



## Technical Assignment 3:

### Alternative Methods and Research

# Capital One Lecture Hall Addition





## Executive Summary

This technical assignment serves as a starting block for research and analyses that will be drawn over the next few months. Attending the 14<sup>th</sup> Annual **PACE Roundtable** at the Penn Stater Hotel and Conference Center was a great source to converse with current industry members and issues affecting the construction business today. With an interest in project and in-house team development, it seemed only natural to attend both *Team Building* sessions. At the conclusion of the morning discussion groups, it was quite evident that the brief and unmotivated *Project-Level Team Development* discussion should be a topic of concern.

Here is where research interests lie. As construction projects get larger and more technical, the interaction of design teams and contractors is one of the most important aspects of any job, yet is often overlooked. In the construction industry, seeing as though projects may last from a few months to a few years, temporary teams affect the way they perceive their working relationships with each other. While looking at team building and partnering, one would hope to get a better understanding of processes to enhance the communication and trust between companies. When looking at the value engineering process and the increased communication between different project teams, having a mutual objective may improve the outcome.

In addition to the current industry issues, initial research and methods analyses discuss possible variations to systems within the Capital One Lecture Hall. Some of the proposed alternates include the redesign of the HVAC system, the steel catwalk, the support system for the garden atrium skylight, and other construction management issues. The research information includes a problem statement, accompanied by its relevant methodology for analysis.



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### Team Building/Partnering for VE Survey



## Critical Industry Issues

### Executive Summary

On Thursday, October 13, 2005, I was given the opportunity to attend the **PACE Roundtable** conference located within the Penn Stater Hotel and Conference Center. The day's events were split into two different sections around our lunch break. The morning consisted of two separate debate sessions, lasting approximately an hour and a half each. Summaries of the respective topics can be viewed in the pages to follow, denoted as "Sessions 1-D and 2-D." After lunch, our afternoon was comprised of a team building workshop and a concluding discussion. One of many objectives of this conference, by speaking with industry members, was for students to develop preliminary ideas and research topics to be pursued in the near future.

Having the chance to converse with numerous PACE members concerning current construction industry topics was an invaluable experience and very educational. Discussing *Team Building* and other non-analytical topics is quite different than normal, every-day interactions. It seems as though in many cases, such theoretical strategies like *Team Building*, is overlooked and not given enough attention in our expertise of work. As on any project, having a cohesive team is one of the most important factors in a successful outcome.

Learning about team members and having a good line of communication are two of the easiest and most effective aspects of thriving project teams. These processes are beneficial not only for internal company teams, but also group interaction with other companies. Although project teams are unique in the construction industry because of their temporary structure and work durations, improved team building skills can offset, possibly even prevent future difficulties.

### The 14<sup>th</sup> Annual PACE Roundtable

#### Session 1-D: Team Building – In House Teams and Business Development

- What makes in-house teams in the building industry unique?
  - In the building industry, managers are normally analytical and task-driven, instead of being a "people person" manager.
  - Having portions of a project team who have worked together on previous jobs is typically advantageous.



- Teams in this industry have a temporary structure and project duration, making competition between other project teams level. This may cause the success of a project to depend somewhat on the team experiences and inner personalities.
- Different delivery systems could determine the motives behind making a project team. Numerous project sizes and types create unique processes in how to make appropriate teams.
- Sponsorship, Training, Mentorship make a successful team.
- What are the best ways to develop proposal teams?
  - Make sure there is a balance of personalities within the team. Too many leaders can cause conflicts in power, while too many followers may not have enough drive to get things done or do something different.
  - Allow team members the chance to choose their project. By advertising internally and showing incentive, it is a greater possibility that they will take ownership of the entire project.
  - In this industry, there is an intrinsic problem with single team members being on several proposals. Although companies may only win 3 projects out of 10, staffing problems arise if one person is on each of the proposal teams.
- How does the company get to know its teams?
  - The use of standardized tests, such as Myers-Briggs personality test, can help create a team with strength balance.
  - Having functions outside the work place may allow team members to get to know each other on a different level, not just being co-workers.
  - Informal staff meetings can facilitate easy-going, yet hard working atmosphere to draw team member's interest.
- How are technologies changing the way we build teams and proposals?
  - Having to utilize the expertise of consultants with new technology tools that might not be "in-house."
  - It is important to have someone who can explain and understand the technologies that are used, instead of just presenting it.



- How do/can team members learn what motivates each other?
  - The most informal, yet effective method is to just be observant and get to know your team as individuals.
  - Understand the previous training of individuals and their professional comfort zone.

### **Session 2-D: Team Building – Project Level Team Development**

- How do/can team members learn what motivates owners?
  - The most effective method is just communicating with the owner and learning their past experiences. Get to know if they care most about the “bells and whistles” or the bottom line cost.
  - Spend time away from the work place and learn what the owners/developers go through outside the construction industry.
- What leadership skills and traits are needed to manage design teams?
  - Different leadership skills are needed for different delivery types. Stereotypically a strong leader is needed on a Design-Build job and a softer leader can be effective on a Design-Bid-Build job with less responsibility.
  - It is important to have a balance of technical skills, soft communication skills, and leadership styles.
- What motivates design professionals? How does that impact how to lead project teams?
  - Many times engineers want to get through a job knowing that their work was successful and did not cause problems during construction. This will allow a good reputation to spread and draw additional work, increasing profit possibilities.
  - Architects normally want to have the most innovative and noticeable design, which could win them awards. Sometimes if an owner won't spend as much money as the architect would like, they may leave the project.
- Does prequalification of prime contractors help or hurt the formation of project teams?
  - Help in the sense that one would understand contractor's capabilities, past experiences, bonding capacity, previous clients, and project team members. Less concern in knowing if they are or are not suitable for specific jobs.



- Prequalification can also hurt the formation of teams because preferred subs might not want to “touch” certain prices for some work. This can be very difficult in Lump Sum jobs.

The level of enthusiasm and overall knowledge of the subject matter between the two sessions is what surprised me the most. During the “in-house” project development, almost every industry member was eager to discuss the methods and inner workings of their company. This included some mention of a few points of concern and how they felt the development within their company could be improved. When the time came around to discuss owner/designer motivation and other issues related to outside parties, conversations seemed to lessen. It was a struggle to keep the session progressing through the entire hour.

This makes me wonder whether the GC/CM project teams really ever go the extra mile to figure out project teams away from their own. Could it be because of a lack of available time, lack of interest, or what? Digging further into research about *Project-Level Team Development* may hit points of new concern and educate the industry, but it also seems like it could turn into a “vent” for frustrated employees to mud-sling. Coming to such a conclusion this early may be brash, but numerous accounts of Architect problems arose during the afternoon session.

After attending the two *Team Building* sessions, I am most interested in how companies develop their “in-house” project teams. Using the Myers-Briggs personality tests and other formal screening methods, as discussed with John Tarpay of Centex Construction, doing such theoretical/psychological processes in this industry seems original. Comparing how well projects develop and finish, depending on the structure of teams seems applicable to not only the construction industry, but also scenarios outside the work place.

Although no real problems have been encountered within my chosen building for thesis, it will be interesting to evaluate what was done by DAVIS Construction in their development of our project team. Doing further evaluations with multiple companies and projects, concerning project development and their success/failures, may be quite interesting.



## Key Contacts

The top three contacts listed below are people who had shown an interest in a number of Team Building issues discussed during the PACE Roundtable. Mention of the Myers-Briggs testing methodology within each company and how project teams are put together has grabbed my interest with them. The final two contacts from DAVIS will be a source to relate any findings to the Capital One Lecture Hall and how it may or may not be applicable to my experience with DAVIS.

Katie Lynahan – Barton Malow Company

Greg Stewart – Gilbane Building Company

Mark Konchar – Centex Construction

Mike Pittsman & Bill Moyer – James G. Davis Construction Corp.





## Critical Issues Research Method

After further thought and discussion of the Roundtable issues, I feel it would be most beneficial to direct my research more towards design teams and their interaction with the GC/CM's. Seeing as though the *Project-Level Team Development* discussion was lacking enthusiasm from numerous project managers; I feel that this detached perception of design teams may be widespread through the construction industry. The only way to develop these relations and communication between teams is to expose problems at the root and suggest improvements.

**Problem Statement** – As projects and the teams working on them get larger, open communication and integrity seem to be put on the “back-burner.” If design teams and contractors do not accept each other as working for the same cause, many problems may arise during preconstruction and construction phases. Due to the increased flow of communication between project teams during value engineering, it is imperative to have team building and partnering exercises put into place.

**Audience and Benefiting Groups** – Although the main emphasis of this research will be in relating design teams with general contractors and construction managers, owners shall also benefit in knowing how their players interact. By increasing partnering relationships, the goals and needs of whoever is involved shall be considered.

Construction projects change in duration and team members from job to job. The only way to overcome differences in team objectives and motivating factors is increase trust and open communication. Exercising team building activities between contractors and design teams may not only improve project costs, but also improve coordination and decrease schedule durations. In hopes of collected relevant data, a preliminary survey has been included as part of **Appendix A**. The key contacts listed in the previous section shall be altered and may include any company that had attended **Career Fair**, not just the **PACE Roundtable**.



## Problem Identification

### **Construction Management**

A few months into the project, after the basement excavation was complete and cast-in-place walls were in progress, Capital One brought up the idea of finishing construction two months earlier than previously agreed upon. By doing a time and cost analysis of its feasibility, DAVIS could determine if pursuing such a task would be profitable.

- Consider sheeting and shoring systems into the excavation and prep work for the Lecture Hall's foundation. By utilizing soil retention methods, footings for the auditorium and lobby space would have been completed earlier, instead of waiting for the completion of the basement and backfilling.
- Develop an analysis for overtime work, increasing crew sizes, and alternate construction methods in order to shorten the project schedule. See if the initial cost increase would be offset by the savings Capital One would receive from the completion of their project two months earlier.

After running a few parametric and square foot estimates in our Technical Assignment #1, it was clear to notice the extremely high cost of construction compared to similar facilities. During the initial development phase of the Lecture Hall, obtaining a reasonable figure for DAVIS' Interim GMP was quite difficult. Utilizing a few more VE items listed below may further decrease the overall cost of construction.

- The exterior glass and glazing has been estimated to cost roughly \$1.5 million, including the skylight and curtain wall. The curtain wall system is from Italy, with glass coming from Asia.
- With the approximated 400-450 seats in the auditorium, coming from outside the US, a cost of \$800 thousand is expected.
- Although the large garden atrium inside the main lobby will be beautiful, additional systems will be required to keep the space kept in shape. Some of these being maintenance of the water fountain feature, landscaping, and proper interior lighting for the trees.



## Structural System

The current design for the auditorium's catwalk consists of the same steel beams and joists seen for larger structural systems. This type of methodology is quite expensive and contributes to a substantial portion of the steel subcontractor's bid.

- Determine what kinds of loads are expected on the catwalk, including more than typical stage lighting systems and its operators. Research and propose a different structural system for the catwalk which would be less expensive, yet still be able to withstand estimated loads.

Initially, the large skylight in the garden atrium was only figured to support vertical loads. After further consideration with wind and other horizontal movements, especially loads transferred from the base building, more structural design calculations would need to be made.

- Assume magnitudes of typical loads which may cause horizontal movement from base building or environment. Design columns and lateral support system accordingly.

## Mechanical System

At the current moment, heating and hot water shall be supplied by two boilers in a second, smaller mechanical room. All of the cold water and air conditioning for the lecture hall space shall be produced from three air handling units contained within the main mechanical space. Having two separate locations for HVAC and plumbing equipment creates a very congested basement, in addition to extra mechanical lines throughout the building.

- In order to conserve space, remove the boilers and all associated piping. Redesign the proposed AHU's with electric heaters and necessary connections. Analyze this option as a possible VE item as well. When removing the two boilers and adding electric heaters into the air handling units, is there a savings in cost? How will this effect the electrical demand and proposed distribution panel layout?



## Electrical/Lighting System

With an existing 595,000ft<sup>2</sup> base building attached to the Lecture Hall, providing natural light into the garden atrium poses to be a problem. Grolites had been redesigned into the space, although the extra heat source created a problem for the mechanical system. The additional heat loads would not be offset by the current sized AHU equipment.

Propose an alternate lighting system for the garden atrium which may not produce as much heat, forcing the mechanical system to be changed. How might this new lighting layout effect additional distribution panel requirements? Analyze the cost difference between changing the lighting system and resizing the mechanical equipment. Which is least expensive?

]



## Technical Analysis Methods

### Value Engineering

#### *Problem:*

Like many construction projects, obtaining reasonable costs for every building system within the Lecture Hall was quite difficult. The main concern for this building was being able to provide the pre-negotiated GMP of around \$15 million as the final agreed upon price. From Technical Assignment #2, this dilemma became more evident while performing parametric and square foot estimates in comparison with similar project. The purpose of this analysis is to accompany the research into the idea of value engineering previously discussed as a critical industry issue with team building and partnering.

**Figure 1. Garden Atrium**



**Figure 2. Curtain Wall System**



#### *Research and Methodology:*

Looking over the Total Project Bid Summary sheet provided by DAVIS would be an easy start in determining which building systems may be open to value engineering. Diving further into the project specifications and drawings could also provide a more clear idea of superfluous scopes of work. Speaking with DAVIS will be another option to get ideas where alternate products can be used. Once a list of VE items has been obtained, obtaining proper approval of their adequacy from the architect and design teams is a must.



## Redesign of the Steel Catwalk

### *Problem:*

As currently designed, the catwalk included within the auditorium consists of large steel members. Stated in the previous section, this system is quite expensive due to the ever increasing market price of steel and contributes to a large portion of the subcontractor's scope of work. If it is possible, propose an alternate structural system for the steel catwalk. As shown in the accompanying picture, the catwalk will be fastened to the steel trusses being put in place.

### *Research and Methodology:*

To begin this process, it will be important to consider all of the possible equipment and live loads on the catwalk during any given conference. Once all of these calculations have been figured, reviewing the original cost estimates and schedule duration will be beneficial as a starting block for comparison. Research for an alternate system will start with conversing with the structural engineer and possibly a theatrical system consultant. After different options have been discussed, figuring out whether the proposal is structurally sound would be the first check. Analyzing its value savings, constructability, and possible reduction in construction time would be the final concerns to determine.



Figure 3. Placement of Steel Trusses



## **Redesign and Deletion of Boilers**

### ***Problem:***

With DAVIS' Interim GMP being greater than what was desired by Capital One and a lack of available space within the basement floor plan, an alternate mechanical system seemed imperative. Besides the three air handling units, two boilers were designed in a congested area distant from the main mechanical room. Having two separate mechanical rooms and additional pieces of equipment did not seem cost or space effective. In order to conserve space and decrease the overall mechanical scope of work, removing the boilers and all associated piping would have numerous benefits. By removing the boilers, an addition of electric heaters within the air handling units would be needed.

### ***Research and Methodology:***

Before any proposals can be made, it would be important to speak with the mechanical engineer (KTA Group) about the feasibility of such a change. In order to receive a basis of which to compare an alternate mechanical system to, it will be necessary to perform preliminary load calculations of the initial system. Not only will the loads be important, but also an understanding of its space requirements and material costs can be helpful in the system analyses.

Once all of the preliminary thesis investigation areas have been considered, an analysis of the electric heaters within the air handling units is required. First, it would be important to check whether load requirements within the atrium and auditorium can be met. An investigation of the alternate HVAC system concerning cost savings and constructability will be the main focus of this redesign.



## Appendix A

### **Team Building/Partnering for Value Engineering**

*Company:* \_\_\_\_\_

*Name (optional):* \_\_\_\_\_

*Project Type:* \_\_\_\_\_

*The first section of the questionnaire consists of a sequence of positive statements to which you are requested to indicate how much you strongly agree (5) or strongly disagree (1). Please rate the accompanying statements to indicate how you feel at the present time.*

1. I feel I am working in a trusting environment: \_\_\_\_\_
2. I feel I am working in a positive atmosphere and being respected: \_\_\_\_\_
3. I feel that good communication is being maintained: \_\_\_\_\_
4. I feel that working relationships are honest and upheld with integrity: \_\_\_\_\_
5. I feel that I am working in a team, with no exclusions: \_\_\_\_\_
6. When disputes arise, I feel that they are being resolved in a timely manner: \_\_\_\_\_
7. I feel that disputes are being resolved considering the needs of everyone: \_\_\_\_\_
8. I feel that every party is contributing to the overall goal of the Contract: \_\_\_\_\_
9. I feel that every party is working to minimize waste from design and construction: \_\_\_\_\_

*The second section of the questionnaire consists of a sequence of short answer questions relating to Value Engineering and similar activities. Please respond to each question that may apply to your given project. Additional comments to increase understanding of the answers may be added at the conclusion of this survey. If value engineering or other activities to add value to your project were not performed, you may omit this part.*

1. What was the date of release of the 50%, 75%, and 100% Construction Documents?
2. When was value engineering first considered as an option?
3. Was the aim of value engineering to cut job costs? If so/not, what about it?
4. Was the aim of value engineering to add value to the job? If so/not, what about it?
5. Were the Owner's needs considered when evaluation value engineering? If so/not, why or why not?