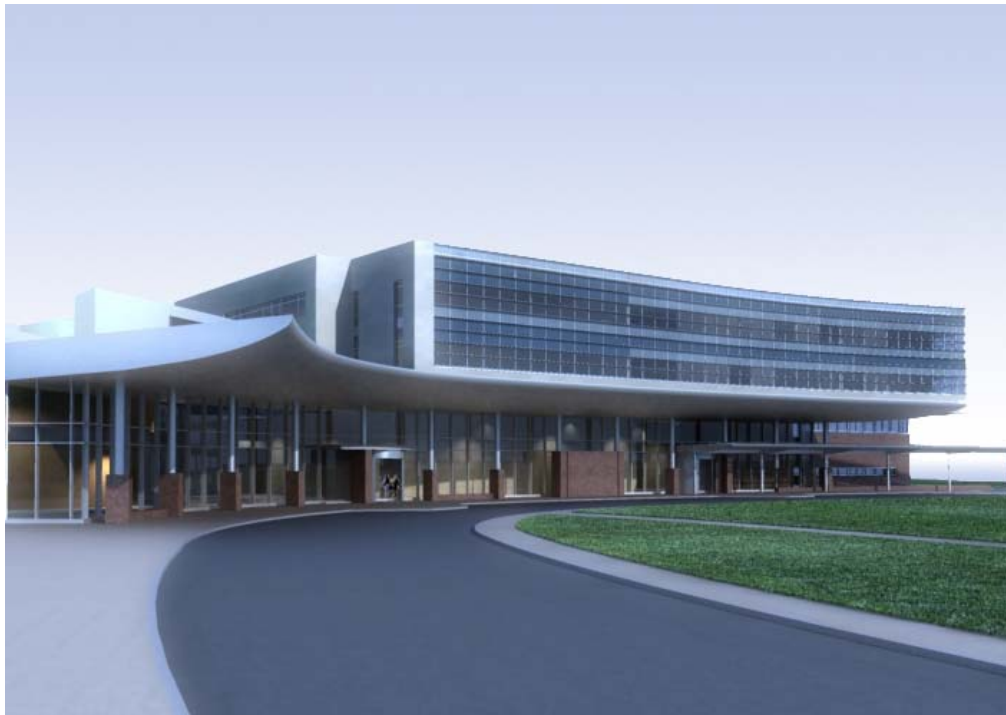


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TECHNICAL ASSIGNMENT 3:
ALTERNATIVE METHODS AND RESEARCH

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Executive Summary

The following report identifies problems and concerns with the Cancer Institute project and the construction industry as a whole, presenting opportunities for further analysis and research. These issues will become the core of the final thesis proposal, and eventually the topics of interest for the upcoming semester's research.

The first section of the report summarizes three sessions attended at the PACE Roundtable Meeting held in October of 2006. Breakout sessions were held on three general industry issues, with each session looking at a particular aspect of the problem. This paper focuses on complex MEP systems, BIM implementation and challenges, and building respect with the owner. Ideas generated through these discussions helped to shape some of the technical analysis proposals.

Next, a critical industry issue is analyzed and discussed with the intent of carrying out thorough research on the topic. The problem identified deals with subcontractor bid markups and their relationship to the construction manager (CM) or general contractor (GC) that is on the job. A survey-based analysis will lead to the formation of a matrix which will aid these companies in reevaluating their subcontractor management methods and how to better their relationships and bid competition.

This section is followed by an identification of project-specific problems that the project team is facing or will potentially encounter. This includes the Emergency Delivery renovation plan as related to the Infection Control Risk Assessment (ICRA) plan, the radiotherapy construction, and the early phasing plans.

Following this problem identification are summaries of the applicable analysis methods that will be used for each, falling under the core thesis investigation areas of value engineering, constructability review, and schedule reduction / acceleration. Lastly, a weighted matrix depicts the distribution of effort that will be expected for all four research topics throughout the second semester.

Critical Industry Issues Analysis

The 2006 PACE Roundtable Meeting was a success in bringing together industry professionals, students, and professors to discuss the critical issues facing the construction industry today. Three breakout sessions throughout the day provided everyone with a smaller forum to openly share their ideas and concerns on a particular focus area, and it was during this time that potential research topics developed for the students. Overall my experience was very beneficial, as the sessions I chose to participate in directly correlated with the research ideas I had going into the day.

Session 1- Mechanical and Electrical Building Systems

The first session I attended dealt with complex mechanical and electrical systems and the trends and issues facing this aspect of construction. Some of the ideas discussed dealt with the future cost of energy and how prefabrication, LEED accreditation, and flexible designs lend to the owner's interests. It was particularly interesting to hear how ASHRAE is currently making standards that correlate to LEED points, making it easier for owner's to see value in an engineer's recommendations. Other concerns addressed were the usage of labor saving materials and how to achieve A/E approval on these new technologies. It was also interesting to hear about underfloor air distribution systems and the challenges they present to trade coordination and sequencing.

Session 2- Modeling Implementation and Challenges

Following a short break, the second breakout sessions began, with all three focusing on Building Information Modeling, or BIM. In particular, I selected the session on modeling implementation and the challenges associated with BIM. Coming into this session I had little knowledge on how exactly BIM was defined, and it soon became clear that I was not alone: many of the professionals had little to no experience with BIM in their work experiences. The reason for this is that BIM is still in its early stages of use by construction managers and requires a high level of dedication from an owner in realizing its benefits. Currently, BIM is most beneficial in the design-build market because these companies understand how it is a solution technique for reducing data duplication and improving on bid accuracy. It will be interesting to see how BIM is implemented into a

traditional delivery method for a project as the technology progresses and owners realize its potential for reducing costs and easing the construction process.

Session 3- Building Respect with Owners and Operators

The last sessions of the day, and the main focus of this year's Roundtable was respect within the industry. In particular, I chose to attend the meeting on owner and operator respect, as this was a research idea I had considered during my summer at PSHMC. My thesis project consists of a multiple entity owner in the healthcare business, and thus I was interested in expanding on the research performed by Abrahm Vogel for his thesis last year. Abrahm focused on the issues and strategies for dealing with the owner; I may be able to provide guided solutions based on his research and my experience with the construction management side of the relationship.

At one point I sparked a discussion with two professionals, one of whom is an owner's consultant, where the topic dealt with accountability among the various entities. My main concern was how to get the correct person on the same page as the CM when their cooperation is needed. Throughout all healthcare projects, there will be a time when things go wrong and the CM needs direct authorization to act. It seems that at times a communication breakdown occurs and the CM is left with a decision to make: either wait for approval, or take the action best fitted for the situation and to the best interest of the owner. The discussion turned to the fact that the owner needs to know of the issue immediately and must be cognizant of where the responsibility lies. Though an issue may be serious and require immediate action, the owner may not be aware that the authority lies with him rather than the CM. Likewise, a situation may not be dire and have a predictable response, with the owner expecting a CM to take action without his immediate approval.

The main conclusion of this discussion came back to respect. The owner/CM relationship must be one of trust, with the CM doing what's best for the owner and the owner valuing their actions. This understanding only develops on an individual basis, and is critical for achieving a free flow of information on a project.

Roundtable Conclusion Statement

In the end, I feel the third session was most beneficial in producing research ideas. I plan to discuss with Abraham where he saw his research progressing and how I may be able to build on it. Other research ideas will be discussed with Andreas Phelps, graduate student and current researcher on PSHMC's methodologies. The PACE Roundtable reinforced one key contact, John Bechtel, for this particular research topic. I dealt with John over the summer at PSHMC as he works for the Penn State Office of Physical Plant, and he will be able to provide insight on at least one facet of the owner entity.

Critical Issues Research Method

The industry issue I will research this upcoming semester was identified during my internship with Gilbane this past summer at PSHMC. Though the topics discussed above do not directly correlate to this problem, the contacts made will become an asset to the research.

Problem Statement

Bid package markups of individual subcontractors are typically consistent from one project to the next, provided there is similar risk associated to the jobs. However, a much different relationship exists between a subcontractor's markup and the construction manager or general contractor that is on the job. This variation results from the practices and structure of different CM and GC companies as perceived by the subcontractor. Not only does this impact the overall bid of a CM or GC to an owner, but it also creates tension in the industry when contractors have difficulty of subs returning to them for work on later projects.

Research Goal

To aid CM companies in evaluating their bid package markups, I will attempt to identify the key elements of their organizations that differentiate themselves in the eyes of the subcontractor. Through two different surveys, one tailored to the CM and GC companies and one to the subcontractors, I expect to discover the defining characteristics that cause

subs to vary their markups dependent upon the CM or GC that is on the job. It is my ultimate goal that companies will take this matrix and internally examine their subcontractor management methods so as to identify areas where they can reduce their markups or increase the competition of bids on future projects.

Research Plan

Research will begin by developing a comprehensive survey for the CM/GC, with questions designed to elicit the aspects that impact their management methods and ultimately the bid package markups. The questions will be based on an initial survey of key contacts with Gilbane at PSHMC so as to narrow the target on the key aspects related to subcontractor markups. Sample questions for the CM/GC can be found in Figure 1 of page 8.

After retrieving a majority of the CM/GC surveys, an initial side-by-side comparison of five to ten CM and GC companies will be performed to show the correlation between their common or uncommon practices that influence a subcontractor's markup. These case-study companies will remain anonymous so as to avoid any ethical conflict; a successful comparison relies only on their company structure and practices, not on their company name. A preliminary weighted matrix will then be formed to determine how influential certain attributes are to the markup.

With a basic matrix in place, a second survey will be developed for the subcontractors (see page 8, Fig. 2). This will be a combination of general survey questions and case study analyses. The general survey questions will evaluate the relevance of certain CM/GC characteristics on their markups. The second part of the survey will be comprised of several case study companies, both real and fictional, as determined in the CM/GC survey. The subcontractor will be presented a company description as related to their structure and management methodologies, and will then be asked to provide a typical markup that they would use for such a company. Whereas all companies will remain anonymous in the case-study evaluation, several actual companies will be used in

combination with theoretical company profiles, with the theoretical companies conjured through combining varied characteristics of CM/GC companies.

It is the hope of this second survey that the subcontractor's projected markups for the case study companies will align with the actual markups of the surveyed CM's and GC's. Further, this will determine the accuracy of the initial weighted matrix in predicting the fictional companies' markups as stated by the subcontractors.

After all the results have been tabulated, the initial weighted matrix will be modified based on the results of the subcontractor survey, so as to more accurately reflect the influence of each specific attribute. An industry average as well as outlier situation will be provided to show the range of markup possibilities. Multipliers for each characteristic will influence the actual markup of a company profile as compared to the industry average.

The research will conclude with a qualitative evaluation of why subcontractors vary their bid markups, and will assess the accuracy of the matrix in determining a markup. The results will be highly subjective, and thus it is important to retrieve a large number of results so as to identify the key aspects of CM's and GC's that influence a subcontractor's markup decision.

Data Collection Tools

The following sample surveys are preliminary only, but contain the general format planned for each. Much further refinement will be done after the initial survey of the Gilbane project team. It is important to take notice of the structure of each survey. Whereas the CM/GC survey will be a user-intensive, written evaluation, the subcontractor survey will use a weighting scale to determine the impact of certain CM/GC characteristics on their markup procedure. The subcontractor survey also contains a case study evaluation of several companies to gauge their thinking process when determining markups. This case study will be much more specific in its company profile so as to cover all of the major characteristics of the CM/GC companies that impact markups.

Figure 1- CM / GC Survey

1	Name: Company: Position:
2	What is the typical markup you receive for bid packages?
3	What do you feel is the major determinant of this markup?
4	Are markups typically the same from subcontractor to subcontractor on bid packages?
5	How would you rate yourself in terms of having subcontractors return for future work?
6	How would you define your negotiating practices for subcontractor change-orders?
7	How would you characterize your client base- one-shot deals or repeat clients?
8	How would you characterize your project teams- a lot of change or keep them together?

Figure 2- Subcontractor Survey

Part 1					
Issue	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Past experiences with a CM/GC influence a bid markup.	1	2	3	4	5
"Nickel-and-diming" practices of a CM/GC cause an increase in a markup.	1	2	3	4	5
The specific CM/GC personnel used for a job influences a markup.	1	2	3	4	5
"One-shot jobs" result in a higher markup.	1	2	3	4	5
The organizational structure of a CM/GC company influences markup.	1	2	3	4	5
Change-order negotiation strategies of a CM/GC impact markup.	1	2	3	4	5
Part 2					
<p>Case Study 1: Alpha Construction Company is a large CM company that is dealing with a repeat client. You have had a few past experiences with the CM, though the last job had a number of complications that led to frustration when change orders for work were being negotiated. With the exception of the project engineer and general superintendent, you are familiar with the project team of the CM and are comfortable working with them. Despite this team chemistry, you are not very confident in the accuracy of design and expect design changes...</p>					
Answer the following questions:		What markup would you assign for the bid package?			
		What is the key deciding factor(s) for this decision?			

Problem Identification

The following section identifies problems associated with the design and construction of the PSHMC Cancer Institute. These areas lend themselves to further investigation to determine ways in which schedule, cost, or both can be reduced on the project.

Problem 1: Emergency Delivery Renovation

The current emergency delivery renovation sequence has had difficulty in getting off the ground, mainly due to redesign of the basement and complications with relocating the existing ED department. Also of major concern is adhering to the ICRA plan to ensure no contamination of sensitive areas occurs during the demolition and construction. The current schedule has been pushed back significantly to facilitate the plan changes.

Problem 2: Radiotherapy Enclosure and Equipment Installation

The recently completed Oncology Treatment Building had planned for modular installation of its equipment, but had difficulties in the procurement and pre-fabrication processes. On-site installed enclosures and equipment had to be used, greatly impacting the overall cost. The radiotherapy equipment for the Cancer Institute, and in particular the enclosures, is a highly intensive portion of the project, and will employ the on-site method of construction. The four Linear Accelerator units require 4' thick walls with encased lead bricks, as well as a 5' thick ceiling. The risk of form blow-out and unsuitable concrete for the enclosure pours present the potential for increased costs and schedule delays.

Problem 3: Early Phasing Plan

The current phasing plan for the early stages of construction have become a nuisance, with schedule overruns being incurred already as a result of improper logistical planning for the parking lot takeovers, helipad construction, and ED renovation. Not only has this impacted

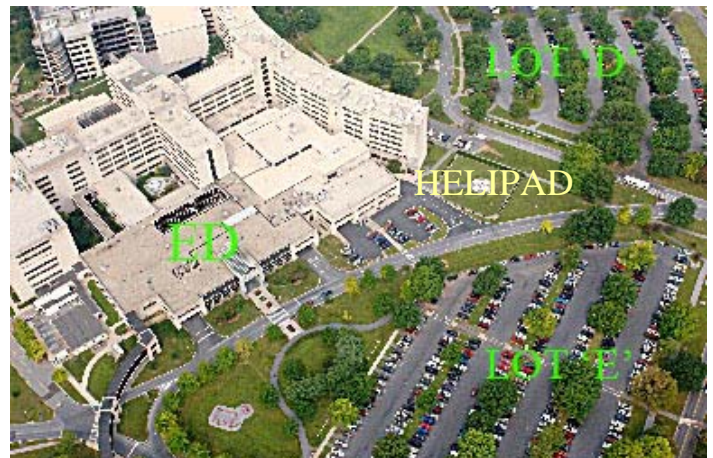


Fig. 3- Aerial Shot, East-end of PSHMC

the proposed schedule, but it places a hindrance on the PSHMC staff in coordinating the change-over for its employees, patients, and visitors. Coupled with the ED redesign issues, the schedule outlined by Gilbane has been significantly lengthened.

Technical Analysis Methods

In this section, the problems outlined above are discussed according to the analysis techniques that will be taken to resolve or alleviate them on the project. These areas include value engineering, constructability review, and schedule reduction, with each problem incorporating two of these criteria in the process.

Emergency Delivery Renovation

The issue of the ED renovation will be analyzed from the perspective of a value engineering and constructability review, with special attention paid to the ICRA plan and its impact on the cost of the sequence. Research will begin by comparing the original plan and the recent changes. It will be important to identify the major mechanical and structural redesign elements associated with the basement and the applicable changes that were made to the ICRA plan for this new construction. Through this research, I expect to find further areas in the mechanical sequencing that could better facilitate the ICRA requirements. Though it will be too late in materializing to impact the current construction, the analysis will be beneficial to PSHMC when considering the ICRA plan developed for the Children's Hospital construction and its tie-in to the Cancer Institute.

Radiotherapy Enclosure and Equipment Installation

Modular installation of the radiotherapy enclosures and equipment requires a great deal of back-study, not only in prefabrication of the specific models but also into the OTB project. A cost and schedule comparison of the proposed modular system versus the current cast-in-place enclosures and equipment will determine which is

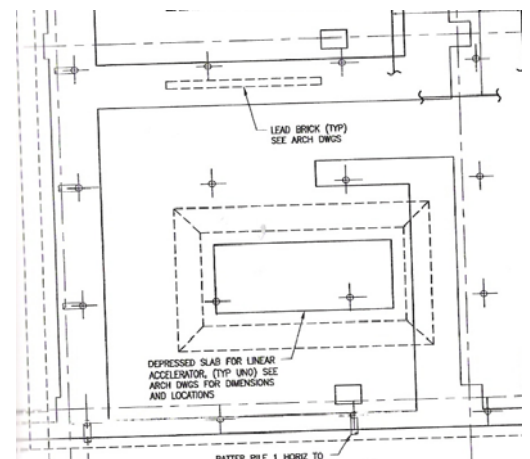


Fig. 4- Plan View, Typical Linac Vault

favorable in the long-run for PSHMC. This analysis could be of particular interest to other medical centers planning on installing similar equipment. The analysis will result in a short qualitative comparison of projects that used both methods, describing the benefits and challenges of each, as well as the lessons learned by the project teams.

Early Phasing Plan

The examination of the early phasing plans will focus on the potential for schedule reduction through a small constructability review of its particular construction activities. Analysis will focus on the joint plan developed by PSHMC and Gilbane, and will evaluate the sequencing of the helipad construction and ED renovation. This research will highlight the critical issues during the early phasing of the job and will present opportunities to rework the transition from the early phases to the major construction



Fig. 5- Future ED Drop-off Area

phase of the Cancer Institute. This research will again be far too late to realize an actual impact on the job at hand. However, it will aid PSHMC and other hospitals in evaluating the manner in which they approach renovation projects to their facilities, identifying some of the intricacies that need to be considered for a smooth project.

Weight Matrix

The following table outlines the expected distribution of effort among the four research topics. It is broken down by the individual analyses and their attributed core investigation areas, as defined by the faculty. From left to right and abbreviated below, these areas are: Critical Issues Research, Value Engineering Analysis, Constructability Review, and Schedule Reduction/ Acceleration.

Figure 6- Weight Matrix

Analysis Description	Research	Value Eng.	Const. Rev.	Sched. Red.	Total
ED Renovation		5%	20%		25%
Radiotherapy Area		15%		10%	25%
Early Phasing Plan			5%	10%	15%
Sub Bid Markups	35%				35%
Total	35%	20%	25%	20%	100%