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Technical Assignment 3

Construction

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Executive Summary

This report analyses possible alternative methods for construction and design through means of scheduling and communication. The underlining concerns for the construction of the Charlottesville Community Hospital include a tight site boundary and top quality finishing projects. These topics will be the basis for discussion throughout the report, with a strong emphasis on job-site safety.

Scheduling risks should be determined during the design phase of a project so that they can be accounted for once construction starts. During Construction, poor installation of a foundation waterproofing membrane affected the schedule by prohibiting further materials, like flooring and casework, to be installed. Also, modifications to owner's demands as well as inconsistent changing drawings led to confusion among trades and delays due to communication. To alleviate scheduling delays, work can be prioritized during the end of construction, to accommodate the tasks that are more vital to achieving building turnover and occupancy. Such work should be outlined by the project team before construction begins, to prepare for possible interruptions later on. Other influences on the schedule were simple value engineering items such as drywall and plywood. Moisture absorbent drywall was used in several corridors and $\frac{3}{4}$ inch plywood was used in lobby area to act as backing for hanging fixtures. Additionally, tile flooring was proposed by the General Contractor in emergency rooms in order to save installation time and material costs, but the idea was not implemented due to the quality standards of the hospital.

Industry issues discussed in the report include preventative safety measures and the delivery of facility management information. Modularization is one method that can reduce construction risk by removing much of the assembly from the job site to a manufacture's facility. Another tactic discussed is a safety rating system for a project, which designates the level of safety measures taken for a specific building and tries to quantify them. Sharing Facility Management information through the use of Building Information Modeling may not be a successful tool depending on the type of owner. The first step to choosing a communication method is to know and understand the facility management team so that project turnover is a smooth and successful transition. For one research topic, the exterior construction safety will be analyzed by means of looking at site restraints, delivery methods, and neighboring occupied buildings that must not be disturbed throughout construction.

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Schedule Acceleration Scenarios

During the construction stage of the project, there are certain tasks that require greater attention than others. Some of these tasks may also be considered critical to a successful completion date. The Charlottesville Community Hospital's project team put a large emphasis on the building's excavation. The excavated footprint of the building closely borders vehicle and pedestrian traffic, as well as neighboring buildings on two sides. Careful logistics planning for the excavation of the building was necessary in order to begin future building applications such as its foundation and the erection of the tower crane.

One detail of early construction which proved to affect the schedule was an error in the application of waterproofing under the slab on grade. Leaks in the slab eventually led to delays for flooring and casework placement due to the existent moisture. Another more general risk to the project's completion date was the indecisions of building owners and design teams. Because of strict owner specifications and the complexity of this new state of the art hospital, final decisions of items such as finishes and room layouts often took supplementary time. Furthermore, construction tolerances grew tighter as production increased. For example, a concrete grade may have been off by a small amount, which could have potentially prevented a glass window from being installed. These types of details become much more vital towards the end of construction when design becomes tighter and more significant. Lastly, inconsistent construction plans are also a great risk to the project's completion. With changing designs and new drawings being composed regularly, a common set of documents must be accessible to the entire project team at all times.

To accelerate the project schedule, the most effective way of doing so would be to increase the man power of construction. Another method would include putting emphasis on tasks that impact the transition to building occupancy. Prioritizing these certain items can eliminate their duration and accelerate the important parts the schedule. Examples of tasks that may be able to be pushed back in a schedule include landscaping and other exterior aesthetics. A valuable technique for limiting schedule risks is simply taking proactive measures to assure quality from the beginning. This includes both quality of construction applications as well as quality plans and specs that are available to everyone. The majority of the scheduling delays of this project could have been prevented early on in construction if they were noticed and understood. A discussion of which tasks are most important and time sensitive may be effective if carried out early on. Also at this point, the project team can outline probable areas of delay, and select which items to prolong in order to complete tasks that are more important, in case of a scheduling emergency.

Value Engineering Topics

Closely related to a successful project schedule are value engineering issues which could potentially save time and energy on a construction project. The Charlottesville Community Hospital implements value engineering during both the design phase and the construction phases of the project. A simple example of this method is the use of moisture resistant drywall, especially around the perimeters of the structure. Although slightly more expensive, this type of drywall is less likely to fail over its lifetime to moisture that it may be introduced to via leaks. More importantly to the construction team, this drywall can be installed before the structure is completely enclosed due to its increased protection from possible inclement weather. Therefore, the time that is usually spent waiting for other trades to finish can be saved and the project schedule can benefit.

Another value engineering idea proposed by the general contractor was to use $\frac{3}{4}$ inch plywood on the ceilings of certain lobby and waiting areas. The plywood would serve as a backing for a number of fixtures that were designed to hang from the ceiling. This method of installing plywood differed from the original plan of installing blocking for each individual fixture. It therefore eliminated the process of cutting every slot for the backing of the fixtures. Now, sheets of plywood could be installed quickly which could serve as backing for wherever the location of the fixture may be. The material costs were slightly higher but the plywood method saved time and labor costs. The owners, whom were most cautious about quality, accepted both the drywall and plywood changes. They gained higher quality products and slight schedule acceleration.

Like many construction projects, not every opportunity for value engineering was taken advantage of. One idea proposed by the general contractor was to use tile flooring in the emergency rooms instead of an epoxy resin. This would decrease the cost to the contractor as well as the time it took to install the flooring. The epoxy floor, which was ultimately chosen, required more care and effort to install. However, it was more durable than the tile system and was generally of higher quality.

Critical Industry Issues

Prevention through Design

A general assumption exists within the design community that construction safety should be mandated and fulfilled by the construction manager. The safety of a job site is often viewed as just another service, like excavation or steel erection that is provided by the builder. This methodology has existed in the past, but should be reconsidered for today's construction. Most safety related accidents that occur on a job site could have been prevented, by players other than the construction team. Often, site logistics can be considered early on in the project design, by the design team, which could eliminate hazards during construction. An example of such a design idea was recently implemented in a high-rise building in Finland by Skanska. On this project, they used a center resource tower, which was located on site and housed items for first aid, site clean-up equipment, and egress points. This minimized job site clutter and served as a known common area for contractors. Another method for eliminating risk through design involves the use of modularization. This would bring a substantial amount of the construction process away from the site, and into a manufacturer's warehouse, which is a safer atmosphere. To effectively execute this strategy, strong emphasis must be put on the idea from the beginning of design. The entire design and project team must be on board early on in order for the goals and overall message to be clearly understood. Besides construction applications of safety, a different idea was brought up suggesting that safety be categorized by individual job and given a ranking as to how effective the safety plan was. Similar to a LEED accreditation, this ranking would put a label on a project as to the degree of safety that is implemented on it, through both design and construction. Of course, much research and analysis would need to first be conducted to determine the effectiveness of such a system, and how to quantify construction safety.

The Charlottesville Community Hospital may benefit from early safety design considerations, particularly pertaining to the confined site restraints of the project. Locations for material deliveries, contractor access and egress points, and trash removal are some areas that could be investigated to make sure they are located a reasonable distance from pedestrians and local traffic. Albert from Skanska may be able to provide useful information for the topic as he has experience on unique construction projects throughout the world.

Efficient Delivery of Facility Management Information

Building Information Modeling is commonly used as a tool for communicating the construction process within the project team and with owners. The theory of this technology is that the construction sequence will run smoother and will be better understood from an early stage. Although this theory usually holds true, it may have a contradicting effect on certain owners. Depending on the expertise of the owners, a project team may or may not find BIM useful. In the case of an older generation owner, or those who are simply not experienced with this new delivery system, there could be a technology gap between the construction team and the facility managers. It is of the best interest of the construction firm to be familiar with the owner of a project as to their preference and experience with technology. This will help determine before a project begins, if BIM implementation would have any positive impacts of construction flow.

Once an information delivery system is established, it is the responsibility of the project team to deliver to the owner all systems information. It is also important to inform the facility of new equipment and building processes. One of the obligations of the builder is to not only construct a building, but to teach its future occupants how to operate and maintain it. Furthermore, the turnover of a building is the most important part of the project sequence. The owner will always remember this part because it finally displays the results of all their planning, designs, and cost efforts. With ownership come many responsibilities that influence the design, materials, and equipment used in a facility. Most obvious is the initial cost of the new building, which usually consists of fees associated with construction and permits. Three other costs to the owner include maintenance costs, replacements costs, and repair cost. These costs may not be apparent during construction, but the facility manager should consider them during the design phases, and clearly describe them to the project team.

An area of dilemma throughout the project's duration was the communication between the owners and project team as to construction methods and finish materials used. Both of these problems may have arisen from the general contractor not understanding the owner's specific needs from the beginning. Construction methods for assemblies such as the first floor feature wall, discussed in technical assignment two, could have been reviewed in more detail before scheduled construction. In addition, both parties could have better understood the quality and application of several specific building finishes such as flooring, wood paneling, and exam room hardware. To further pursue these ideas in more detail, professionals such as Ed Gannon from Penn State and Mike Arnold from the Diocese of Pittsburgh's facilities management department may be able to provide specific communication strategies to research.

Feedback from Industry Roundtable

To conclude the pace roundtable seminar, an industry professional was assigned to further explore research ideas for the hospital. The general topic discussed was creating a safe external working environment with the provided site space and dense surroundings. One goal of the research would be to avoid scheduling delays due to material delivery backup and general construction traffic. Another would be to devise a way to communicate with subcontractors for how they will be staging their material and transporting it into the building. Preparation before construction begins is important for creating a safe working environment that satisfies the owner's needs.