Design, Development, and Deployment of a Rapid Universal Safety and Health System for Construction

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Abstract: Rapid construction projects and processes will become increasingly important as customers demand better project management performance and globally, as countries plan for and respond to the aftermath of natural and/or unnatural disasters. For use in expedited projects (as well as traditional projects), a rapid universal safety and health system (RUSH) was designed, developed, deployed, and evaluated. For its inaugural application, the RUSH was applied to a 106-hour construction project. Results from an initial application included a safe build in approximately 5 days without recordable incidents. More importantly, lessons were learned by a multidisciplinary team of researchers who observed safety 24/5 for the life of the project. Lessons learned and recommendations for future research are provided as a result of this experience.

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Introduction

Construction is characterized by several factors that present it as a challenging, yet strategically important, industry. Nothing is more vital to the infrastructure of a community or a nation than the ability to efficiently and effectively construct residential and commercial structures. While safety and health in construction is an international concern, the performance in the United States has been reported as worse than Europe. For example, in 2001, Europe had a fatality incidence rate of 10.4 per 100,000 (Karjalainen 2007), and for the same year, in the United States, there were 13.3 deaths per 100,000 construction workers (U.S. Department of Labor 2001). Traditional attention has been on a hierarchy of controls that includes personal protection, tool design, training, and external controls. Consistent with the systems safety view though, international scholars such as Dekkar (2005) deemphasize the need to place blame or assign cause, and emphasize the need to understand why people involved in safety incidents perceived the need to do what they did at the time.

Even more poignant is the situation that arises when time is compressed, as in response to natural or unnatural disasters. While specialized commercial applications, such as roadway and runway construction, have historically required rapid or so-called "fast-track" construction (Lee et al. 2005), effective and safe fast track or rapid construction has yet to be formalized for the building or rebuilding of structures. Levee breaches in New Orleans following a hurricane or destruction of entire Asian communities following a tsunami are dramatic examples of the need.

Within this context of a dangerous industry operating in a dangerous environment, there is expected to emerge increasing pressure to perform more efficiently and effectively. For example, the U.S. Army Corps of Engineers has established a new strategic direction for enabling capabilities to deliver products and services better, faster, cheaper, safer, and greener (U.S. Army Corps of Engineers 2006). In an industry that has struggled with project management performance, it is predicted that in response to natural and unnatural disasters, the expected over budget, behind schedule, and unsafe attributes often associated with construction projects will not be tolerated in the future.

Theoretical Foundation

The challenges posed by the 21st century are not completely unlike those resulting from World War II. Across Europe and Japan, vast devastation was a main remnant of a global war. As a direct response to this devastation, the Tavistok School of the United Kingdom created the sociotechnical systems model and approach to work system design (Hendrick and Kleiner 2001). This model serves as the theoretical framework for a work system analysis and design approach to overall construction safety and health.

Fig. 1 illustrates a basic construction work system model. A work system is comprised of two or more people interacting with technology designed within a management and organizational structure, operating within an internal and external environment (Hendrick and Kleiner 2001). In the case of a construction work

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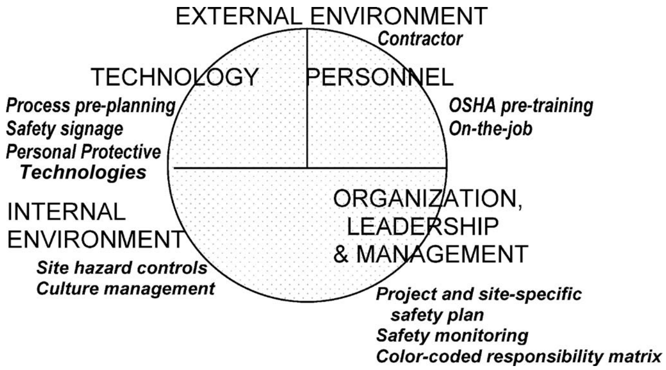

Fig. 1. Construction work system with major RUSH components identified

system, the technical subsystem is focused on the work performed. This includes the technology, such as heavy machinery and equipment, power tools, hand tools, methods, and procedures. The personnel subsystem is comprised of the sociocultural and socioeconomic characteristics of the construction workers, including selection and training.

The external environment is comprised of subenvironments, including political, economic, technological, educational, and cultural subenvironments. The internal environment in construction is conceptualized as the physical and cultural job site. Whether formalized or not, every work system also has an organizational and management structure (Kleiner and Smith-Jackson 2005).

Concept of a Rapid Universal Safety and Health System

The risks are assumed to be higher on a rapid build project as compared to a traditional project. A rapid build project is operationally defined as a project that is completed in days and weeks, when a comparable project historically would be completed in months and perhaps years. The risks are assumed to be greater for rapid build projects in part due to the expedited schedule and in part due to the resourcing characteristics. Regarding human resource management, such projects can be heavily resourced, requiring many more people to be on site at a given time as compared to the typical number and distribution of workers. In addition, trades typically accustomed to working sequentially, work concurrently in a rapid build environment.

The notion of a "universal" system is that the system is not limited to a rapid build project. It is contended that the principles and components of this system can be applied to any construction project. Although the case described here to validate the system is a residential project, it is also suggested that the system is potentially applicable to nonresidential projects as well.

Methodology

Planning Process

An opportunity to provide safety support in a rapid build project presented itself. A rapid universal safety and health (RUSH) system was designed and prototyped in the context of this opportunity. Unfortunately, the planning horizon to design and develop this system was only a couple of weeks. However, having little time to plan would also be a characteristic of a disaster-induced need to build quickly; thus, the experience provided a reasonable simulation of such an event. Rather than formally progress through standardized development methodologies such as macroergonomic analysis and design (MEAD) (Hendrick and Kleiner 2001), a more informal adoption of the sociotechnical framework was performed. It should be noted that one principle of sociotechnical systems design is to adapt design methodology to align with characteristics of the implementation. Rapid build thus required rapid planning! The actual project was scheduled to be a 106-hour job, from trees (i.e., demolition) to keys (i.e., completion). Fig. 1 illustrates the major components of the RUSH system that were developed and deployed. Each component will be briefly discussed in the context of its associated sociotechnical subsystem.

Organizational and Managerial Structure

Project and Site-Specific Safety Plan

Large, midsized, and many smaller construction firms possess company safety plans. For typical projects, such plans, with minor modification, may be used and are frequently considered adequate. However, it is suggested that rapid build projects are unique and possess specific characteristics from project management and construction perspectives. Therefore, this component of the system is concerned with the requirement to *develop a safety plan that is project and site specific and paced to the work plan*. Properly developed, the project plan should be aligned with the company (contractor) plan. This project-specific plan is detailed enough to address risks posed by the project, but generic and value centric enough that all subs and volunteer work crews can support and follow the plan.

Safety Monitoring

Another component of the system is the existence of on-site safety monitors/observers who facilitate the safety function during all working hours of the project. Building a 3000+ square foot residence in 106 hours makes this a firm requirement. This component of the system involves *proactive, positive, on-site facilitation of safety and integration of safety with efficiency, quality, and effectiveness*. Since all risks cannot be predetermined in construction, effective teams are useful during the project (Rahman and Kumaraswamy 2005). However, construction projects can often be characterized by transient or temporary "teams," since subcontractors and personnel within a sub's firm can change from project to project. This makes the development of a true, cohesive team culture challenging. Unless performed by established teams, rapid build projects simply do not afford the time necessary to mature a nominal group of subs into a cohesive team. Therefore, it was predicted that safety monitors could serve as the stabilizing, integrating mechanism to maintain a safe environment. In theory, this is not unlike the role of systems engineering in manufacturing. The safety monitor role was not one of enforcement per se, but rather a proactive and positive force to emphasize that the safety value was not inconsistent with the productivity value. In a rapid build project, productivity is the performance driver that supports the schedule and project completion objectives. Quality addresses all phases of the project and effectiveness is concerned with scope objectives (Kleiner 1997). Simply, safety should not trade off against efficiency, quality, and/or effectiveness. Certainly, should an incident occur on a project, the schedule will be adversely affected. However, even in a steady state condition, proper safety can and should lead to greater efficiency, quality, and effectiveness, although most con-

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struction workers (and many managers) really do not believe this mantra. This cultural need will be addressed shortly.

Site Responsibility Matrix and Organizational Design

A rapid build construction project, at least a 106-hour project, is a cross between an old fashioned barn raising and a battlefield. Depending upon the application, the project could involve trades and others not normally accustomed to working with one another. In addition, again, depending upon the application, inexperienced volunteers could also be integrated into the resource pool. With respect to project management, but especially with respect to safety, *a clear authority hierarchy should be designed before the project begins*. This, like the other components of the RUSH system, should be detailed in the project/site-specific plan. A typical structure might include workers, leads (i.e., of trades), superintendents, and a project manager. Others, such as safety personnel, should be part of the structure. Such support personnel would support the superintendents and/or project manager.

In a rapid build project, all workers should be empowered to raise risk concerns to the authorities. If a level of concern exists, any employee should be able to stop work proactively until the matter is investigated and resolved.

Technical Subsystem

Safe Building Process Preplanning

Design decisions made during conceptual and preliminary design can greatly affect subsequent building process. Thus, ideally, building processes should be considered during the design phases. Even if building process is considered late in the process, there are often alternatives regarding how a particular architectural design is executed. This component of the system is concerned with the *need to provide building process input as early in the design process as possible and ensure the process as safe as possible*. The major project-specific safety hazards can be identified at this time and form the basis for safety awareness and risk mitigation consciousness. These major hazards can then be passed forward to the safety signage and job aids foci.

Safety Signage and Job Aids

In a systems safety approach, the focus is on changing (i.e., designing) the system to minimize risk and maximize performance and well being of the workers. Training is viewed as an important support function, but it is mostly an off-line function. This RUSH component addresses the *need to provide on-the-job support*. Signage is one way to reinforce the knowledge learned in training and to reinforce the values inherent to a safety culture. Signage should not be patronizing or presumptive, giving the impression that workers intentionally commit unsafe behavior or cause accidents. General reminders that safety is important are especially valuable in a rapid build environment in which it would be easy to neglect safety and health in favor of expedition. In addition, specific effective warnings regarding specific equipment risk are also vital to a safe environment. An effective warning sign captures attention, communicates the hazard, consequences if exposed to the hazard, and provides instructions to avoid the hazard or presents protective measures (Wogalter et al. 1999). Beyond signage, job aids can be provided to support workers, superintendents, safety personnel, and unskilled volunteers.

Personal Protective Technologies

Proper personal protective technologies (PPE) is vital in a rapid build environment in which risks are increased. As previously mentioned, these risks are increased due to the expedited schedule and due to the fact that trades that normally work sequentially, can work in parallel in a rapid build environment. While hard hats have been generally accepted in construction cultures (albeit worn incorrectly in many cases), other PPE have not been similarly embraced. For example, steel-toed boots, ear plugs or muffs, safety glasses or goggles, proper gloves, and respirators are critical in a rapid build environment.

Personnel Subsystem

Occupational Safety and Health Training

Training to support the safety function is a vital component of the system. Under the auspices of the lead builder, the subcontractors should receive training to compliment the project-specific safety plan. In particular, subcontractors who will be working in an unusual concurrent workflow with other subcontractors need to be briefed on overhead, noise, chemical, and particulate risks they would not normally encounter or be equipped for protection. In addition, the on-site safety monitors should be OSHA certified. This component of the system involves the *need to provide safety training to the contractor, subcontractors, and safety monitors*. Once a rapid build project is underway, safety is at risk of being ignored or forgotten so the more training can embed safety into processes and into project management, the better.

Many rapid build projects make use of volunteer, unskilled laborers. Since it is assumed there would be no opportunity for advanced training of such helpers, the important need to train them is discussed as an on-the-job training (OJT) issue. Additionally, subcontractor workers, many of whom could be day laborers, should be briefed on site.

On-the-Job Training

Traditional training is usually an offline affair. In a rapid build project, there may be workers who are unaccustomed to rapid builds and who missed the offline training. In addition, naïve volunteers may be on site and as was the case in this project, media and/or dignitaries could be present if the project has high visibility. These two constituencies are examples of personnel who would need on site, "just-in-time" training.

Internal Environment

Site Hazard Controls

Traditional controls and safeguards, such as taping hazardous areas, using appropriate scaffolding, and tying off workers, are not to be ignored in rapid build projects. In fact, such controls are even more vital due to the increased number of personnel on site and due to the potential number of naïve volunteers working along skilled laborers. Safety personnel or other support people can help with such activities, including the removal of trip/fall hazards that occur due to the dominant mindset for production.

Safety Culture Management

The construction industry is changing demographically. It has been established for example, that the number of Hispanic workers is increasing and that Hispanic workers experience more accidents and fatalities than any other ethnic group (Brunette 2004). In addition, as previously mentioned, rapid build projects are expected to utilize volunteers. In addition to the ethnic and language diversity exhibited by the skilled workforce on a site, volunteers add gender, age, and experience diversity. From a safety stand-

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Table 1. Frequency Table for Survey Responses

	SA+A
Valuable having safety people	91%
Valuable having different colored hard hats	93%
Important knowing how a building will be constructed for safety	98%
Valuable having safety banners and decals on hard hats	91%
Important having safety measures for unskilled volunteers	98%
Important having appropriate PPE	100%
Valuable having safety leads provide a safety briefing to the unskilled volunteers	93%
Safety was considered important on this project	95%
Important having typical safety controls	91%
Valuable having safety people help with directing traffic	96%
Cameras were a safety reminder	47%

Table 2. Project Performance Compared to Expected Incidence Rate

Project total number of nonfatal work-related injury and illness cases	Calculated project incidence rate	VA private industry–residential building construction total incidence rate (2005)[a]
0	0	4.5
1	1.17	
2	2.33	
3	3.50	
4	4.66	

[a]Source: http://data.bls.gov/IIRC/calculate.do (Code: 236100).

point as indicated earlier, the existence of novice volunteers, irrespective of cultural orientation, creates risk. This component of the project is concerned with the *need to support the diversity and culture on the site*. Since culture (as opposed to climate) requires time to develop, achieving a safety culture on an expedited project is a major challenge.

External Environment

The sociotechnical systems literature suggests that the external environment could well be the most powerful of the subsystems (Hendrick and Kleiner 2001). In a rapid build construction context, a supportive builder is perhaps the most important component of the external environment if safety is to be one of the core project objectives. That is, unless the builder and therefore, project manager, believe in safety and drive the process, the safety system will break down. Embracing safety as part of the solution, not a problem to overcome exemplifies safety as a core value and offers positive influence on the external environment. Leadership in fostering project values leadership is also known to be a key factor in developing a desirable culture (Schein 1985).

Results and Discussion

Application of a RUSH System

The authors had the opportunity to design, develop, deploy, and evaluate a prototype RUSH system on a unique project. The project had the objective to design and build an "over the top" house for a deserving family with donated labor and materials in under 106 nonstop hours. The project was also to be implemented in the month of December, in a part of the country in which the weather is characteristically variable during late fall-early winter. "Extreme safety" was the name given to this application of the RUSH system.

Health and Safety Performance Results

As reported in Kleiner et al. (2006), a survey was administered a few weeks after the project to formatively evaluate the system. As illustrated in Table 1, apart from the camera item, which was included due to the suggestion by some that webcam monitoring might be an effective safety control, all items received relatively high scores by 57 respondents.

A relatively high internal consistency was achieved with a Chronbach's alpha=0.74. Since 14 out of 57 respondents identified themselves as safety team members, the Wilcoxon Mann–Whitney Test was applied. The two samples differed only with respect to the number of hours spent on site ($p=0.0299$), the perceived helpfulness of on-site orientation ($p=0.0002$), and hard hat color ($p=0.0147$). For all other items, there was no statistical difference between the groups.

In terms of safety performance, there were no major incidents. In fact, given the number of person hours compressed into 106 project hours, there was ample opportunity for accidents, injuries, health maladies, and fatalities. Several hundred workers constructed this residence. In addition, dozens of unskilled volunteers populated the site at any give time. Further creating pressure, spectators and other distractions (e.g., media crew, onlookers) were evident.

To evaluate health and safety results, total person hours was estimated given the total number of workers and average number of hours worked as reported in the survey findings. While there were no recordable incidents on this project, one individual had hypothermia-like symptoms from prolonged sock wear. With 4,200 workers and volunteers on this project, it is possible there were other minor unreported symptoms. Therefore, taking a conservative approach, Table 2 reports the incidence rates for a hypothetical number of cases in the event that there were cases that went unreported, although with the existence of safety monitors 24/5, this is considered unlikely. The data are provided to illustrate that the "breakeven" point would be between three and four cases to match the published expected incidence rate for the geographic area. With no official "recordables" and at worst a few minor symptoms, health and safety performance on this project can be assumed to be respectable.

While the safety team was not able to implement the planned RUSH system completely, it is respectable that no serious incidents resulted on this project. It is also instructive to evaluate what worked and why and which aspects of the system could not be implemented and why this was the case. Unlike a formal experiment, implementation followed an action research paradigm where subtle adjustments to the system were made in real time to minimize risk. Discussion of implementation and associated lessons learned and real time modifications follows.

Organizational and Managerial Structure

A clear and visible authority structure was established and symbolized through hard hat color. Workers (both skilled and unskilled), including volunteers, wore white hats. Trade leads wore

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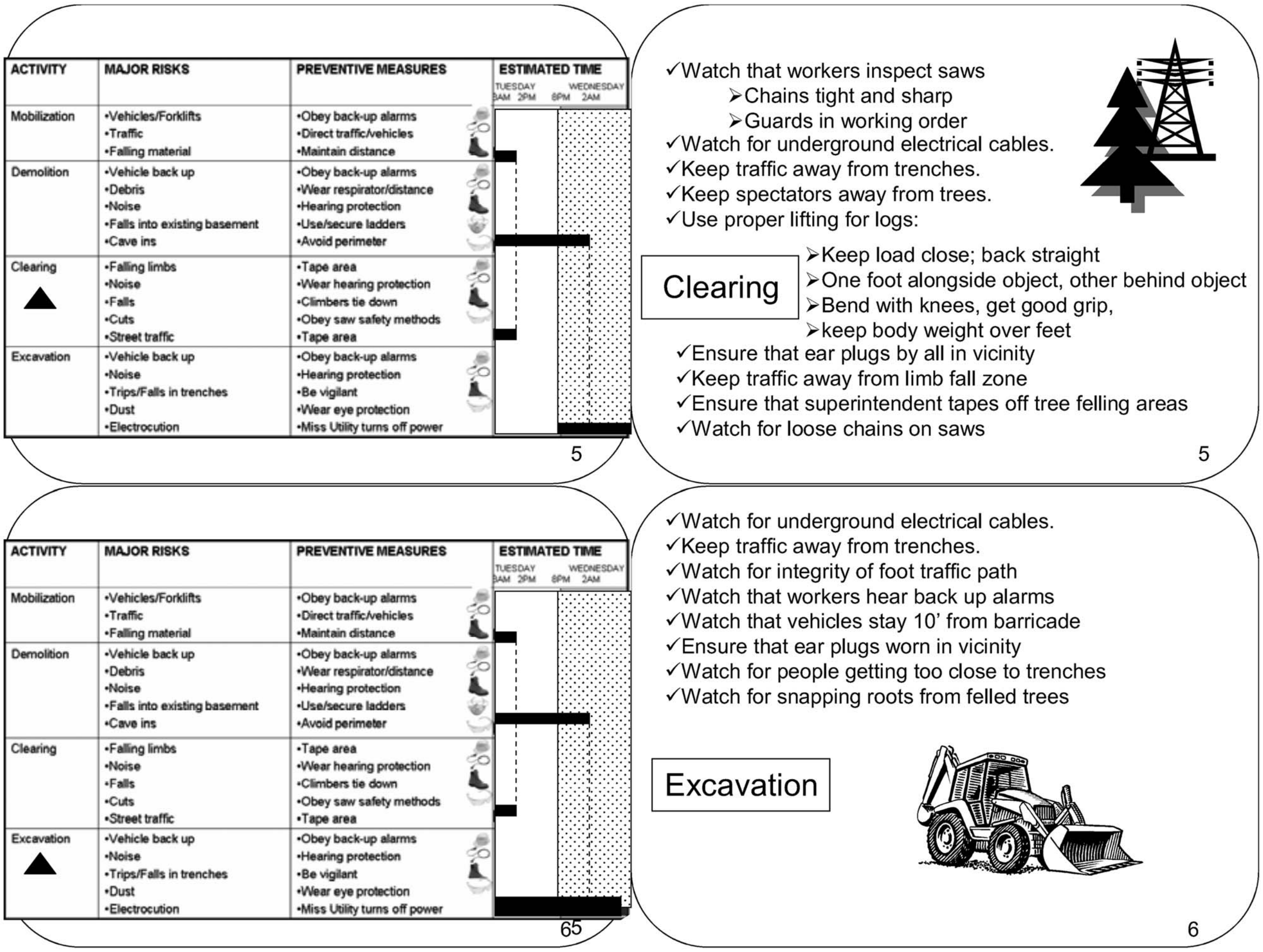

Fig. 2. Sample monitoring cards

yellow. Superintendents and the project manager wore blue and the team of safety monitors wore orange. In addition, a special decal was designed for the orange safety hard hats that read, "VT Extreme Safety" as a visual reminder of the safety value and objective.

In the case of this project, there were really two projects simultaneously managed—a construction project and a media production. The Blue Hats and key production personnel wore wireless headsets. In safety pretraining and in the safety plan, it was stated that everyone was empowered to contact anyone with a headset should a serious safety issue occur. The plan was that anyone with a headset could, through the wireless communication network, shut down the entire site until the situation could be resolved. In addition, fire and rescue as well as a sponsor medic, were on site at all times. While initially, a safety lead was supposed to be wired into the communication network, this did not occur. An adjustment made was for him or her to physically be in regular contact with personnel who had headsets.

A team of 50 faculty and upper level students was created to serve as safety monitors for the project. Faculty hailed from several departments—building construction, civil and environmental engineering, forestry, and industrial and systems engineering. Students were seniors and graduate students from these departments. Safety team members received the safety plan and training (see personnel subsystem).

External Environment

The beneficiary for this project was the homeowner, but the homeowner was not the customer in the traditional sense of the term. In actuality, it was the sponsor driving the schedule. The "supplier" in the system was the contractor. In essence, the university safety personnel provided safety function support to the contractor. Comparable to working in a matrix organizational environment, flexibility was required due to the concurrent existence of multiple supervising authorities. As a systems integrator, the safety lead would contact both the contractor and media leads if directions conflicted or were perceived contributors to risk.

Technical Subsystem

An attempt was made to design a safe building process. This involved having the building process specialists work with the architects so that design and building were considered concurrently. The team reviewed designs as they developed where it became apparent that the steep roof pitches critical to the design posed a significant risk for falls. As the schedule developed, the wall panels were to be in place 6 h after the slab was poured. To enhance productivity (maximize the number of concurrent construction processes underway during all phases of the project), the team proposed assembling the roof trusses, roofing paper, and shingles on the ground, and lifting the larger, stable assemblies onto the braced wall panels. The designers supported this effort

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Table 3. Prospective Research Questions

RUSH component	Research question	Potential methodology
Safer building processes.	What are more effective ways to perform concurrent engineering/design with architects/engineers/builders?	Survey methods.
More effective signage.	What is the best way to integrate signage into a system safety approach versus a behavior-based approach?	Field experimentation or quasi-experimentation, ethnographic, and observation methods.
More effective safety planning.	What are the best methods for designing and achieving adoption of project safety plans?	Survey methods, focus groups, evaluation research.
Achieve safety culture more efficiently.	How can safety cultures be achieved on short-term projects?	Survey methods, focus groups, interviews, observations.
Achieve better safety statistics.	Which environmental factors are drivers of safety and health (or lack thereof)?	Surveys, interviews, focus groups, archival research.
Achieve better personnel/system interaction.	Which training content and methods are most likely to achieve success rapidly?	Evaluation research, field experimentation.
Better adoption of PPE.	How can design of PPE and culture be changed to improve compliance?	Lab and field experimentation, surveys, focus groups.
	How can PPE be redesigned to allow quick change overs?	

by designing the roof assembly to include glue-laminated beams below the trusses to act as strongbacks supporting and aligning the trusses above with the walls below. A late change from the sponsor eliminated these beams and rejected the preassembly of the roof on the ground. During construction, it was perceived that this decision contributed to delays and increased the risks for both the truss and roofing crews, as well as the plumbing and electrical crews, who were forced to work below the roof during truss installation.

The project also included a small outbuilding to be built on the same site as the main house, and an offsite business space renovation. The safety team assisted the design team with preparations for off site prefabrication and on site preassembly operations by reviewing provisions for temporary structures, bracing of wall and column elements for roof installation, and on site power and PPE availability for their student-based build team. Thanks to autonomy for this part of the project, this in-process collaboration was successful in integrating process efficiency and safety, while meeting quality and design goals.

The offsite project was proposed by the sponsor, days before commencing the build. Rapid assessment of the existing building condition for hazardous materials, leadership by the head of the building construction department at the university, and the use of experienced students drawn from the building construction graduate and undergraduate program allowed design, safety, and production to be efficiently integrated.

For the residential portion of the project, workers, trades, and volunteers all checked in at a centralized location. A simple sign that read, "SAFETY," was placed immediately behind the check-in table as a visual reminder of a core site value. In addition, the "VT Extreme Safety" decal was located on the orange safety hard hats worn by safety team members. Three additional safety banners were located on bicycle barriers, along side other company banners.

A monitoring schedule was created to provide a minimum of one faculty supervisor and two student observers on site at all times. The schedule was staggered to allow overlap of on-site personnel for monitoring continuity and passage of critical information. To support safety team member training, OJT materials were developed. These materials consisted of 5×7 in. laminated cards with risk mitigation information provided. Risk and PPE per stage of the project were printed on the cards (see Fig. 2). Cards were color coded. A schedule was created to provide a minimum of one faculty supervisor and two student observers on site at all times. The schedule was staggered to provide continuity throughout the nonstop round-the-clock build period.

Personnel Subsystem

Given the short planning horizon, a pre-OSHA certification course was created and delivered to safety team members. In an abbreviated, yet focused manner, most of the relevant content from the OSHA ten-hour course was covered. As discussed previously, the training program was supported by OJT materials and process. A progressive-part training scheme was employed in which the trainee learns the content on the first card, moves to the second, returns to the first, studies 1–2, then on to the third card, etc. (Kleiner and Drury 1993).

Generally, the tasks designed during the planning phase were executed during implementation. However, additional, important, and time-consuming tasks or task durations were added as the project unfolded. In particular, the need for traffic control was much higher than envisioned initially. Just-in-time deliveries and heavy equipment usage with so many workers and volunteers on site required several safety monitors to serve as traffic control personnel. In addition, two winter storms necessitated that safety personnel lead efforts to clear ice and snow, which caused risky conditions.

Internal Environment

To create a safety culture, a variety of strategies was employed. Since culture, as contrasted with climate, is a more pervasive phenomenon, it could be argued that in a five-day rapid build project, it would be impossible to create a "culture" of any kind, let alone a safety culture. Therefore, it was decided to build upon the safety culture already established at the contractor's firm and then attempt to extend the inherent values to subcontractors and others who also worked on the project. The project leaders (president, project manager, and superintendents) stressed the importance of safety on the project. The signage also reminded workers of the safety value, and training provided the specific skills and knowledge to create and maintain a safe environment. As a real time, continuous reinforcement of safety values and

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practices, safety team members "patrolled" the site offering PPE to unprotected workers and encouraging safe practices. The safety team members were trained to communicate reinforcement or suggestions in a manner that did not alienate construction workers on site. The safety team, wearing orange hard hats marked maintained high visibility 24 hours per day. This presented a dynamically and usable on-site safety presence. Safety controls and the other interventions previously discussed completed the system.

Future Research

Unfortunately, many still maintain the attitude that safety trades off against timeliness and other project management metrics. This project demonstrated that a remarkable schedule can be achieved without safety incident. The project also demonstrated that unskilled volunteers can be integrated into the worker pool safely. However, the exact relationship between safety and other aspects of performance (e.g., schedule and cost) is still unknown, especially for rapid build projects. Within each of the system component areas, more research is needed. A sample of prospective research questions appears in Table 3.

Preplanning and planning for safety in the future will require better integration between architects, engineers, and builders. The optimal kind of signage to support a systems safety perspective should be researched. Better adoption methods for safety plans is needed. Creating a simulated safety culture on short-term projects is an interesting domain of inquiry. A better understanding of environmental drivers for or against safety in rapid build projects can help with future design and implementation. To support rapid build safety, off-site and OJT methods can be improved further. Finally, PPE in general and in particular, PPE for rapid build environments, can be improved. Of particular note is the need to communicate efficiently and effectively in such environments (Grugle 2001).

Conclusion

In recent times, many natural and unnatural disasters have been experienced internationally. Hurricanes Katrina and Rita in the United States left structures within a vast region of the United States either partially or completely destroyed in 2005. The tsunami of 2004 resulted in devastation to many countries across the Pacific Rim. The events of 9-11 are symbolic of the impact to physical structures associated with unnatural or "human-made" disasters. What all of these disasters have in common is a need that at present cannot be met by general construction process, management, and culture. That need is to rapidly design, develop, and deploy construction projects in such a manner that the process is as safe as it is fast. As evidence of these trends, an excerpt from the U.S. Army Corps of Engineers' new strategic directions includes, adopting an "expeditionary mindset," which is defined as the need to "adopt a cultural attitude that recognizes that we will be called to deploy around the globe, often with little notice, to support wartime or disaster recovery requirements" (U.S. Army Corps of Engineers 2006).

The need for speed is also apparent when considering the size of the residential crisis related to poverty. According to Habitat for Humanity (2005), 5.1 million American families have "worst-case" housing needs defined as the need to pay more than 50% of their income for housing. Conditions in these dwellings are often unsuitable and inhumane. Affordable rental alternatives and government assistance do not seem to be solving the problem (Habitat for Humanity 2005). Internationally, an estimated 2 billion people live in poverty housing with 1 billion living in urban slums. According to Habitat for Humanity (2005), this figure is expected to reach two billion people by 2030. Therefore, there is a systemic need to do more. Since time pressure has been shown to lead to accidents (Greiner et al. 1998), a systematic and comprehensive approach must be taken.

Rapid build projects are, therefore, important strategically and socially. As demonstrated on a 5-day rapid build project, through a rapid universal safety and health (RUSH) system, a rapid build construction project can be as safe as it is productive.

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