safety Plan:

Any constructor that has a direct contractual agreement with OPP must submit a site specific safety plan to the owner before their first pay application to receive payment for the work performed. This means that in the CMA project all seven Prime Contractors had to separately submit their site specific safety plan to the owner; whereas, in the CMR project only the Construction Manager was required to submit a site specific safety plan to the owner, in order for their first pay application to be processed.

5.4.2 Safety Incentive Programs

Neither of the projects had a safety incentive program. In the case of the CMA project, the state funding source does not allow the use of contractor incentives with state money. For the CMR project, there were no explicit restrictions, but OPP has not previously used incentives on projects.

5.4.3 Safety Audits, Inspections, and Reporting

CMA Project (Project A): Under, "Safety Responsibility of the Construction Manager", the CM Agency was required "… to make regular and complete inspections to check safety precautions and programs in connection with the Project." The CM Agency was required to inspect the trade contractors' jobs on a weekly basis. The safety walks were usually done with the presence of the superintendent and the trade contractors. Since the CM Agency is essentially serving as an onsite consultant and monitor for the owner, the need to define the contractual safety review procedures is greater than in the case of a CMR project.

CMR Project (Project B): The CMR project had similar safety inspection reporting requirements as the CMA project. More specifically, the Safety Director of the Construction Manager was required to pay monthly visits to the job site and submit monthly safety report to the owner. The weekly safety reviews was not specifically stated.

5.4.4 Incident/Accident Investigations, Reporting, and Record Keeping

In Project A, the CM should immediately advise the owner of possible hazardous or toxic materials on the site. The work in the affected area should not be resumed until the hazard is removed by the owner.

6. CONCLUSION AND FUTURE WORK

The goal of this study was to provide owner construction safety best practices through a review of the literature and safety requirements of 15 university owners for comparison to Penn State's safety practices. The intent was to pilot the ability to compare and profile an owner agency's level of safety involvement. This study is not a replacement to the current owner safety practices. It highlights owner safety practices during different stages of a project to improve construction project safety outcomes. In particular, Penn State's practices were very closely aligned with many of the surveyed owners, though found notably limited in the areas of prequalification of contractors, designer involvement in safety, contractor safety program, and use of incentives to improve construction safety.

This study contributes to the current body of construction safety knowledge by building on the concept of "six-step safety program" developed by Gambatese (2000a). The involvement of owners in safety during different stages of a project poses added value to the safety of construction workers. Rigorous safety requirements in the contractor pre-qualification process can reduce the construction risk by avoiding unsafe contractors on the job sites. The results showed variability in owner safety requirements. It was also found that implementation of Design for Safety in construction projects is in its infancy in the studied universities. The findings of this study can be utilized to define the framework for a comprehensive owner construction safety program.

It is important to note that this study was based on the university's publically available information. This limited the number of documents reviewed in some categories. For future work, the authors recommend that researchers contact the universities and ask for their standard documents. This can result in a more complete database of documents and more accurate results. Also, as a future work, more project delivery methods, such as, Design-Build, Single Prime, and Job Order Contracting can be studied to identify consistency in the owner safety requirements and practices. Further work will also explore the process for implementing design for safety review opportunities and the potential challenges and impact it has on safety during the construction process.

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REFERENCES

Gambatese, J.A., 2000a. Owner Involvement in Construction Site Safety. *Construction Congress VI*, ASCE, 278: 661-670.

Gambatese, J.A., 2000b. Safety Constructability: Designer Involvement in Construction Site Safety. *Construction Congress VI: Building Together for a Better Tomorrow in an Increasingly Complex World*, ASCE, Orlando, FL, USA, 650–660.

Hallowell, M., Hinze, J., Baud, K., and Wehle, A., 2013. Pro-Active Construction Safety Control: Measuring, Monitoring, and Responding to Safety Leading Indicators. *Journal of Construction Engineering and Management*, ASCE. (accepted)

Hinze, J.W., 1994. A Study of the Construction Activity Projections for 1994. Merit Shop Foundation, Washington, DC, USA.

Hinze, J.W., 1997. *Construction Safety*. Prentice-Hall, Upper Saddle River, NJ, USA.

Huang, X. and Hinze, J., 2006. Owner's Role in Construction Safety. *Journal of Construction Engineering and Management*, ASCE, 132: 164–173.

Levitt, R.E. and Samelson, N.M., 1993. *Construction Safety Management*. 2nd ed., Wiley, New York, NY, USA.

Levitt, R.E. and Samelson, N.M., Mummy, G., 1981. *Improving Construction Safety Performance: The User's Role* (Technical Report No. 260). Stanford University, Stanford, CA, USA.

Liska, R.W., Goodloe, D.W., and Sen, R., 1993. *Zero Accident Techniques: A Report to the Construction Industry Institute*. CII, Austin, TX, USA.

Nelson, E.J. and Haggard, R., 1993. *Zero Injury Techniques*. CII, Austin, TX, USA.

Rajendran, S. and Gambatese, J.A., 2009. Development and Initial Validation of Sustainable Construction Safety and Health Rating System. *Journal of Construction Engineering and Management*, ASCE, 135: 1067–1075.

Szymberski, R., 1997. Construction Project Safety Planning. *TAPPI Journal* 80, 69.

Ulang, N.M., Gibb, A., and Anumba, C.J., 2009. Communication of Health and Safety Information in Construction. *W099-Special Track 18th CIB World Building Congress*, CIB, Salford, UK, 265-277.