Baltimore Washington Medical Center
Women's Center and Inpatient Tower *Glen Burnie, MD*

Technical Assignment #3

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Executive Summary

Technical Assignment #3 addresses Critical Industry Issues, Critical Issues Research Method, Problem Identification, Technical Analysis Methods, and Weight Matrix. The following report gives a brief summary of the areas that I plan to focus on for my thesis proposal. My investigation of these areas will include research, value engineering, schedule compression, and constructability reviews.

The Critical Industry Issues section of this tech report deals with the issues discussed at the PACE Roundtable. This portion of the report gives a brief overview of the three topics plus any thoughts that I had about the discussions. The three issues at the roundtable included Prefabrication, Building Information Modeling (BIM), and Workforce Development. I learned a great deal from this event, and I plan to incorporate some of the information into my thesis proposal.

The Critical Issues Research Method consists of an important issue within the construction industry that I plan to investigate in my thesis proposal. This section is broken up into two sections: a problem statement and a research goal. My research method consists of developing a guide about BIM that can be accessible to anyone in the building industry.

The Problem Identification area provides a list of items that have become concerns on the Women's Center and Inpatient Tower project. This section includes a problem or concern and a proposed solution for that problem. I have chosen two of these problems to look at in more depth for my technical analysis area. In the Technical Analysis Methods, I plan to look at cast-in-place concrete vs. precast concrete planks for the flooring system in an area above the existing mechanical room and mechanical interstitial spaces for the air-handling units. The Weight Matrix at the end of this report shows the breakdown of how I plan to investigate each of these issues.

Critical Industry Issues

On October 24 2007, the annual PACE Roundtable was held to discuss various topics that are prevalent in the construction industry today. The focus of this year's PACE Roundtable was Building Collaboration. This meeting included various industry members along with all of the 5th year CM students. At this meeting, a group of panelists were selected to start the discussions for each topic. The three topics selected for this year's roundtable were Prefabrication, BIM, and Workforce Development. Below is a summary of the three sessions that occurred at the PACE Roundtable.

Session 1: Prefabrication

Prefabrication was the first topic discussed at the PACE Roundtable. Each of the panelists for this topic gave an introduction to their experiences with prefabrication. One of the panelists brought up the idea that prefabrication can help with LEED buildings. This idea created interest among the group, and we discussed some of the potential benefits of using prefabrication for LEED. Because prefabrication is typically very efficient for producing materials, the cost of producing the materials is often lower, and the amount of waste is minimized. Also, because prefabrication occurs in a controlled environment, the systems that are produced are typically higher quality systems. We discussed that it is possible to obtain LEED points by using prefabrication for a building. Because LEED is becoming so common, I think there is going to be a lot more prefabrication of systems in the near future.

One major issue that came up about prefabrication was how it would affect the designer. This issue seemed to very important especially for the designers who attended the roundtable. Because prefabrication is a very detailed process, the entire team needs to be involved including the owner, architect, engineers, and construction manager. During this discussion, some of the industry members stated how crucial it is to make a decision early in the design process whether or not to use prefabrication. I think this is interesting because many times an owner may not realize prefabrication is an option. Some believed this decision process also affects the architect and engineers because it may require more time, money, and planning on their part. This discussion led to the fact that in the US, an owner typically hires a design team first and worries about the construction manager later in the design process. Because the construction team is only brought on the project later, it is very difficult to use prefabrication this late in the process. Some of the industry members that attended from other countries stated that prefabrication is widely used. One of these members was an architect, and he said that the majority of the design was prefabricated. I was very surprised to hear that there was such a difference in the amount of prefabrication used in the US and other countries.

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Another issue that was discussed was the coordination process between trades for prefabricated systems. One of the biggest concerns with this was how to bring all of the trades together to coordinate their own prefabricated systems. This idea then led to the discussion on who would be liable for this prefabricated systems. Because many of the prefabricated components are made up of various trades, it would be difficult to make one trade responsible for the requirements of all the prefabricated parts.

Based on this discussion, I do not think prefabrication would be a good analysis for my project because my project team was brought onto the project late in the design. Because the patient tower is an unusual shape and has only a few typical floors, utilizing prefabrication seems to be more complicated. Also, the new patient connects to the existing hospital in various locations; therefore, I think it would be difficult to use a prefabricated structural system in the areas where the two buildings meet. I could possibly use prefabrication for the MEP systems; however at this point I do not feel that this is a good topic for my thesis research. If I would decide to use prefabrication later in my thesis project, I would contact Ted Border from Whiting-Turner. At the roundtable session, Ted was very involved with the discussion, and he seemed to have a lot of experience with this area. After the roundtable, Ted came and spoke to the AE 473 class about prefabrication. He discussed one of the projects that used prefabricated components. For this area of research, I think he would be a great person to speak.

Session 2: Building Information Modeling

Building Information Modeling (BIM) was the topic I was particularly interested at the PACE Roundtable. Last semester I had completed an independent study focusing on BIM, so I was interested in hearing what the industry members had to say about this topic. During this session, I was not surprised by some of the discussions that developed about BIM. Many of the industry members that attended the roundtable seemed very engaged in this specific topic. Some of the members had used BIM in the past mainly for marketing purposes. However, it seemed like very few of the industry members were using BIM outside of the marketing approach. In the near future, I think we are going to see more BIM being used within the construction industry.

During the discussion about BIM, many people expressed their fascination with this technology. Some of the benefits discussed were better analysis of the construction process, minimal waste on site, improved communication, and digital fabrication. Another major benefit is the marketing tactic used to win a project. I was already aware of the many benefits that BIM provides; however, I wanted to learn more about the constraints for implementing BIM in the construction industry. One of the major problems with implementing BIM is that the owners are not requiring it. Some owners know very little about BIM;

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therefore, they need to be educated before they can require it on any projects. Some of the other constraints included no standard programs, liability issues, and constructability. I think a big issue is who is responsible for the models if the models are created in the design phase and then shifted to the construction phase. One problem with the models being created by the designer first is that in many instances, the designers tend to have an architectural vision of the building. They do not necessarily focus on the constructability of the building. Going along with idea of who is responsible, there was also a discussion about who authorization over the model components. Many of the trades have authorization over their own components; however, the concern is who has authorization over the entire model. One answer to this issue is to have an integrator who would combine all of the components into a central model. I think this was a great idea. In fact, the CIC group here at Penn State is now acting as the integrator for the Dickinson School of Law model. Each of the trades will model their components and send them to a Penn State student to integrate the components into a central model.

During this session, there was also the discussion about how a company would start to implement BIM. I think many companies are interested in BIM, but they do not know where to begin. Some companies are not even certain on what BIM really means. For this area, I would be interested in researching BIM and finding ways to convey BIM to the construction industry.

Another issue that was brought up at the roundtable was how to get all trades especially the smaller trades involved with BIM. Many of the trades do not have the resources to create models. Some industry members also questioned whether it was possible to measure the benefits for using BIM on a project.

One of the industry members asked if it is possible to measure the benefits of BIM. This is a great question because many people are reluctant to use BIM since there is no defined way to measure the benefits. I think it is difficult to measure these benefits in terms of money or time. Over time, I believe that BIM will ultimately decrease costs and time; however, at the beginning stages of BIM, it may be hard to see these results. Because I have worked with BIM in the past, I am interested in developing a model to convey some of the benefits for using BIM. With this model, I could look at estimating, constructability, clash detection, or scheduling.

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I really enjoyed listening to all of the industry members' opinions about BIM. I think this was a great topic because most of the students are familiar with BIM, and we were able to give our input on the subject. I plan to look at this topic in more detail for my thesis project. When researching this topic, one person I plan to contact is Bill Moyer. At the PACE Roundtable, I spoke to Bill Moyer about BIM, and also about the Long and Foster's Headquarters Building, which is being constructed by Davis Construction. Last semester, I worked with a few Penn State students to complete the BIM model for that specific project. Once the model was completed, I met with some of Davis's employees who worked on this project. Bill Moyer was one of the employees who gave us feedback about the BIM model. I think he would be a great contact because he is already aware of how BIM can benefit an actual project.

Session 3: Workforce Development

I really enjoyed this topic because it dealt more with people than technical issues. Many of the discussions were very interesting because I had never really given any thought to this area of construction. One of the biggest issues brought up was the negative connotation that is placed on working in the construction industry. Many people have this idea that those who work in construction are not intelligent people. This discussion led to the issue about immigrants working in this industry. Because many of these immigrants cannot speak English, some people look down upon them. One of the panelists spoke about this issue and brought up some of his experiences with these workers. He said that many of these immigrants are actually very intelligent, and some of them even move up to higher positions in a company. One example he gave was a construction worker who was actually a doctor back in his home country. Another example was a labor worker who had a background in accounting in his home country. Once the company found this background information, the worker was able to work his way up the ladder, and eventually he was promoted to an accountant for the company. From my own internship experiences, I have learned that many of these workers are very smart people. I was fortunate to learn a great deal of information from these construction workers. Although this topic is not an important issue for my thesis project, it gave me a new perspective on the workforce. From this session, I have gained more respect for these workers in the construction industry.

Critical Issues Research Method

Problem Statement:

Even though BIM is becoming more prevalent in the building industry, there are still many obstacles for implementing BIM. Because BIM is a fairly new term used in the industry, many are still learning the basics about what BIM is. As more of the industry becomes familiar with the term, the next step will be how to begin implementing BIM. By creating a guide that provides a clear description of what BIM is and the benefits of using BIM, many people will have understanding of BIM and will become more interested in the topic.

Research Goal:

The goal of this research is to develop a clear and concise understanding of BIM and what is has to offer. My research will focus on basic definitions of BIM, the benefits of BIM, and case studies that have incorporated BIM. I became very interested in this topic through an independent study focusing on BIM that I completed last semester. This is the new topic that all industry members are now talking about; therefore, I feel that many people will be interested in learning more about this topic. I think this topic is great for my thesis project because BIM can provide a variety of benefits that will provide a smoother construction process. Most of the project team for the Women's Center and Inpatient Tower were at least familiar with the term BIM; however, very few knew about the benefits of BIM. If BIM was incorporated into this project, it could have made a huge impact on the project schedule, constructability, and cost. If the project team was familiar with BIM, it would have made some processes easier such as material quantity takeoffs. I would like to make this guide available to any company or project team that wants to incorporate BIM in their projects.

Research Steps:

1. In order to develop a clear and concise description of BIM, I must first research the topic in depth so that I have a good grasp of the subject. The research will consist of finding the definition of BIM, the benefits of BIM, and the constraints of BIM. I will look at various case studies that deal with BIM to find some of this information.
2. I will then send out a survey that asks a variety of questions dealing with BIM. The survey will be given to project managers, trades' foremen, and project executives.

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3. The results will then be compiled, and I will focus my research based on the areas where the group appeared to know the least amount about BIM. From the results, I will also look at the various constraints that prevent the industry from implementing BIM.
4. I will continue to research this topic in more depth by asking professionals who know a great deal about BIM.
5. The research and survey results will be compiled, and a guide will be developed that informs all industry members about BIM.
6. Then, I will test this guide by sending it to a variety of industry members and asking for their feedback.
7. I will revise the guide based on the feedback that I receive from these members.
8. This guide will then be made available to anyone interested in learning more about BIM and how to implement it into projects.

Survey Questions:

- Are you aware of what BIM is?
- What do you feel are some of the benefits for using BIM?
- What are some of the constraints that prevent BIM from being implemented into the construction industry?
- What would you like to learn about BIM?
- Have you ever worked with BIM or have you ever used BIM on a project?
    - If so, what did you use BIM for (ex. MEP coordination, visualization, etc.)?

Problem Identification

Infection Control Risk Assessment

The healthcare sector of the construction industry is one of the most challenging areas to work in due to the many requirements that are needed to maintain a sterile environment. In order to uphold this sterile environment, it is crucial to have an Infection Control Risk Assessment for these types of projects. The construction of the Women's Center and Inpatient Tower involves renovation of the existing hospital along with an addition of the new patient tower.

Precast Planks vs. Cast-in-Place Concrete

The primary structural system for the new tower is a cast-in-place concrete system. However, part of the structural system is composed of structural steel framing with precast hollowcore concrete panels. The structural steel framing with precast concrete floors is used as the structural support system for the area above the existing mechanical room. This area of the building is located at the northeast corner of the Women's Center and Inpatient Tower. The steel framed truss supports the area above the existing mechanical room for levels three through eight and the penthouse level. The mix of these three materials creates a complex structural system. One possible solution would be to use composite metal decking and cast-in-place concrete slab for the flooring in this area.

Mechanical Interstitial Spaces

The majority of the mechanical equipment for the patient tower is located in the roof penthouse. Because the air-handling units are located in the penthouse, the ductwork that runs throughout the building is very large and takes up a lot of plenum space. One solution would be to include interstitial spaces throughout the tower that house air-handling units. These air-handling units would supply only a few floors; therefore, the ductwork would be much smaller.

EIFS vs. GFRC

The original design of the Women's Center and Inpatient Tower included Glass-Fiber Reinforced Concrete (GFRC) Panels for the majority of the façade. During the value engineering process, these panels were replaced with Exterior Insulation Finishing System (EIFS) Panels. During the construction of the building façade, there have been a few problems with EIFS Panels. The problems with the EIFS have delayed the project schedule, which may have an impact on the project cost. One possible solution is to look at the original design using GFRC Panels.

Technical Analysis Methods

From the Problem Identification section above, I have chosen two issues that I plan analyze in more depth for my thesis project. For my technical analysis topics, I will look at precast planks vs. cast-in-place concrete and mechanical interstitial spaces for the air-handling units. Each topic is broken down into the investigations areas that I plan focus on.

Precast Concrete Planks vs. Cast-in-Place Concrete

Value Engineering

The structure for the Women's Center and Inpatient Tower is primary a cast-in-place concrete system; however, part of the structural system is composed of structural steel framing with precast hollowcore concrete panels. Because part of the new patient tower is being built over-top of an existing mechanical room, a structural steel truss system was used in this area to support the patient tower. The steel framed truss supports the area above the existing mechanical room for levels three through eight and the penthouse level. For this area, precast hollowcore concrete planks were used for the flooring of the structure. One possible value engineering idea is to use composite metal deck with cast-in-place concrete for the flooring system in this area. For this analysis, the cost of using cast-in-place concrete would be compared to the cost of precast concrete planks.

Constructability Review

By changing the structural system in this area, the constructability of the composite metal decking and concrete slab will also be reviewed. The review will consist of an analysis of the structural performance of the composite decking and slab. This analysis will then be compared to the precast concrete planks performance. The review will also look at the challenges for constructing the structural system.

Schedule Reduction

The change from precast hollowcore concrete planks to composite metal decking with concrete slab will potentially reduce the project schedule duration for the structural system of the patient tower. Because cast-in-place concrete is used for the rest of the tower, the time required to get the concrete is minimum. By using cast-in-place concrete, the concrete planks will be eliminated; therefore, the time needed to order and deliver the planks can be reduced. With cast-in-place concrete, the slabs in this area can be poured with the rest of the slabs for the tower whereas the precast planks would only be placed later in the process.

Technical Analysis Methods

Mechanical Interstitial Spaces

Value Engineering

For the Women's Center and Inpatient Tower, a mechanical penthouse was design to house most of the mechanical equipment. In the penthouse, there are two air-handling units that serve the patient tower area. The third air-handling unit, which serves the West Lobby area, is located on the roof of the West Lobby. Because these air-handling units sit on the top of the building, the ductwork required to serve the spaces is very large. One possible value engineering idea is to design mechanical interstitial spaces for the air-handling units. This idea would require more, smaller units to serve the patient tower. By including interstitial spaces throughout the tower, the size of ductwork required would be much smaller. The cost analysis for designing interstitial spaces will include costs of air-handling units and ductwork along with costs for constructing these spaces. The analysis will also look at the difference in plenum space between the large ductwork and small ductwork.

Constructability Review

Because the air-handling units will be placed throughout the building, a constructability review will be required to ensure that the concrete floors can support the equipment. This review will also look at the amount of space available to create these spaces.

Weight Matrix

Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
CIP vs. Precast		10%	10%	10%	30%
Interstitial Spaces	10%	10%	10%		30%
BIM	20%		10%	10%	40%
Total	30%	20%	30%	20%	100%