How Do Project Manager's View Construction Safety in Australia versus the United States?

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Abstract:

This paper investigates differences between the safety cultures in the United States and Australia from the viewpoint of constructor project managers. The authors conducted interviews with the project managers on three large construction projects in both countries to qualitatively examine differences of how safety is considered throughout the construction project lifecycle. The results indicate that while constructability reviews during the design phase occur in both countries, safety is considered as an explicit factor in constructability reviews in Australia, while in the United States safety is considered after this review is completed. It is contended that this difference has a major impact on safety culture.

Keywords: construction safety, safety culture, occupational safety and health

1. Introduction

Australia is generally considered to perform better in regard to occupational safety and health in the construction industry than the United States as evidenced by fatalities per 100,000 workers and other indices (Safe Work Australia 2010; BLS 2010). There are a variety of factors that differ in the two countries, such as greater project involvement by unions and more stringent legislation concerning safety procedures in Australia than in the United States. This has led to differences in the safety attitudes within the construction industries of the two countries. Exploration of these differences could lead to a better understanding of why these differences exist, and generate knowledge that can be used to improve occupational safety and health (OSH) performance in the United States.

An active concern for worker safety during the design phase of a project and management's commitment to safety have both been described as major influences on

construction site safety (Mohamed 2002; Hecker and Gambatese 2003; Behm 2005). The project manager on a construction project is in a unique position, as he or she is many times involved during the design phase of a project and is often the top level of management on site during a project. This paper compares the initial perceptions of construction safety between Australia and the United States project managers (PM's). Three project managers were interviewed in each country to collect viewpoints on how safety was considered during the design phase of a project and the impact of decisions on safety during the lifecycle of the project.

Safety in Design

Safety consideration in the design of a construction project is a growing concept in the construction safety field, and can have a significant effect on the hazards that are present on a construction site. Prevention through design is a major component of the National Occupational Research Agenda (NORA) in the U.S. One project found that 42% of fatalities in a study were linked to decisions made during the design phase (Behm 2005). Research collecting data from designers and contractors has detailed numerous examples of decisions made during the design phase of a project that positively impacted construction worker safety through site layout, access points for work, design changes, stairways, location of material, walkways, fall protection, guardrail height and locations, and utility locations (Hinze and Wiegand 1992; Gambatese, Behm et al. 2005; Weinstein, Gambatese et al. 2005). Implementing these design modifications and tools through education, training, and legislation can increase safety visibility throughout the entire supply chain of a project, and ultimately lead to safer working environments for construction workers (Hecker and Gambatese 2003).

Time/Safety Influence Curve

The time/safety influence curve is shown in Figure 1, and illustrates the impact that design can have on safety compared to other supply chain phases (Szymberski 1997). In the U.S., construction worker safety is primarily left to the constructor. The primary consideration for this position is to avoid the liability that can be associated with dictating the "means and methods" of construction as currently assigned to the constructor by contract (Hecker and Gambatese 2003). While architects are hesitant to address these issues, identification of hazards earlier in the construction lifecycle can have a greater impact, because the hazards can possibly be eliminated or controlled more effectively than using PPE and other methods that are usually utilized during the construction phase (Behm 2005). Significant safety improvements gained from focusing on safety earlier in the lifecycle will not only increase the perception of safety in these stages, but also in the construction phase with the partnerships that these initiatives create (Hecker and Gambatese 2003).

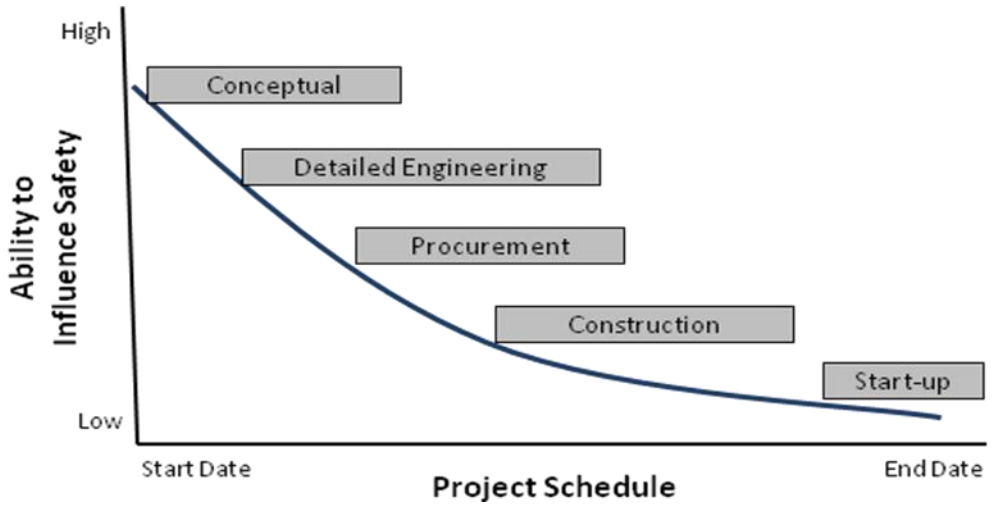

Figure 1 Time/Safety Influence Curve (Szymberski 1997)

Hierarchy of Safety Controls

The hierarchy of safety controls is another framework that illustrates how hazard controls are more effective in earlier versus later stages of a construction project. A depiction of the hierarchy is shown in Figure 1.2 (adapted from SA 2007), and the main concept behind the hierarchy is that control methods are potentially more effective, protective, and cost-effective from top to bottom of the hierarchy (NIOSH 2010). The controls at the top of the pyramid are normally associated with design aspects earlier in the delivery of a construction project. Therefore using this approach can lead to more emphasis and procedures for focusing on construction worker safety during the design and engineering stages of a project by eliminating potential hazards (engineering controls) versus trying to control them with administrative controls (Gambatese and Hinze 1999; Behm 2005; Gambatese, Behm et al. 2005).

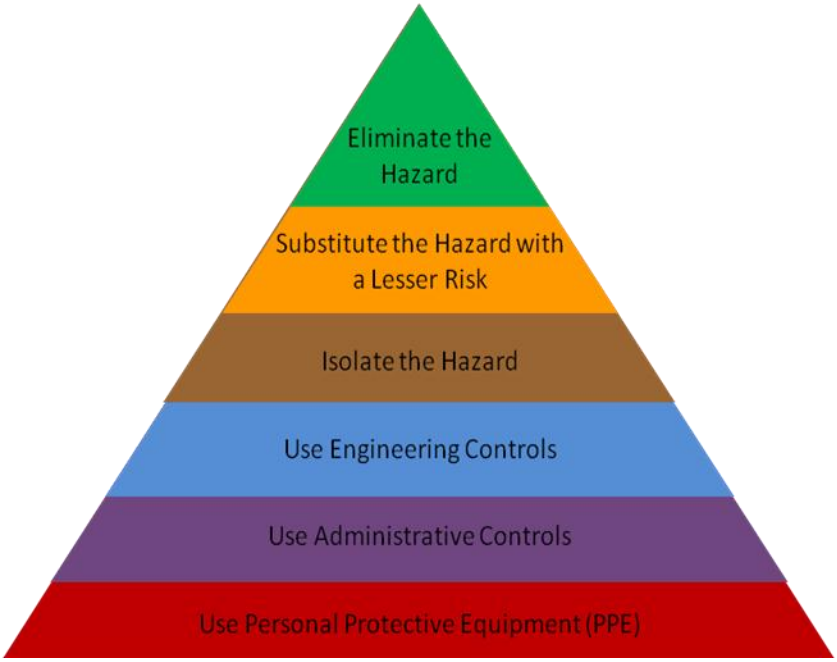

Figure 1 Hierarchy of Safety Controls (adapted from SA 2007)

Management Commitment to Safety

Several studies have found that management's commitment to a safety is one of the most important factors affecting the success of an organization's OSH program (Zohar 1980; Jeselskis, Anderson et al. 1996; Flin, Mearns et al. 2000), and that workers also view management positions as the most safety critical (Dingsdag, Biggs et al. 2008). Other work has shown that construction site safety initiatives that have more management support and commitment are more effectively implemented than ones with less management engagement (Duff, Robertson et al. 1994; Lingard and Rowlinson 1998). The most important initiative that management can be committed to in order to improve the success of safety programs is increased communication in regards to OSH (Marsh, Davies et al. 1998). This communication allows management to learn what factors workers perceived to be the most important blockages to increased safety performance. Taking action on removing these blockages on a consistent basis has also been shown as a factor on the level of commitment that workers perceive (Hinze 1996; Gittleman, Gardner et al. 2010). Taking action shows that management is committed to improving OSH, and workers are more willing to support OSH programs when they perceive that management listens to their concerns and is genuinely concerned about their personal safety (Langford, Rowlinson et al. 1993).

2. Projects Overview, Data Collection and Research Methods

Australia Projects

The project managers that were interviewed in Australia were all involved on urban projects in the state of Victoria that were $100+ million (AU) in cost. The constructors on these projects were all major commercial builders with extensive experience with large construction projects. The projects and their procurement methods are as follows:

Table 1: Australia Projects

Project Number	Industrial Sector	Delivery Type	Size
1	Commercial (residential high-rise)	Traditional (design-bid-build with CM @ risk with preconstruction services contract)	Large (48-story residential tower with 412 units)
2	Commercial (academic low-rise)	Design-Build	Large (10-story, 370,000 square foot building)
3	Commercial (civic low-rise)	Alliance (Collaborative)	Large (2300+ seating capacity theatre)

United States Projects

The project managers interviewed in the United States were also all involved on large projects in excess of $20 million (US), and were all located in the Southeastern United States. These constructors are all comparable to the constructors in Australia in size and experience managing large construction projects. The projects and their procurement methods are as follows:

Table 2: United States Projects

Project Number	Industrial Sector	Delivery Type	Size
1	Heavy Construction	Traditional (design-bid-build with CM @ risk with preconstruction services contract)	Large (6 million gallon wastewater overflow tank)
2	Commercial (mixed-use low-rise)	Traditional (design-bid-build with CM @ risk contract)	Medium (5 story, 91,000 square foot building)
3	Commercial (civic low-rise)	Accelerated (Fast Track with guaranteed maximum price)	Large (25,000 seat football stadium expansion)

The projects were chosen for the Australian case studies based on opportunity samples while the primary American researchers were located in Australia. The United States projects are all participating on a larger research project funded by NIOSH, and were chosen because they were the most similar to the Australian ones in terms of industrial sector, delivery type, and size. The construction management organizations on all of the projects are large firms with extensive experience on large projects, and all have established safety management programs in place. All of these organizations are also corporations, and thus the authority structure above the project managers is somewhat similar.

Data Collection and Research Methods

Yin (2009) promoted the case-study methodology as the best approach to investigating how or why phenomena occurred and relationships among these phenomena. Accordingly, the research team used case studies to discover key relationships within the context of safety during the design phase of a construction project. The team began by collecting interview data through participant-observers, those individuals from firms who have knowledge of project delivery decisions and actions from concept to the current state of construction (Yin 2009). The team identified appropriate individuals for interviewing as those in the role of project manager of the construction phase. These PM's were also involved in early decisions of the project design and could attest to the influence of such decisions early on the project lifecycle. The team used criterion-based sampling processes (LeCompte and Preissle 1993) to solicit knowledge of safety decisions that were made during the project lifecycle that could not be obtained from other subjects (Maxwell 2005).

3. Findings

Australia

- Unions are very prevalent in Australia, and drive many safety initiatives because the general labor position is not to work unless the job is considered safe. Safety us generally very strong from the bottom up according to all three PM's.
  - PM on Project 1stated he tries to remove hazards as an excuse for not doing certain tasks so the focus on safety is high when determining construction methods during the design phase of the project.
  - Safety committees were present on all three projects, and were involved in ensuring the job can be done safely. These committees include management and workers, and at least 50 percent of the members must be employees. These committees are required by employers in Victoria if the required Health and Safety Representative for employees requests their establishment, and their goal is to create a healthy environment between management and employees (WorkSafe Victoria 2006). All three PM's said that the safety committee discussed important safety issues on the

project such as using fencing to surround exposed edges at heights and construction of the building core.

- Union workers cannot work in the rain or above 35 degrees Celsius (95 degrees Fahrenheit), so all three project manager's said that they took care to provide cover for these working conditions as soon as possible in the schedule. The Project 2 project manager said that they had spent almost $100,000 (AU) for covers at the site, but that this cost was more than offset by losing $50,000 (AU) for every day of lost work.

- All three project managers mentioned design phase workshops for safety in which the design documents were reviewed specifically for safety issues.
  - The scheduling of demolition was changed on Project 3 in order to allow large ducts to be removed using a different removal method than originally planned due to safety concerns.
  - Cages were used on Project 1 to allow the windows to be installed from the outside, but in a manner that allowed the workers to not be tied off to improve productivity. The cages surrounded the building and were self-pumping to rise up the building with the core, and used a wooden platform to allow workers to stand on the outside surrounded by the cage structure. This method was reviewed by the safety committee, and was developed during the design phase by a temporary structure engineer. This type of cage structure was also used on Project 2 instead of barriers at the edge of the building.
  - All three project managers were familiar with and discussed the hierarchy of controls from the safety literature (Behm 2005). The goal of eliminating or substituting a hazard versus mitigating risk with administrative controls was a central part of the safety workshops.
- Safety for maintenance after completion of the project was mentioned as part of the safety review during the design phase. The owner partner for Project 3 approved a design change to ensure that food shipments and delivery of sets for performances were separated so that they were not "running on top of each other".
- Laws in Victoria require all constructors and sub-contractors to develop job safety analysis (JSA) documents, have safety management plans, perform safety meetings, and have appropriate PPE.
  - Project managers all said one of their job responsibilities was ensuring that safety procedures were followed, but that subcontractors are all used to following these procedures due to regulations.
  - All three project managers felt that administrative controls such as PPE and JSA's were just part of the business, and did not see them as a practice within their safety programs that set them apart from others.
  - If an accident occurs there is the risk of liability if the hazard that should have been known was not identified on the JSA, and so all three project managers said focus should be taken to these are not completed casually.
- Constructability was cited as a large concern by all three project managers, but they all also said they consider the ability to construct safely when determining construction methods. Cost and schedule were mentioned by all three project managers as a major concern, but safety was considered as another factor prior to making decisions.

- Additional cost due to safety controls was present at all three sites. The PM on Project 1 said that this cost is basically reflected in the final price of each unit, and was included in the cost of the contract. He said that cost is a primary factor in all decisions, but that at times cost, quality, and safety can be improved together if construction methods are developed early that require less labor and eliminate potential hazards. (Note: Jointly "optimizing" multiple factors is a tenet of socio-technical approaches (Hendrick and Kleiner 2001))
  - The reinforced concrete core of Project 1 was an example (this type of core was also used on Project 2) of this concept. The constructor was pushed by the safety committee to find a safer way to construct the core and stay within budget.
  - The pre-cast floor sections of Project 2 were poured on top of the existing concrete slab on each floor then lifted out to the edge of the building to avoid workers pouring at the edge of the structure.
- Drawings for the facility were 5-10% completed when the constructor became involved on Project 2 and 3, and 60% on Project 1.

United States

- All three projects involved constructability reviews with the constructor during the design phase of the project.
  - Cost and schedule were the primary factors in these discussions according to all three project managers, but constructing safely was considered to be the responsibility of the construction management firm.
  - A design change on Project 1 was made to the excavation methods due to safety concerns. This design change was made outside of the design review process however, and was initiated by the subcontractor once they were brought onto the project.
  - The Project 3 project manager said that they considered safety during these reviews as to whether they could safely construct a design, but that this was not a formal part of the review. The roof type of the elevator shaft and the type of panels used on the outside of the stadium were changed during the constructability reviews due in part to safety concerns of the construction manager.
- The Project 2 PM said that the owner made it clear that the constructor was responsible for safety "inside the fence" and that safety was not discussed during the design phase. The owner was however concerned with the safety of the interaction between the site and general public users, and that was the focus of most safety related discussions.
- The Project 3 project manager stated that safety was left up to their firm. An example was that their firm took the lead in determining how the excavation for the largest set of seats would be undertaken because they knew the architect would only be concerned that it met the appropriate depth.
- The project manager for Project 1 was primarily responsible for the scheduling and cost, and there was a superintendent on the project that was at the same level organizationally that was responsible for construction issues.

- Dictating the means and methods to subcontractors and the associated liability was mentioned by the Project 1 and 2 PM's as an issue in determining construction methods to subcontractors.
- All project managers said that they included administrative controls such as PPE and JSA's requirements in their subcontracts because their safety management programs almost always exceeded those of subcontractors. Project 2 stated that if they did not make JSA's a subcontract requirement that the subcontractors would in most cases not provide them.

4. Conclusions and Next Steps

Collecting data from three project managers on large projects in Australia and the United States highlights differences in the safety attitudes and practices within the construction industries of the two countries. The Australian construction industry is exemplified by government regulations and unions that create a driving force to review safety at all stages of a project (including design). While factors such as cost and schedule are primary decision drivers in both countries, the data gathered for this paper suggests that safety is more of a decision factor during the design stages in Australia as compared to the United States. Can this be a major driver for fatality rate difference between the two countries? Constructability reviews are evident in both countries, but safety seems to be more of a lagging practice in the United States once the design and associated construction methods have been identified. The attitude that once the design is finalized then the constructor can figure out how to build it was much more evident in the United States than in Australia where the safety of building a proposed design seemed to be a factor on all three projects.

One small detail that the authors felt was indicative of the different safety cultures in the two countries was that Worksafe Victoria (a government agency) ran commercials on major TV stations that discuss that it is law to work safely and inspections are in work places every 12 minutes. This was not just for the construction industry, but highlights the importance placed on occupational safety and health in Australia. The projects at which data was collected were all large commercial projects, and all three project managers said that the measures in place would not be as strong in smaller projects with small subcontractors or in the residential market. This is also true in the United States, but the comparison between the sample projects still displays some potential differences in occupational safety and health attitudes and practices between the two countries. The main conclusion from the data that was collected for this paper is that the focus on safety in the design phase is more prevalent in Australia versus the United States. The focus on technological controls such as elimination and substitution was higher in Australia in the projects that were studied. In the United States, the project managers interviewed indicated that constructability was the main focus in design, and that the focus was on cost and meeting the schedule. All U.S. project managers interviewed felt that OSH concerns were left up to the constructor to figure out how to build the project safely once the design was completed. The next steps to better support the conclusions above is to expand the sample and collect quantitative data using methods such as

surveys to collect data on potential differences between the construction industries in the two countries.

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