3. Technical Report #2: Analysis of Key Construction Features

3.1 Executive Summary

This technical assignment covers the analysis of key construction features of the Penn State Fayette's Multi-Purpose Community Center located in Uniontown, PA. Within this document a detailed project schedule, an assemblies estimate on the foundation system, an expanded report of contractual agreements, a staffing plan, a breakdown of the MEP design coordination, and critical industry issues discussed during the PACE roundtable can be found within this document.

The detailed project schedule expands upon the schedule found in tech report 1. This schedule reflects how the project was built over its 307 days, 14 month construction time. This schedule is the basis by which all coordination and planning will be made and or resolved.

Cost Works was utilized to perform an assemblies estimate. The foundation system was estimated to roughly 10% of actually construction, both material and installation, costs. The take off of the substructure system includes spread footings, strip footings, and slab on grade. The total estimate cost of the foundation system is approximately $320,000. In the following technical report, technical report 3, a more detailed unit price system estimate will be performed and include the foundation system and structural system, as these system are a possibility for further investigation into value engineering ideas.

The contract, staffing plan, and design coordination sections have an in-depth evaluation of the contractual agreements between parties, there interaction with one another, challenges, pre-qualifications, insurances, bonding, and the commissioning processes found on the Multi-Purpose Community Center's job site. The project delivery method used on this project along with contractual agreements and project staffing are standard among the constructing industry. Penn State is an experienced owner and has a highly detailed direction they take with most of there projects, as they have on this specific one.

Critical Industry Issues covers the PACE roundtable discussions had between key industry members and their soon to be colleagues as well as possible topics of interest for my senior thesis. Green buildings, LEED rating, Value Engineering, and Sustainability are of great interest to me as I will be perusing them in future reports for Architectural Engineering Senior Thesis 2005.

This Technical Assignment #2 will allow the analysis of key construction features on the project that affect the overall project execution.

3.2 Assemblies Estimate:

A change/revision to the foundation system/substructure has been considered for a possible value engineering idea on the Multi-Purpose Community Center. In considering V.E. the foundation system it was decided to perform an assemblies estimate for the specific system. The assemblies estimate is a fast and efficient way to produce a quality cost analysis of a specific system in under a day's time and with an accuracy of approximately 10%. A more in-depth and accurate unit price estimate will be submitted in Technical assignment #3.

The first spreadsheet provides information on the cost, both material and installation, of a single unit. The second spreadsheet provides a quantity takeoff on the footings and slab-on-grade as well as provides an overall assemblies estimate/cost of the substructure found on the Community Center.

Penn State Fayette Multi-Purpose Community Center (Foundations Est.)					
Qty	**Description**	**Unit**	**Mat.**	**Inst.**	**Total**
1	Strip footing, load 11.1KLF, soil cap 6 KSF, 24"wide x 12"deep, reinf	L.F.	9.00	17.90	26.90
1	Strip footing, load 14.8 KLF, soil cap 6 KSF, 32"wide x 12"d, reinf	L.F.	11.20	19.60	30.80
1	Strip footing, load 22KLF, soil cap 6 KSF, 48"wide, 16"deep, reinf	L.F.	19.50	27.50	47.00
1	Strip footing, load 25.6KLF, soil cap 6 KSF, 56"wide x 16"deep, reinf	L.F.	23.00	39.50	62.50
1	Spread ftgs,3000 PSI conc, load 50K, soil cap 6 KSF, 3'-0" sq x 12" d	Ea.	38.50	91.50	130.00
1	Spread ftgs,3000 PSI conc, load 75K, soil cap 6 KSF, 4'-0" sq x 12" d	Ea.	66.00	136.00	202.00
1	Spread ftgs,3000 PSI conc, ld 100K, soil cap 6 KSF, 4'-6" sq x 15" d	Ea.	99.50	186.00	285.50
1	Spread ftgs,3000 PSI conc, ld 125K, soil cap 6 KSF, 5'-0" sq x 16" d	Ea.	128.00	224.00	352.00
1	Spread ftgs,3000 PSI conc, ld 200K, soil cap 6 KSF, 6'-0" sq x 20" d	Ea.	223.00	350.00	573.00
1	Spread ftgs,3000 PSI conc, ld 400K, soil cap 6 KSF, 8'-6" sq x 27" d	Ea.	585.00	765.00	1,350.00
1	Spread ftgs,3000 PSI conc, ld 800K, soil cap 6 KSF, 12'-0" sq x 37" d	Ea.	1,550.00	1,700.00	3,250.00
1	Slab on grade, 5" thick, non industrial, reinforced	S.F.	1.54	2.33	3.87
	Totals		**$2,754.24**	**$3,559.33**	**$6,313.57**

Penn State Fayette Multi-Purpose Community Center (Foundations Est.)					
Qty	**Description**	**Unit**	**Mat.**	**Inst.**	**Total**
40	Strip footing, load 11.1KLF, soil cap 6 KSF, 24"wide x 12"deep, reinf	L.F.	360	716	1,076
1,475	Strip footing, load 14.8 KLF, soil cap 6 KSF, 32"wide x 12"d, reinf	L.F.	16,520	28,910	45,430
700	Strip footing, load 22KLF, soil cap 6 KSF, 48"wide, 16"deep, reinf	L.F.	13,650	19,250	32,900
340	Strip footing, load 25.6KLF, soil cap 6 KSF, 56"wide x 16"deep, reinf	L.F.	7,820	13,430	21,250
11	Spread ftgs,3000 PSI conc, load 50K, soil cap 6 KSF, 3'-0" sq x 12" d	Ea.	424	1,007	1,430
5	Spread ftgs,3000 PSI conc, load 75K, soil cap 6 KSF, 4'-0" sq x 12" d	Ea.	330	680	1,010
5	Spread ftgs,3000 PSI conc, ld 100K, soil cap 6 KSF, 4'-6" sq x 15" d	Ea.	498	930	1,428
17	Spread ftgs,3000 PSI conc, ld 125K, soil cap 6 KSF, 5'-0" sq x 16" d	Ea.	2,176	3,808	5,984
2	Spread ftgs,3000 PSI conc, ld 200K, soil cap 6 KSF, 6'-0" sq x 20" d	Ea.	446	700	1,146
4	Spread ftgs,3000 PSI conc, ld 400K, soil cap 6 KSF, 8'-6" sq x 27" d	Ea.	2,340	3,060	5,400
1	Spread ftgs,3000 PSI conc, ld 800K, soil cap 6 KSF, 12'-0" sq x 37" d	Ea.	1,550	1,700	3,250
50,700	Slab on grade, 5" thick, non industrial, reinforced	S.F.	78,078	118,131	196,209
	Totals		**$ 124,191**	**$ 192,322**	**$ 316,513**

*Note – construction costs listed here are only material and installation estimates. This estimate does not take into account:

- General Conditions
- Home office overhead
- Design fees
- Contingencies
- Profit.

These specific fees and project costs will be looked at more in depth during Technical Assignment #3. The estimate was adjusted for time and location.

The Cost Works software used to produce the assemblies estimate was very user friendly and efficient in design. The soft ware helped produce quality numbers in a short amount of time. It helped save time because the estimate was able to be exported to excel with all the formulas for tabulation already assigned. The Cost Works software, in my opinion, is an efficient means to produce an assemblies estimate and with a little more time or tutorial I am sure I would find new features which enable me to produce a more accurate result.

The Cost Works did have it short comings though. The amount of various sizes, reinforcements, and under filling hurt the estimate. Various sizes for the footings, strip and spread, were not found with in the data base. The majority of the dimensions were not accurate to specs. Most footing sizes were found to be too large or too small in numerous directions, so a smart average was taken to produce the best overall results. This is most notably the cause for only 12 line items being shown even though there were many more 12 items that were taken off. Another item that was not found on the Cost Works software was the usage of an under filling consisting of 1,500 PSI concrete below the footers were the geo-technical engineer determined the soil to be less than sufficient to support the required loads.

3.3 Contracts / Staffing Plan / Design Coordination

Contractor Selection:

Project No: 04-11866.01, Single Prime Contract No.1

- General
- HVAC
- Plumbing
- Electrical
- Telecommunications

Notes:

- Mandatory Pre-Bid Conference
- Prequalification- All contractors bidding directly to Penn State and certain other contractors (even if acting in a subcontractor capacity) are required to be pre-qualified. For prequalification consult or see below: www.opp.psu.edu/divisions/dc/bids/index.html

Requirements for Prequalification

1. Submit on Corporate Letterhead:
   A. Firm's legal name, address, primary contact, phone and fax numbers, and corporate e-mail address.
   B. Summary of Financial Statement indicating firm's positive equity. (Attach a current reviewed financial statement covering at least a one-year period. All Accountants' Notes to the Financial Statement must be included.)
   C. Summary of both single and aggregate bonding capacities. (Attach a current statement from bonding company (on bonding company's letterhead) identifying single and aggregate bonding capacity in dollar amounts.)
   D. List of Penn State campuses where firm desires to be considered for work.
   E. Prequalification categories. (Attach three (3) references each on reference forms for recently completed projects and architectural or engineering firms. Penn State has a preference for projects performed in Pennsylvania. Provide separate forms for each category that firm requests prequalification.) Penn State requires six (6) references (use two pages for project references and two pages for AE references) if applying for telecommunications trade category.

* Penn State requires Contractors performing the following categories of work to be prequalified.

1. Construction Manager	2. General	3. Asbestos Abatement
4. Earthwork	5. Paving	6. Landscaping
7. Concrete	8. Pre Cast	9. Masonry
10. Structural Steel	11. Mill Work	12. Roofing
13. Painting	14. Elevators	15. HVAC
16. Fire Protection	17. Plumbing	18. Building Mgt. Systems
19. Electrical	20. Telecommunications	21. Erectors
22. Underground Site Utilities		

2. List your firm's Interstate Experience Modification Rate (EMR) and Commonwealth of Pennsylvania Experience Modification Rate (EMR) for the three most recent years including total hours worked and total hours worked in the Commonwealth of Pennsylvania.

3. Upon completion, send the information to:
   Manager, Contract Administration
   The Pennsylvania State University
   Physical Plant Building, Room 106
   University Park, PA 16802-1118

   INCOMPLETE PACKAGES WILL NOT BE CONSIDERED.

4. The Prequalification Process typically requires two weeks.

5. After required information is reviewed, contractor will be notified by e-mail that either (1) company is now on Prequalified List or (2) application has not met Penn State requirements.

Requirements for Remaining On Prequalified List

1. Acceptable ratings on Contractor Performance Evaluation Form.
2. Annual submission of complete and current reviewed financial statement with all Accountants' Notes.
   Financial Statements older than six months will not be accepted.
3. Annual submission of updated bonding capacity (single and aggregate) on bonding company letterhead.
4. Written verification of Company name, address, phone and fax numbers, and corporate e-mail address, and trade category(ies) from web site when updating information.

5. Annual submission of most recent Interstate Experience Modification Rate (EMR) and (EMR) for the Commonwealth of Pennsylvania. Include also total hours worked and total hours worked in the Commonwealth of Pennsylvania.
6. IT IS THE COMPANY'S RESPONSIBILITY TO PROVIDE UPDATED INFORMATION TO THE UNIVERSITY.

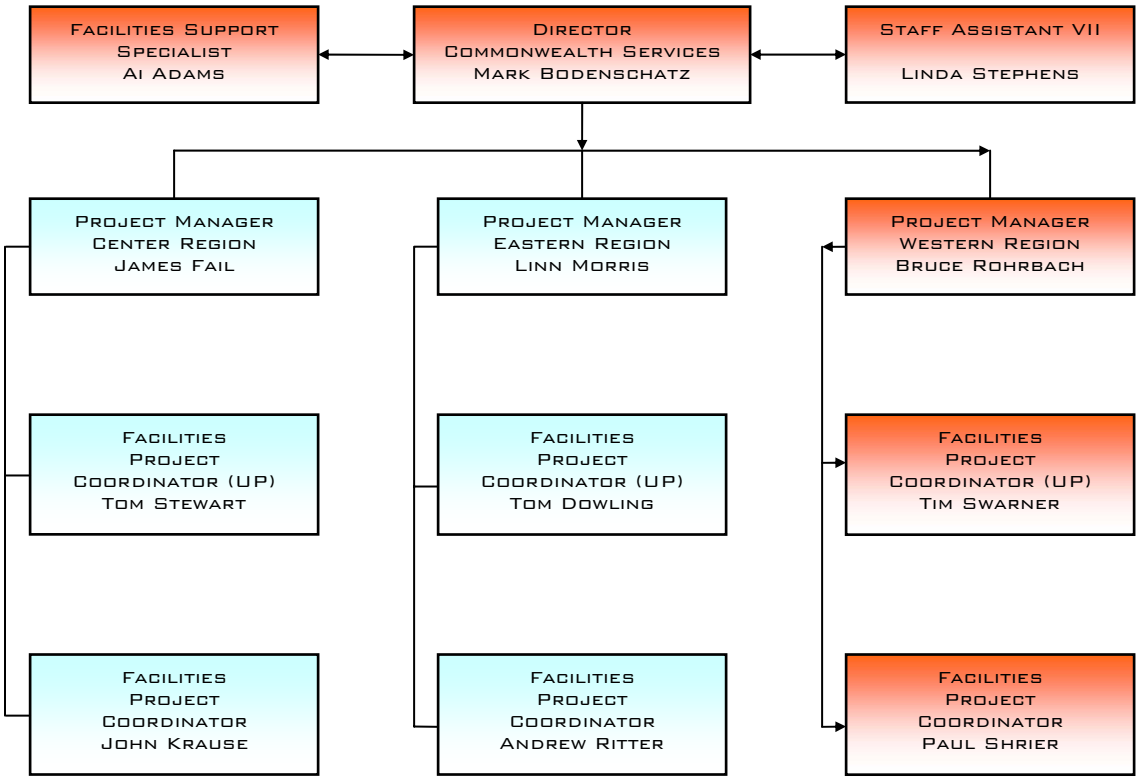
- Bonding Required
  - Bid – 5% of the total bid amount
  - Performance – 100% of the contract price
  - Payment – 100% of the contract price
  - Worker's Compensation Insurance
  - General Liability Insurance
- Owners are not obligate to accept the lowest bid.
- Owner shall have the right to accept alternatives.
- Bidders shall to commence work at the site within ten days (10) after the date of "Notice to Proceed" of the contract is awarded.
- Building permits are to be included in the cost of the bid.
- Prevailing wage.

Penn State usually bids out all of their construction projects. To be eligible for bidding the contractor must meet the above requirements found in the prequalification for Penn State, located in the previous paragraphs. The bonding capacity as well as the companies financial security is taken into account to qualify. Once the contractor has been approved, they are then invited to bid on that specific project. Penn State will usually award the contract to the low contract bidder, although as stated earlier, Penn State is not required to award the contract to the low bidder. On this specific project Penn State only need to fund approximately $4.5 for the project as $6.1 million was donated by Mr. Eberly, a wealth and generous entrepreneur from Uniontown.

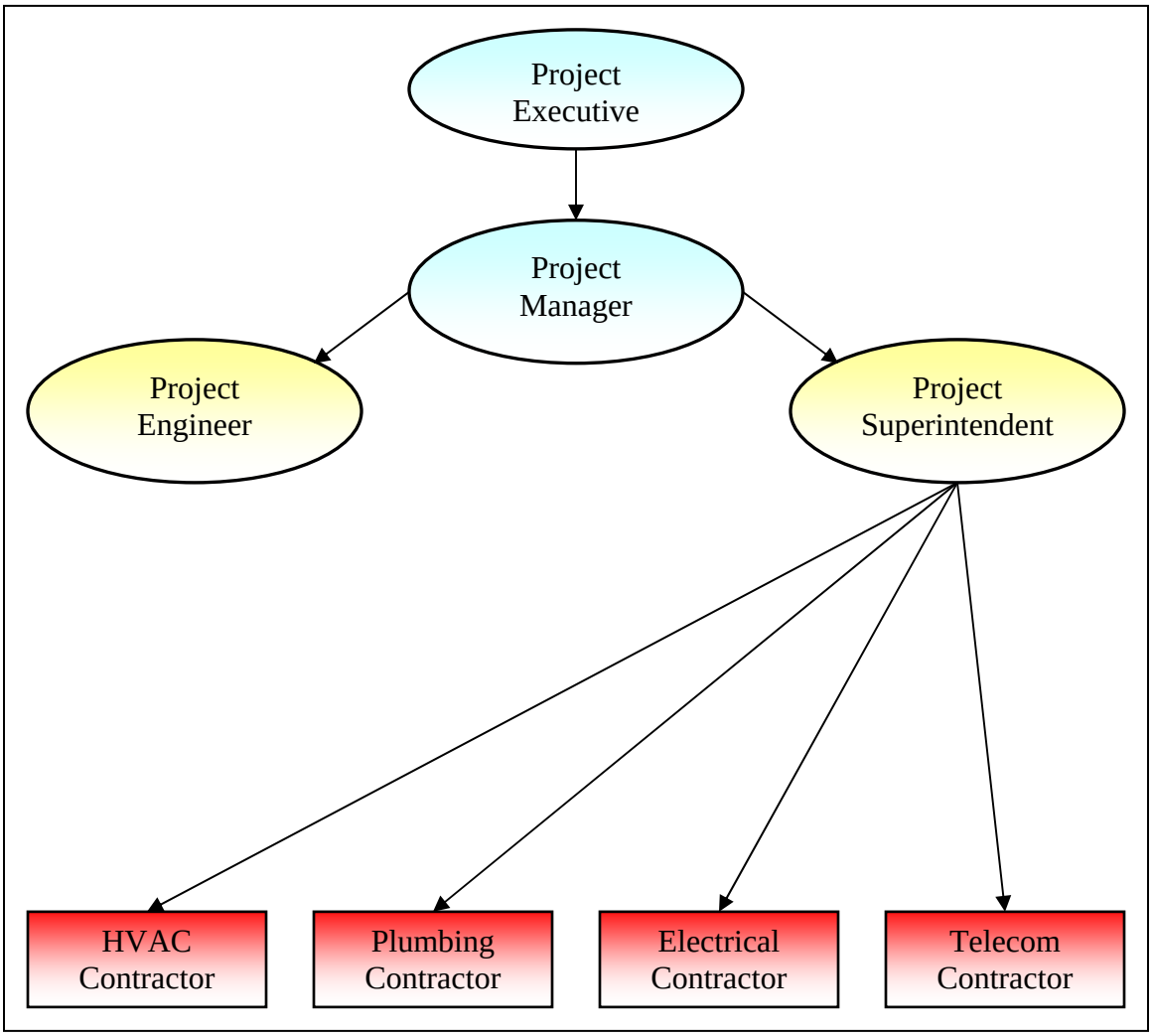
Penn State as an owner is very experienced. They build and finance numerous multi-million dollars projects every year at University Park or any of there 28 branch campuses. Penn State usually chooses the appropriate contract type and delivery system to get the desired job done on time and within budget with their desired high level of quality. This project specifically in particular was no different. The job is currently operating smooth with no major hiccups thus far.

As stated in this and past technical reports, Penn State has a highly detailed qualification and commissioning process/plan. Penn State / OPP have teams designated to specifically work with the branch campuses. The Commonwealth Services (CS) is a division within OPP that helps the supplemental staff at each campus with establishment, origination, planning, coordination, monitoring, and enforcement for policies, and procedures to ensure a quality, and a well coordinated construction project within the various branch campuses of Penn State. The organization chart of the Commonwealth Services of OPP can be found below. The specific team (the Western Region) utilized on this project is highlighted in this organizational chart.

3.4 Commonwealth Services Chart



3.5 Staffing Plan:



The General Contractor, Mucci Construction is in charge of all project coordination. The Project Manager, Engineer, and Superintendent are all located on site full time during this 14 month, highly MEP intensive project. With the help of OPP and a set of detailed MEP coordination drawings from Mechanical Contractor, Whitby, everything on the Multi-Purpose Community Center at Penn State Fayette has proceeded with little fuss.

Mucci Construction has the Project Manager, Engineer, and Superintendent on the site full time. As usual various other member of the General Contracting team are involved throughout the project such as the estimator, secretary, scheduler, purchasing agent, accountant, and Project Executive, but are commonly involved with some of the behind the scenes processes such as financing, change orders, and RFI's.

Proposed Staffing Plan - GC- Mucci Construction				
Month	PM	Exec.	PE	Super
1	1	1	1	1
2	1	1	1	1
3	1	0.5	1	1
4	1	0.5	1	1
5	1	0.5	1	1
6	1	0.5	1	1
7	1	0.5	1	1
8	1	0.5	1	1
9	1	0.5	1	1
10	1	0.5	1	1
11	1	0.5	1	1
12	1	0.5	1	1
13	1	1	1	1
14	1	1	1	1

Note*

- Biweekly project meeting required.
- PM, PE, and Super are all located on the job site full time (40 hours).
- Table value is equal to 1 full month's time.

Coordination:

- The General Contractor shall be responsible for the overall coordination, control, and progress of the work for all of the other Prime Contractors, Subcontractors, and material suppliers involved in the project.
- The Contractor shall also be responsible for preparing the progress schedule indicating the sequence and time required for the varied disciplines of the work. The progress schedule shall be submitted by the General Contractor to the other Prime Contractors requesting their sequence and time requirement input. The Prime Contractors will be required to either approve the progress schedule submitted by the General Contractor or give comments for correction.
- After approval by all Prime Contractors, one progress schedule showing all disciplines shall be prepared. The completed progress schedule shall then be submitted to the Professional for review and approval. The approved progress schedule shall then be issued by the General Contractor to all Prime Contractors, the Professional, and the University.
- The General Contractor shall coordinate all work on the project so as to insure the proper incorporation, within the project, of all necessary items and to insure the proper execution or the work.

Project Meetings:

- Preconstruction Conference- Prior to commencement of the work, the Contractors shall meet in conference with the representatives of the Owner, to discuss and develop a mutual understanding, relative to administration of the project, general conduct of the work, progress schedules, safety programs, labor provisions, and other contract procedures relating to the work.
- The General Contractor shall provide space to conduct a regularly scheduled, biweekly meeting at the site for the purpose of coordinating the work. The General Contractor shall require representation from all Prime Contractors and by any Subcontractors upon the request of the Professional or the University.
- The Professional shall take and retain a verbatim record of the biweekly meeting by tape recorder, and shall prepare and distribute summary minutes of each meeting within four (4) days to the University, the Contractors, and all other interested parties.

The main issue of concern during MEP coordination is as usual ductwork, as it is usually the most space consuming and rigid task. As stated prior, Penn State has a detailed commissioning plan and coordination plan. Burt Hill the Architect does a comprehensive "Ready Check" review. Then, the coordination requirement of the GC contract takes over. Burt Hill & PSU do on-site inspections to see that all is in order. The commissioning agent does this as well; please see the commissioning plan for further detain.

3.6 Critical Industries Issues (PACE Roundtable)

Integrated Design and Construction I – Dr. Messner

Within the integrated design and construction session with Dr. Messner we cover topics that I considered to be general knowledge and some which surprised me. We covered issues that will concern me within the near future such as the time and coordination required to produce quality building from a distance. Other topics of concern to me are the overall impact to globalization and the various aspects of distribution team and how they have and will deal with the design and construction process. As stated before, some of the issues/solutions to some of these problems seem like common knowledge, such as early CM involvement, and more detailed front end planning.

There were a few thinks that had surprised me as well, such as a new movement to overseas detailing and fabrication. producers can have a choke hold on the market if they can roll, design, and fabricate quality structural steel members in one general location, so why not? Obviously the financial benefits out weigh the coordination costs. Another issue that I found interesting was the fact that if you are designing a structure on East Coast but are based on the West Coast, you need to familiarize yourself with local codes, regulations, material availability, and construction techniques. We discussed and analyzed some horror stories of such a situation. I find it hard to believe that a PE would make such foolish mistakes but I guess that it is common as we have discussed numerous real life examples.

Although I did learn a few valuable lesions throughout this session I really didn't find anything in particular that would apply to my specific project. I had never really heard any mention about this until the PACE roundtable. I knew that the majority of steel was now being shipped from across the ocean, but detailing and fabrication as well. Seems a little difficult to coordinate such an activity, but I guess since the steel is being rolled over there, the

Integrated Design Management II – Mike Pulaski

I walked away from this session feeling much more knowledgeable about the construction industry, value engineering, value enhancement, and green building. This session in particular was definitely a worthwhile experience for me. I received some good ideas about my thesis project and made very knowledgeable contact in Mike Pulaski.

We covered an array of topics in this session. We covered easy value engineering ideas called low hanging fruit that can basically be applied to any project. Some examples of low hanging fruit are: resizing cable trays, brick facades, flooring types, mechanical types, and even water less toilets. Another topic of interest to me is value engineering more specifically value engineering vs. life cycle cost, and how exactly they intertwine with one another. Value engineering has often been given a negative connotation, most notably with cost cutting when a project is coming in over budget. There are two very distinct value engineering approaches, cost cutting exercises and value adding efforts. A major movement to green buildings has made the ladder more apparent to the construction industry. The VE ideas in green buildings are helping solve some of the industries issues by getting the CM involved with the process earlier. Construction teams are using tools such as life cycle costing and return on investments to make an educated decision on the best option. The CM is spending more time evaluating VE options and learning what the owner truly wants and what is the best course of action to get there.

I found a topic that I would be interested in researching for my thesis project, funding and LEED rating for green buildings. Through this session I made a quality contact in Mike Pulaski. He is very knowledgeable in the area of sustainability and green buildings. Penn State is soon going to require that building built by Penn State be LEED rated. Even though my project, Penn State Fayette Multi-Purpose Community Center is not rated, I would like to see what ranking my building currently could obtain, and what ranking it could receive with a few tweaks in the design. Follow that up with a cost analysis of these proposed changes in the design and provide some insight on where the funding would possibly come from.