TECHNICAL ASSIGNMENT THREE

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Virginia Commonwealth University

School of Business and School of Engineering

Richmond, VA

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CONSTRUCTION MANAGEMENT

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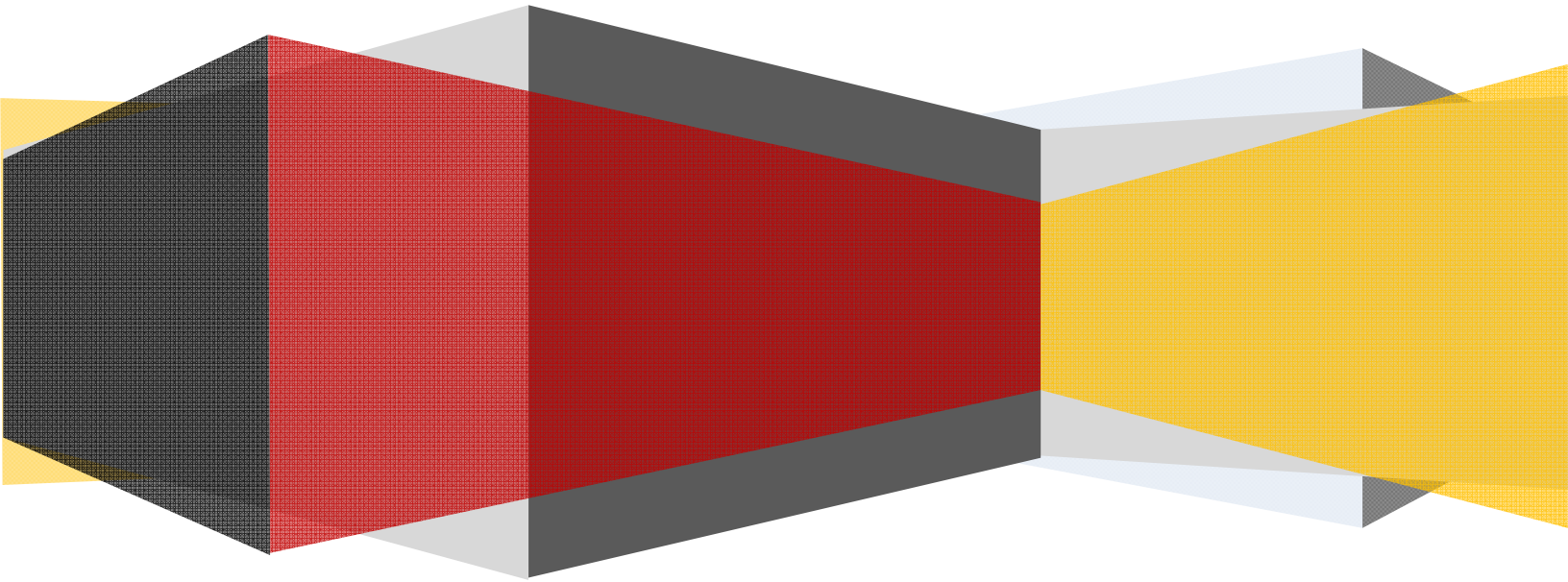

TABLE OF GUIDANCE

EXECUTIVE SUMMARY

Technical Assignment Three aims to explore the areas of research, alternative methods, value engineering, and schedule compression on the Virginia Commonwealth University School of Business and Engineering, and develop topics from these areas that I would like to direct my efforts towards in the upcoming spring semester.

In an effort to generate interest and identify potential research candidates, the first section of this assignment is dedicated to the PACE Roundtable. Through this event, I was able to become familiarized with current industry issues and take part in discussion with the industry members. The topics covered were:

- Prefabrication
- Building Information Modeling (BIM)
- Labor/Management Shortages

Through the discussion I was able to recognize that BIM would be a beneficial research topic for me and for the Gilbane Building Company due to the coordination issues that arose during the construction of the building. I would like to research this critical issue and it's development within the industry. I hope to do this through continual contact with industry members and assessing their information.

Issues regarding the construction of the VCU School of Business and Engineering also led into other areas that are of probably research. After contacting the Gilbane Building Company, the main issues were coordination conflicts, the excavating and installation of the foundations system, and an elaborate rooftop screen as well as mechanical system. All of these issues impacted the schedule, which has a critical end date so that the doors of the school can open for the spring semester in early January of 2008.

From these issues, I was able to determine the areas I want to research for next semester. These include an analysis of the cost and schedule comparison of the proposed deep foundation system to the previous pile system, the possibility of prefabricating the intricate roof screen, and value engineering the current rooftop mechanical system.

The final inclusion of this report is a weight matrix of how I plan to distribute my efforts among my proposed thesis research topics.

CRITICAL INDUSTY ISSUES – *The PACE Roundtable*

This year, the PACE (Partnership in Achieving Construction Excellence) Roundtable was held on October 24, 2007 at the Nittany Lion Inn. Here, industry representatives, architectural engineering faculty and students attended the seminar to gain an awareness of current issues within the construction industry. The roundtable was presented in a single-group fashion due to the camaraderie that the group possessed, as opposed to other years where discussions were held in smaller groups. The three critical issues that were discussed were prefabrication, building information modeling, better known as BIM, and the current labor and management shortages within the industry.

- **TOPIC 1: PREFABRICATION**

The seminar began with a focus on prefabrication. While individuals within the industry can recognize the benefits of prefabrication, convincing owners and builders of the benefits may be more difficult than easy. While prefabrication is currently gaining momentum, it is still not a conventional way of building. There are no standards to prefabrication; there is no single applicable technique. These facts raise difficulty in getting owners onboard early, which is a critical step in prefabrication. On the opposite side of the spectrum, are the subcontractors. As general contractors or construction managers, we must optimize prefabrication into a project through the individual trades making it necessary to recognize the opportunities and integrate them into the design of the structure. While there was a question addressing any union issues within the subcontractors, the panel and attendees expressed that there was little resistance from those union workers. The panel also discussed prefabrication from a green-build standpoint and the potential advantages that it can incur. Due to the fact that green-build continues to be a growing trend in the construction industry, it is logical to relate any sustainable opportunities to the act of prefabrication. Such "green" advantages that prefabrication can invite are a reduction in production costs, more efficient building systems, a better quality of building systems, a lessening of generated waste onsite, and a lower disturbance of the environment through minimizing lay down areas for materials.

- **TOPIC 2: CONVR/BIM**

The next focal point was Building Information Modeling. The panel began by taking a poll of the audience to see who knew what BIM was and then subsequently who has implemented BIM on any of their projects. While everyone in the room knew of BIM, there were only a handful of the industry attendees who practiced BIM on a project. BIM is relatively young in development and hence, there are no standard methods or packages, which can lead to liability and insurance issues. The question arose of how to embed BIM into the industry and the solution to this challenge was addressed through research. The areas of analysis that need to be preformed were said to be on the cost-benefits for owners, contract liabilities in assessing risk sharing, and it's impact on the different project delivery methods. Pertaining to the owners, they themselves pose as a test for general contractors and construction managers. As seen with prefabrication, a difficulty lies in getting owners onboard to require BIM. When used effectively, BIM can greatly benefit the owner in several ways such as a better analysis of the building design and efficiency, increasing communication by facilitating subcontractor cohesion, and a

faster delivery time. Clash-detection is another particularly beneficial key feature, which advocates how important visualization is in constructing a building.

- **TOPIC 3: LABOR AND MANAGEMENT SHORTAGES**

The third and final panel discussion centralized around the future crackdown on immigration and how the workforce will overcome this concentrated effort. Necessary steps need to be taken to reduce our dependency, as an industry, on importing workers. The consented idea was the need to improve the image of the construction industry. This in turn will allow us to create our own workforce through evaluating the working environment and attracting more people for long-term careers. In addition to this, was the posed question of how to overcome certain barriers that importing workers induces. Such obstacles include the language barrier between management and laborers, which can also reflect onto safety and quality issues. From a management standpoint, incorporating language classes into employee training has become more popular.

CRITICAL ISSUES RESEARCH METHOD

While all the topics presented at the PACE roundtable were of obvious importance, the topic that was most attractive to me was Building Information Modeling (BIM).

Problem

Buildings everywhere are becoming more and more technical. As a result, the coordination process is becoming more difficult and simply over-laying drawings is becoming ineffective. The main challenge though is not the buildings themselves, but rather the unfamiliarity of the industry with BIM. There are many significant worries that the construction industry as a whole will have to deal with if they chose to implement BIM on a project.

Goal

I would like to research and address the following constraints that are hindering the development of BIM within the construction industry.

- Regulating and controlling the revisions to the model
- Ownership and control of the digital information
- Interactions of all parties with the design and construction authorities
- Any risk that goes with the investments of the stakeholders and payment for assigned/assumed risk

This research will extend into discussing the above risk factors with industry members, from architects, to the general contractors/construction managers, to the subcontractors and to insurance companies. It is even logical to contact software engineering firms, or any relating literature published by such firms, to research any future standardization of BIM packages.

Due to the fact that BIM implementation will rely dominantly on the push from Construction Managers/General Contractors, my research will be mostly directed towards such firms that have their own divisions of BIM and training they provide or require. I hope to be advised by Dr. Messner through this research, as well as Michael Grobaski of Gilbane Building Company, who I was able to meet at the PACE Roundtable.

In another sense, if universities would integrate BIM-focused courses, this would create a more general knowledge for the future workforce. If efforts can be made to increase the number of people who know how to utilize and effectively run the program, embedding BIM into the construction industry will be much easier.

Beneficiaries

My core audience would be the Gilbane Building Company. They had major issues with MEP/Structural/Architectural coordination and the benefits of my research would not only provide feedback for them, but for the owner, and any future clients of Gilbane, as well. Through this research I hope to provide them with enough positive feedback and examples of how implementing BIM could have saved them headaches within the coordination process.

Potential Questions

Below is a list of potential questions that I would direct towards the industry members. I would like to get sample standpoints from the various sides of the construction industry. While the blow sample of questions remains brief, more queries will be generated as I receive answers from the following initial questions.

Who should be responsible for implementing BIM?

Who should be in charge of the digital information (i.e. architect, owner, etc…)?

How do you input different models from different subcontractors into one?

How do you track completed work on the model?

How should the liability be addressed when using BIM on a project?

What is the best way to convince the owner to use BIM?

How do you address cost concerns?

Should any type of bonding be included when the decision is made to use BIM?

What kind of payment does the risk holder receive?

How would you recommend any standard be tested?

Since BIIM has the potential to be used for the life of the building, i.e. not just in the construction phase, do you have any success stories or incidents of using the model after construction?

Have you had any recent success in using BIM?

Do you provide any training on the program?

PROBLEM INDENTIFICATION

This section is dedicated toward identifying problems that occurred during the construction of the Virginia Commonwealth University School of Business and Engineering. These problems will serve as potential candidates for research, alternative construction methods, value engineering, and schedule acceleration/reduction. Below are three of the largest problems that occurred on the project.

- **Foundation**

The original specified foundation system was concrete piles and during the early phases of the job, other parties (the owner/architect) elected to change the system to a deep foundation in lieu of piles. This change caused drainage and water issues for Gilbane due to the fact that with a deep foundation, a lot of excavating and water pumping is required because you typically will run into wet soils, etc. Weather, specifically rainy days, hinders the progress when excavating for a deep foundation. Weather is not generally an issue when constructing/installing a pile system.

- **MEP/Structural/Architectural Coordination**

This project had major issues between these three drawings, the largest being the MEP vs. Structural, and Structural vs. Architectural. Such conflicts had a major impact on the schedule and sequencing of the building.

- **Roof Screen**

The rooftop mechanical system was concealed by a roof-screen, which was very labor-intensive, timely and costly. The screen is at a 10:12 pitch and involved laborers to be tied-off at 4-stories above ground, installing the wood-blocking and other roofing materials. Crane remobilization around the perimeter of the building induced extra fees. In addition to this, the roof had the majority of the mechanical system installed, so it was hard to find suitable lay down areas for the roofing materials and also incurred limitations to the maneuverability around the massive ductwork.

- **Rooftop Mechanical System**

The mechanical system for the Virginia Commonwealth School of Business and Engineering is located on the roof of the building, as mentioned above. The equipment alone was very expensive, but also inflicted a large additional cost of the mentioned roof screen. It seems very uneconomical to have such an elaborate system on the roof, rather than create an additional floor when the building is well below the zoning height restrictions.

TECHNICAL ANALYSIS METHODS

Technical analysis methods are committed towards identifying core thesis investigation areas for the 2008 Spring Semester. The technical analysis methods are taken from the previous Problem Identification section and are integrated into the core investigation areas that are comprised of critical issues research, value engineering analysis, constructability review, and schedule reduction/acceleration. Below is a list of the proposed analyses that I would like to perform.

- **Technical Analysis I**

The first analysis that I would like to perform regards the school's foundation system. Pertaining to the problem statement from the Problem Identification section above, this presents an opportunity to analyze a schedule & costs analysis of the two systems (piles vs. deep foundation) as well as breadth in the structural option. This will also allow me to address any water table problems, regarding bearing capacity and hydraulic pressures, the design of temporary foundations or retaining walls and lastly soil remediation.

For this analysis, it will be necessary to consult with a geotechnical engineer to discuss the most efficient options for the determined soils of the project. I would also need to contact a structural engineer to discuss the design and load requirements for a potential system, which would also coincide with a cost and scheduling analysis.

- **Technical Analysis II**

The second analysis I would like to propose would be on the roof screen. I recognize this aspect of the project as a prospect of prefabrication. I would like to research the possibility of prefabricating the roof screen panels, which in turn could condense the schedule and lower any safety factors in having workers of different subcontractors on the steep incline of the roof.

This analysis will require contact with industry members, such as Ted Border of Whiting-Turner Construction, who is extremely familiar with prefabricated construction, to discuss whether or not this is a feasible aspect. Mr. Border would be an excellent contact for this analysis as has prefabricated entire roofs on previous projects.

I would also have to contact the structural engineer, because while the roof screen conceals the mechanical equipment from the neighboring buildings, it also supports some of the ductwork. I would like to incorporate this roof screen into an architectural breadth, seeing as it already is an architectural feature.

- **Technical Analysis III**

The third analysis I would like to perform regards the rooftop mechanical system. Rooftop units are very inefficient and I would like to explore alternate energy sources or ways to conserve energy for this building.

It may also be an option to do a cost-comparison and constructability review of building an additional floor for the mechanical system, rather than travel an extravagant route of the complicated and costly roof screen. This could also reflect potential value engineering opportunities.

Such changes to the architecture of the building will need to be addressed with a structural engineer, and the proposed changes to the mechanical system would need to be discussed with a mechanical engineer.

WEIGHT MATRIX

The following table is a weight matrix that best illustrates how I plan to distribute my effort among the different analyses proposed in the previous section. I am aware that my percentages do not total 100%, but my efforts may be adjusted after I receive feedback on my proposals.

DESCRIPTION	RESEARCH	VALUE ENGINEERING	CONSTRUCTABILITY REVIEW	SCHEDULE REDUCTION	*TOTAL*
Analysis I Foundation	5		5	10	20
Analysis II Roof Screen	5		5	10	20
Analysis III Mechanical System	5	5	5	15	30
BIM	10		5	5	30
TOTAL	25	5	20	40	100%