University Dining Hall

Commercial Design-Bid-Build

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Myers-Lawson School of Construction at Virginia Tech

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1. Case Study Method

The Project Case Study Method involves an in-depth examination of a single project, the case. It provides a systematic way of looking at events, collecting data, analyzing information, and reporting the results. Case Studies are one of the most effective tools you can use to promote best practices and cost-effective, experiential training. A recent search on Google.com for the term "case study" showed over 15 million hits. Of those hits, almost 750,000 hits included references to Java, which demonstrates a phenomenal uptake in the IT industry. Like its close cousin the White Paper, case studies appear to be growing in popularity every year.

1.1. NORA Goal 10

This Case Study was developed under a Cooperative Agreement with NIOSH in support of the National Occupational Research Agenda (NORA), Goal 10. Goal 10 is concerned with improving understanding of how construction industry factors relate to injury and illness outcomes; and increasing the sharing and use of industry-wide practices, policies, and partnerships that improve safety and health performance (NIOSH, 2013).

More specifically, the aim of NORA Goal 10.1 is to: Analyze how construction industry complexity and fragmentation can affect safety and health performance. Evaluate safety roles, responsibilities, interactions, and oversight among the multiple parties involved with complex construction projects. Address regular and accelerated construction project lifecycles. Identify obstacles and opportunities for improving system performance.

National Institute for Occupational Safety & Health. (2013, April 24). "NORA Construction Sector Strategic Goals." Retrieved from http://www.cdc.gov/niosh/programs/const/noragoals/Goal10.0/

1.2. Case Study Design

The research adopted a comparative case study approach (Yin, 1994). Data were collected from a total of 23 construction projects, 10 in Australia/New Zealand and 13 in the United States of America. For each project, features of work were purposefully identified by project participants in consultation with the research team. Features of work were selected as the unit of analysis because they presented a particular health and safety problem or challenge.

"Features of work were selected as the unit of analysis because they presented a particular health and safety problem or challenge."

For each feature of work, comprehensive data was collected to capture decisions that were made in relation to the design of the feature of work, the process by which it was to be constructed and the way that health and safety hazards were to be addressed. Data were collected by conducting in-depth interviews with stakeholders involved in the planning, design and construction of the selected features of work. These interviews explored the timing and sequence of key decisions about each feature of work, and the influences that were at play as these decisions 'unfolded' in the project context. During the course of the research 288 interviews were conducted (185 in Australia and 103 in the USA). The average number of interviews per feature of work was 6.7.

Projects chosen for data collection represent four different construction sectors (residential, commercial, industrial, and heavy) as well as four different delivery methods (Design-Bid-Build, Design-Build, accelerated, and collaborative). This was done to help determine the role OSH plays in each type of construction project. The projects were then placed on a matrix. Figure 1 represents the 14 projects studied within the United States with the project featured in this case study highlighted in yellow. Figure 2 shows where American and Australian projects overlap on the matrix.

Figure 1: Matrix of American projects

	Residential	**Commercial**	Industrial	Heavy
Design-Bid-Build	Roanoke House	**Dining Hall**	Wastewater Tank	Highway Expansion
Design-Build	Blacksburg House	Psychiatric Hospital	Server Farm	New Highway
Accelerated	Blitz Build	Football Stadium	Chemical Plant	Bridge Project
Collaborative	Mountain House	New Hospital	Coal Plant*	Coal Plant*

**Note: The coal plant project is considered to be both an industrial and a heavy construction project.*

Figure 2: Overlap of American and Australian Projects

	Residential	Commercial	Industrial	Heavy
Design-Bid-Build	US	AUS+US	US	US
Design-Build	AUS+US	US	AUS+US	AUS+US
Accelerated	US	AUS+US	AUS+US	AUS+US
Collaborative	US	US	US	AUS+US

From: Wakefield, R., Lingard, H., Blismas, N., Pirzadeh, P., Kleiner, B., Mills, T., McCoy, A. & Saunders, L. (2014). 'Construction Hazard Prevention: The Need to Integrate Process Knowledge into Product Design'. Paper presented at the CIB W099 International Conference: Achieving Sustainable Construction Health and Safety, 2-3 June 2014 Lund, Sweden.

1.3. Case Study Analysis

Dependent variable

Data was collected about OSH hazards and the risk control solutions implemented within the case examples. This data was elicited during the interviews and supplemented with site-based observations and examination of project documentation (e.g. plans and drawings). For each feature of work, a score was generated reflecting the quality of implemented risk control solutions. This score was based on the hierarchy of control (HOC).

> *The Hierarchy of Control classifies ways of dealing with OSH hazards/risks according to the level of effectiveness of the control*

The hierarchy of control (HOC) is a well-established framework in OSH (see, for example, Manuele, 2006). The HOC classifies ways of dealing with OSH hazards/risks according to the level of effectiveness of the control. At the top of the HOC is the elimination of a hazard/risk altogether. This is the most effective form of control because the physical removal of the hazard/risk from the work environment means that workers are not exposed to it. The second level of control is substitution. This involves replacing something that produces a hazard with something less hazardous. At the third level in the HOC are engineering controls, which isolate people from hazards. The top three levels of control (i.e, elimination, substitution and engineering) are technological because they act on changing the physical work environment. Beneath the technological controls, level four controls are administrative in nature, such as developing safe work procedures or implementing a job rotation scheme to limit exposure. At the bottom of the hierarchy at level five is personal protective equipment (PPE) – the lowest form of control. Although, much emphasized and visible on a worksite, at best, PPE should be seen as a “last resort,” see, for example Lombardi et al.’s analysis of barriers to the use of eye protection (Lombardi et al. 2009). The bottom two levels in the HOC represent behavioral controls that they seek to change the way people work (for a summary of the limitations of these controls see Hopkins, 2006).

Each level of the HOC was given a rating ranging from one (personal protective equipment) to five (elimination). The risk controls implemented for hazards/risks presented by each feature of work were assigned a score on this five point scale. In the event that no risk controls were implemented, a value of zero was assigned.

Independent variable

Social network analysis (SNA) was used to map the social relations between participants involved in making design decisions about each feature of work. SNA is an analytical tool to study the exchange of resources between participants in a social network. Using social network analysis, patterns of social relations can be represented in the form of visual models (known as sociograms) and described in terms of quantifiable indicators of network attributes. In a sociogram, participants are represented as nodes. To varying extents, these nodes are connected by links which represent the relationships between participants in the network.

SNA has been recommended as a useful method for understanding and quantifying the roles and relationships between construction project participants (Pryke, 2004; Chinowsky et al. 2008). The technique has been used to analyse knowledge flows between professional contributors to project decision-making (see, for example, Ruan et al. 2012; Zhang et al. 2013). Network characteristics have also been used to explain failures in team-based design tasks (Chinowsky et al. 2008) and identify barriers to collaboration that arise as a result of functional or geographic segregation in construction organizations (Chinowsky et al. 2010). More recently, Alsamadani et al. (2013) used SNA to investigate the relationship between safety communication patterns and OSH performance in construction work crews.

In order to gauge the construction contractor's prominence in a project social network, the contractor's degree centrality was calculated. Degree centrality refers to the extent to which one participant is connected to other participants in a network. Thus, degree centrality is the ratio of the number of relationships the actor has relative to the maximum possible number of relationships that the network participant could have. If a network participant possesses high degree centrality then they are highly involved in communication within the network relative to others. Pryke (2005) argues that degree centrality is a useful indicator of power and influence within a network.

Degree centrality can be measured by combining the number of lines of communication into and out of a node in the network (see, for example, Alsamadani et al., 2013). This presents an aggregate value representing the participant's communication activity. However, the independent variable used in this research was calculated using only the construction contractors' outgoing communication. This was a deliberate choice because the research aim was to investigate whether OSH risk control is of a higher quality when project decisions are made with due consideration of construction process knowledge. Thus, the flow of communication from the construction contractor to other network members was deemed to be of greater relevance that the volume of information they received.

From: Wakefield, R., Lingard, H., Blismas, N., Pirzadeh, P., Kleiner, B., Mills, T., McCoy, A. & Saunders, L. (2014). 'Construction Hazard Prevention: The Need to Integrate Process Knowledge into Product Design'. Paper presented at the CIB W099 International Conference: Achieving Sustainable Construction Health and Safety, 2-3 June 2014 Lund, Sweden.

1.4. Benchmarking and Best Practices

Benchmarking is a powerful management technique that can be used to improve an organization's performance by searching for a partner organization that is the best at a given process and constantly adapting or adopting the partner's practices to increase performance (Kleiner, 1994). The process to be benchmarked is usually determined by analyzing performance figures and other data. A process that has relatively low performance figures and could be improved is often chosen to be benchmarked. Demand for benchmarking comes from several sources, such as increasing enforcement activity, regulations, investor and liability concerns, customer perceptions, and competition with other organizations. The results of effective benchmarking include increased productivity, efficiency, employee morale, and a competitive advantage.

The benchmarking process can be divided into five stages: Planning, analysis, integration, action, and maturity. During the planning stage, the organization identifies the process that needs to be benchmarked. This selection is usually done to fulfill a predetermined need, such as boosting performance figures in an area that needs improvement. Measurable performance variables are also identified. Benchmarking partners are selected based on their best-in-class performance in the targeted process. The partner does not necessarily have to be in the same industry. The organization concludes the planning stage by determining the data collection method and collecting the data. It is important for the organization to be able to distinguish between ethical and unethical means of data collections, especially if it involves handling sensitive inside information from the partner company.

During analysis, the organization determines the current performance gap for the process that will be benchmarked. The team then predicts future performance levels.

The integration stage involves the organization communicating their benchmark findings. Communication is crucial during this phase of benchmarking, especially when seeking approval from those with more organizational authority. Operational goals and plans are established from the benchmarking findings.

The action stage is characterized by implementing practices, monitoring progress and results, comparing results to stakeholder needs, and adjusting the benchmark goals as necessary. Since benchmarking is a continuous process, the last step will certainly be repeated as industry standards and the needs of stakeholders change over time.

A benchmarking process reaches the maturity stage after the best practices are fully implemented into the targeted process. While benchmarking begins with management, the employees involved in the process are the ones who ultimately integrate the new process.

"Kleiner, B. M. (1994). Environmental benchmarking for performance excellence, Federal Facilities Environmental Journal, 5(1), 53-63."

1.5. Learning Objectives

- *Understand sociotechnical systems complexities of a construction work system*
- *Understand different sectors, delivery systems, and cultures*
- *Understand project and industry supply chain and work system complexities*

2. University Dining Hall

2.1. Overview

The project involved in this case study was the construction of a university dining hall on a side of campus that needed one. The university's campus is divided into a residential and an academic side. Prior to construction, most of the major on-campus dining facilities were located on the residential side, with a small number of sandwich and coffee shops near the academic buildings. The university felt that there was a need for a large-scale dining facility to serve faculty and student in the academic side of campus, especially with the number of students who live off-campus and commute to class. An area of green space between two existing buildings was chosen as the site for the new dining complex (Figure 1).

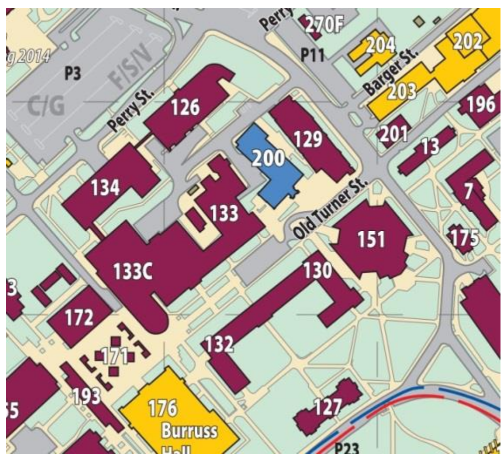

Figure 1: Location of the dining hall (blue building)

The amount of space available on the site did not provide sufficient area for the dining layout the university wanted, and thus two floors were planned for dining. The office that was designed to be in the building as well as the dining could easily fit on a third floor with extra space for classrooms. Thus, the facility was three floors total.

2.2. Project Profile

2.2.1 Case Background

The dining hall was built on the campus of a large public university in the eastern United States. The university is located on a 2,600 acre campus and had an enrollment of 31,000 students and employment of 1,400 full-time faculty members (Virginia Tech, 2014). The campus is divided into two halves separated by a large open field. The southern half comprises of most the university's residence halls and athletic facilities. The northern half contains mostly academic buildings and faculty offices.

The university is nationally recognized for having a wide selection of dining options available. Dining Services is the campus' largest employer with over 2,100 people employed and grosses sales of $51 million annually (Dining Services, n.d.). While the university has an extensive selection of dining areas, all of the larger halls are located on the residential side of campus. Only a few coffee and sandwich shops served the north side of campus, so there was a demand from faculty and commuter students to build a new dining hall close to the academic buildings.

Since the students would be one of the most vital elements in the success of the dining hall, their input was valuable to the university. Feedback came in the form of survey results, advisory committees, open forums in the campus dining centers, and collaboration with the Student Government Association (Virginia Tech, n.d.).

Two floors of dining space were planned for the facility that would feature eight different restaurants, three of which are national chains (Virginia Tech, n.d.(a)). Total seat count is 833 indoors and 244 on the patio outdoors. The university also wanted this building to house the Services for Students with Disabilities Office, which provides assistance and test-taking accommodation for students that are deaf, hard of hearing, or have some other form of a documented disability. The third floor of the building was dedicated to house the Students with Disabilities Office and remaining space on that floor was used for six multi-purpose use classrooms.

The facility also features a 256 seat community-style dining room for the university's corps of cadets (Dining Services, n.d.(b)). The old dining hall used by the cadets was undergoing renovations to become the new performing arts center. The cadets were in need of a large dining space to conduct formation meals, which are an important part of their training program. The dining room dedicated to cadet use is available to the general public when not being used by the cadets.

A green space between two academic buildings was chosen as the site for this new dining facility. There was some consideration for placing the site towards the edge of campus where there would be more space however the university wanted this site to be easily accessible to students and faculty. The location of the construction site was in an area that has heavy pedestrian traffic during the day, so appropriate measures had to be taken to guarantee the safety of those walking by the site during class changes.

Notice to proceed occurred on July 29, 2010. The project took approximately two years to complete and the building was officially opened on August 27, 2012, in time for the 2012-2013 academic year. The new facility earned LEED Silver accreditation (Planning, Design, & Construction, n.d.).

Dining Services. (n.d. (a)). About Dining Services. Retrieved from http://www.dining.vt.edu/about/index.html on 31 July 2014

Dining Services. (n.d.(b)). Turner Place at Lavery Hall. Retrieved from http://www.dining.vt.edu/centers/turnerplace/turner_place.html on 1 August 2014.

Planning, Design, & Construction. (n.d.). University Design & Construction. Retrieved from http://www.pdc.facilities.vt.edu/mediawiki/index.php/Academic_and_Student_Affairs_Building on 1 August 2014.

Virginia Tech. (2014). Factbook: About the University. Retrieved from http://www.vt.edu/about/factbook/about-university.html on 31 July 2014.

Virginia Tech. (n.d.) Lavery Hall. Retrieved from http://www.vt.edu/about/buildings/lavery-hall.html on 31 July 2014.

2.2.2 Case Narrative

Foundation Wall System

The site of the dining hall sloped quite significantly from front to back, so it was necessary to level the area. The design called for the bottom floor to be level with the elevation at the back of the site and the top two floors to be built up when looking at the front of the site. This required that the whole site had to be excavated down to the depth at the back of the site.

When working in the excavated area, there was a risk for those workers to be struck by falling objects or pieces of equipment. Benching the walls of the excavation site added an extra measure of safety and sharply decreased the likelihood of a cave-in or an instance of falling equipment.

Caissons were chosen as the foundation for the dining hall due to the type of soil in the area as well as the precedent set by existing buildings constructed in the area. To help minimize the safety risks, workers were trained in the proper procedures for installing the deep foundation.

A retaining wall was needed at the front of the building, as the back of the building was at grade while the front of the building was at the 2nd story. Cast-in-place concrete was chosen for the front wall of the building during the design development phase. This was chosen over masonry because of the reduced cost and speed of construction of this type of structure versus masonry. This was also safer for workers because it did not involve as many workers in an enclosed space or at heights during construction of the wall.

One mechanism to allow for material laydown at the front of the site was to backfill the front retaining wall early so that the backfill was at grade at the front of the site. The original drawings from the structural engineer stated that the steel superstructure and floor of the first level needed to be braced before the wall could be backfilled. The CM asked for the structural engineer to determine what would be required to allow for the retaining wall to be backfilled before the steel was installed. The structural engineer stated that the retaining wall would have needed increased temporary bracing to allow the backfill to be completed before the 1st floor structure and floor were completed. This cost would have had to have been absorbed by the CM, as it would have been a change the owner would not have paid for. The CM said that once they got far enough along in the design they were able to determine that the front storage would not be required, and the extra cost of the temporary structure would not have been worth the extra laydown area.

Backfilling the wall early would have eliminated the deep and wide space between the retaining wall and building. This would have eliminated worker fall protection when working from the outside of the building at 2nd floor grade entrance. Fall protection was required however, as the retaining wall was not backfilled until after completion of the structure. PPE and engineering controls such as fall arrest systems and barricades were used as a primary means of fall protection.

Deck Construction

When pouring the 2nd floor deck, workers were at risk of falls, slips, and trips. The constructor responded with training as an administrative control. The constructor also decided in the pre-construction phase to have those workers tie off at the leading edge, which served as a fall arrest system.

Structural Steel Erection

For this project, a steel structure was chosen based on the cost versus other options such as cast in place concrete. The building columns were designed to be the full height of the building. The site was very small, and the structural engineer and CM knew that the crane would need to be as small as possible to avoid other buildings in proximity to the construction site. Thus, the columns were originally designed to be spliced less than full building height in order to reduce crane lifting requirements. The CM and steel erector also knew that lifting over the building, when constructing one floor at a time, would mean a larger crane, and thus sequenced the steel to be constructed at full building height. This sequence required that the crane had to be relocated multiple times, allowing a smaller crane with a smaller reach. The splicing allowed a smaller crane to be used than if unspliced columns were installed. This was also cheaper than using a large crane, but involved moving the crane more times than if they had used a larger crane.

Project Access

There was an existing road that gave access to the front of a building behind the project site. This road would have to be closed for construction, but could be used for deliveries. This required backing trucks in from a very busy campus road, and thus created potentially hazardous interactions with pedestrian traffic. The owner's main safety concern was pedestrians, and the CM looked at using a clearing between the two buildings adjacent to the site as an alternate access road. It could not handle all large deliveries, but did allow for better emergency access to the buildings and had much less pedestrians in the area. The size of the site limited laydown area for steel storage. Thus a decision was made to deliver the steel as needed during each sequence in order to minimize the amount of steel stored on site. Another concern was with deliveries happening during class changes, and the amount of pedestrians in the area. Some of the steel had to be delivered from the busier side of the site because of the limited access of the alternative access road. A decision was made to work with the supplier to deliver all of the steel beams before 8am and after 4pm. In addition, a fulltime flagman was employed to monitor the main entrance during construction hours until the superintendent was confident in the safety of the area.

Façade Construction

University policies require that at least 60% of the outside shell of the building must consist of a cut stone material in order to keep the campus uniform. This type of material is much heavier than traditional brick. The size of the perimeter around the building and weight of the stone led to a decision to use hydraulic scaffolding on the outside of the building. For masonry, tubular scaffolding would have taken too much time, and all of the stone would have had to have been hoisted by material lifts to where it was installed. Thus, hydraulic scaffolding that could be easily moved around the building and loaded at ground level was used.

2.2.3 Stakeholders

For this project, internal supply came from the Architect, Principal Contractor, structural engineer, steel fabricator and erector, and the excavation subcontractor. The architect was tasked by the university (client) to design the facility. The Principal Contractor served as the construction management firm for the project, managed trade contractors, and was hired on at maximum guaranteed price once a certain percentage of the design had been completed. The structural engineer designed the foundation and superstructure of the building. The excavation and steel fabricator and erector subs as trade contractors worked with the principal contractor and structural engineer to excavate for the foundation and construct the steel superstructure.

Internal demand came from the university administration as the client, the university’s construction management and facilities departments as the client’s employees, Dining Services, Corp of Cadets, Academic & Student Services and Restaurants as the client's tenants, and students as the future customers. As the client, the university approved the project and overall budget. The university's construction management department managed the design and construction process for the client. The university's facilities department managed utilities owned by the university in the construction area. Facilities also worked with the contractor during the design and construction phases to locate these utilities and tie them into the new building. Dining Services originally proposed the need for a new facility on that side of campus and managed all of the building's end tenants for the client. The Corp of Cadets was part of the justification for the new facility as they would be using the new building as opposed to the old dining hall. Academic & Student Services was also part of the justification for the new building and as end users they had some input on the final design, particularly the office spaces on the third floor. Different restaurants were also end users of the finished facility, so the types of restaurants and their requirements were important to consider during the design stage. Students had some input into the design of the building as well and were end customers once the facility was finished.

2.2.4 Project Objective

The objective of this project was to construct a dining hall for a side of campus that was in need of one. The dining facility had to be designed to accommodate adequate dining space, offices, and room for auxiliary classrooms. The building footprint was limited by the buildings surrounding the site and the heavy pedestrian traffic typical of a university campus posed unique hazards to the construction crews.

2.2.5 Sector x Delivery System

This project is an example of a design-bid-build (DBB) commercial project.

2.2.6 Features of Work

Four features of work are featured in this case study. Those four features are the foundation wall system, deck construction, erection of the steel structure, and construction of the stone façade.

3. Problem

3.1. Context

The site for the dining hall was located between two buildings and two roads, which limited the size of the building's footprint. The site's location among academic buildings meant that pedestrian traffic would be heavy during class changes. This also would affect deliveries since the trucks would be taking roads through campus to access the site.

3.2. Objectives

Despite the small area of the building site, the final design accommodated the necessary spaces for dining and offices in three stories. Administrative controls were placed on deliveries so that they would take place during the mornings and evenings when pedestrian traffic was lower. On-site storage was limited, so deliveries of steel were made on an as-needed basis.

The scope of the project included excavating one end of the site to the first floor level (due to the topography), install the caisson foundation system, erect the steel structure, and install the limestone façade.

4. Results

4.1. Safety-Critical Decision Making

Site selection was a choice between a location on campus or a periphery of campus. While the latter option would allow more space for the facility, the on-campus location was ultimately chosen because of effectiveness and accessibility. The three story layout was chosen because of the small site size that did not allow a one story layout and cost which ruled out more than three stories. Two stories were required to house all the dining facilities and the third floor held offices for Disability Service and multipurpose classrooms. The facade of the building was limestone as per university policy to match surrounding buildings.

During the design phase, the project team made decisions about the excavation of the foundation and the construction of the building's structure. A one-story excavation depth was chosen by the project team. This decision was made due to cost, topography of the site, the two streets on either side of the site, and to match other buildings on campus. Caissons were used for the foundation because of the soil in the area and prior construction projects on campus used similar foundations. The front retaining wall was made of cast-in-place concrete. Masonry was considered, however it was more expensive and would have taken longer to construct. Using masonry would also require more workers to work from enclosed spaces or at heights. The site was to be completely enclosed to address concerns from the university about students walking near the site during class changes. Two areas, one at the front of the site and one at the back, were set aside for material storage.

Decisions, Decisions: Quick View

Thom's table here

The front storage area could not be used unless the area in front of the retaining wall was backfilled early. According to the early designs, the steel superstructure and first floor deck would need to be completed before the wall could be backfilled. The structural engineer determined that the wall could be temporarily braced however the CM would have to absorb the cost. As the design progressed further, the extra storage area in the front of the site was no longer needed, so the extra expense of a temporary support structure would be unnecessary. Had the CM chosen to backfill the space early, fall protection would not have been needed for workers on the 2nd floor deck.

The project team decided on a steel structure since cast-in-place concrete would be too expensive and the size of the structure would have made that option impractical. The columns were spliced instead of full building height since on-site storage was limited and cost concerns. A crane with a smaller swing radius was chosen due to the small site size, proximity of nearby buildings, and cost.

During construction, a clearing between two adjacent buildings was used as an access road for deliveries. This area had a lower amount of pedestrian traffic and could serve as an emergency access route to the site. After the site plan was finalized, it was examined to see if it would be feasible to store steel onsite. Since only one storage area was being utilized, it was not feasible to store steel onsite due to limited space. Instead, steel would be delivered to the site on an as-needed basis. These deliveries only occurred during the early mornings or evenings due to the high levels of pedestrian traffic during the day. The size of the building perimeter and weight of the limestone façade led to the usage of self-pumping scaffolding. Traditional scaffolding would take longer to assemble and disassemble, and the limestone would still need to be lifted up to installation height. With self-pumping scaffolding the stone could be loaded while the lift is on the ground.

4.2. Hierarchy of Controls

An example of elimination in this project was benching the sides of the excavation area to prevent instances where the sides of the excavated area could collapse on a worker. Using a lift when installing the stone façade also eliminated worker exhaustion as opposed to having the workers lift and lower the materials by hand.

If elimination is not a possibility to solve a safety problem, the next desirable alternative is substitution, which could mean substituting in a safer material or a safer process. There were no notable examples of substitution in this project.

Engineering control is the third most effective form of hazard control. If the hazard cannot feasibly be eliminated or substituted, an engineering control reduces worker exposure to the hazard. Guard rails were installed near the perimeter of the excavated area as a form of engineering control to prevent workers falling in. Tag lines were also used with the crane in order to control they payload while it was being hoisted up.

Administrative controls such as worker training and pick plans were used extensively throughout the project.

The least effective form of hazard protection is Personal Protective Equipment (PPE), which was a common response for many tasks throughout the project where the above mentioned controls would not have been possible or economically feasible. Scaffolding was used for workers constructing walls in response to a potential fall hazard. Fall arrest systems were used for workers near the leading edge of the deck and for those setting and connecting steel beams.

4.3. Social Network Analysis

4.4. Project Performance

The scope of the project was the construction of a two-story, 35,000ft^2 dining facility along with office space and multipurpose classrooms on the third level. The dining hall was designed with 833 seats indoors and 244 seats on an outdoor patio with eight different restaurants. A separate dining room for the Corp of Cadets was also included in the design. The total budget for the project was $35.7 million. Notice to Proceed was issued July 29, 2010 and construction lasted around two years. The new facility opened August 27, 2012.

5. Case Evaluation

5.1. Results

The new dining hall opened August 27th for the beginning of the Fall 2012 semester. This building was the university's first dining hall built from the ground up in 42 years (Noe-Payne, 2012) and the new facility earned LEED Silver accreditation. The new facility also won the Grand Award for the Loyal E. Horton Dining Awards in the category of Retail Sales – Multiple Concepts/Marketplace Design. The National Association of College and University Food Services recognized the dining hall as the best new dining facility in the country on July 13, 2013 (Broughton, 2013). Students and faculty waited in long lines to be among the first to enjoy the new facility. By 7:15pm of that same day over 8,000 customers (almost one third of the university's undergraduate population) had been served at the dining facility (Noe-Payne, 2012).

For the Spring 2013 semester, daily customer counts had grown by almost 2,000 (Kulak, 2013). The popularity of the dining hall coupled with the downsized building footprint led to long lines and a shortage of seating. While the facility was designed to serve 8,000 to 10,000 customers per day, the daily total was over 11,000 at this point. The Dining Services Director recommended that students plan in advance to visit the dining hall during the morning or evenings when the facility is not as busy.

Broughton, S. S. (2013, July 2013). Turner Place at Lavery Hall lauded as country's best new dining facility. *VTnews.* Retrieved from http://www.vtnews.vt.edu/articles/2013/07/072313-dsa-hortonaward.html on 31 July 2014.

Kulak, A. (2013, February 27). Crowds an indication of Turner Place's popularity, small design. *Collegiate Times.* Retrieved from http://www.collegiatetimes.com/news/virginia_tech/article_cec2929f-152d-5fce-b0dc-70bd171d4f7c.html on 31 July 2014.

Noe-Payne, M. (2012, August 27). Turner Place opens to frenzy of hungry students, faculty. *Collegiate Times.* Retrieved from http://www.collegiatetimes.com/news/virginia_tech/article_105f2f51-8603-593c-8290-aa02a1c97a35.html on 31 July 2014.

5.2. Lessons Learned

Describe the positive aspects of project implementation, the problems encountered and how (if) were they addressed. Describe how other parties could use the solution. Describe best practices that can be adopted or adapted.

(15 to 25 lines)

6. References

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