Community Healthcare

Mid-Atlantic

Technical Assignment III

Kenna Markel

The Pennsylvania State University
Architectural Engineering
Construction Option

FRAUENSHUH
Commercial Real Estate Group

PERKINS
+ WILL

DPR
CONSTRUCTION

2015
2016

Table of contents

Executive Summary

The following report for Technical Assignment III investigates potential construction depth topics based on project specific issues and critical industry topics. This report will summarize an interview with the project manager of this facility concerning topics of value engineering and lessons learned as well as outline concepts and discussion from this year's PACE Roundtable event. Areas of BIM usage and LEED efforts are analyzed later in this report as well to further develop which degree of implementation would be value adding.

In an interview with Bill Hahner, Project Manager for DPR Construction, issues of constructability and late design changes were among the major issues for this project. The DPR Construction team has been balancing essentially two different owners with different goals for the overall project. While the developer has been keeping their costs down for the core and shell, the primary tenant's concern with functionality of their final space has been driving up the cost of their interiors package with change orders. While many aspects of the project were value engineered to achieve the developers budget goals, potentially working with the tenant more during design could have better helped to illustrate to the tenant the design thus minimizing the change orders.

The PACE Roundtable event covered many different industry issues including BIM and starting work in the industry. Additionally, the sessions covered distributed leadership and improving collaboration in the field. Ultimately, there were many takeaways from these sessions that were reviewed with a leadership member at the end of the day. Potential construction topics specific to Community Healthcare were discussed with Jerry Shaheen of Gilbane; his feedback will be summarized in this report.

While BIM was only used on Community Healthcare project for creating drawings, this report will cover which additional BIM uses could have added value to this project. By reviewing the project goals, potential BIM uses were analyzed to see which ones would improve different aspects of the project. While many different BIM usages appeared to provide added value and potential cost savings, it is ultimately difficult to determine ahead of time which methods would fix the current issues during construction not knowing what issues would arise.

Like BIM, LEED certification was not pursued on the project either. The cost associated with becoming LEED certified did not align with the ultimate project goal of the developer to keep costs down. However, due to current design practices, the project does meet many of the credits for certification according to the LEED BD+C v4 for Healthcare. The project was able to attain thirty eight credits base on the current design. Since the project is only two credits away from becoming Certified, it would be fairly easy to do so, but once again the project goals do not align with becoming LEED Certified.

Project Manager Interview

This section contains a summary of the interview conducted Tuesday, November 3, 2015 with Bill Hahner, Project Manager for DPR Construction on the Community Healthcare Project. For the complete question and answer portion of the interview refer to Appendix A.

The DPR Construction team has been working on this project as early as schematic design providing preconstruction and estimating services. This project was bought out in two separate GMP packages: one for the core and shell and one for the tenant interiors package; therefore, the two different clients had different goals for the project. The developer of the project, building the core and shell, was focused on keeping the cost down in order to maintain profit. Meanwhile the tenant for this space was primary concerned with maintaining the schedule to open the facility up to patients on time. Additionally, this tenant prioritized function of the space over cost. Therefore, one of the major challenges for this project became managing the change orders from the primary tenant. There were also some design issues that lead to constructability issues picked up in the field.

In order to drive down the cost to the developer, many aspects of the building were value engineered out. Since the tenant was more concerned with functionality, it was not difficult to convince the team to rule out some of the architectural features. The only party the pushed back on the architectural features was Perkins +Will, the architect of record. Perkins +Will initially wanted more of the façade to include curtain wall and metal panels. However, after four iterations of value engineering for the façade, the resulting design saved around $160,000. Additionally, some of the acoustical features were value engineered out as well. Originally the design called for all the walls to back up to the deck and be insulated all the way up to improve sound isolation between all the spaces. However, due to the cost, the method was ultimately used only for patient care areas saving between $25,000 and $50,000. Also an earlier design called for all solid surface countertops. This was later revised to only use solid surface for wet areas and plastic laminate for all other countertops.

In terms of potential topics to investigate for next semester thesis, there were a few areas that could be further analyzed. While the project's delivery method and project financing seemed effective, issues of late design changes could have been reduced by better integrating the tenant into design reviews. Potentially using some form of virtual reality or augmented reality could help minimize the change orders from the tenant. Additionally, there were many constructability issues discovered in the field that could have been caught earlier by virtual mockups around areas of concern. The skylight posed as major area of constructability as well; this a feature that could be redesigned. Finally another issue for the project was the civil work schedule. The current plan needs 95% of the site to be stabilized before the civil work can be done on the pond. If this work had been re-sequenced, the project would not have the additional costs associated with planting out of season.

Life after the BIM Revolution

Featuring Robert Amor, PhD

Dr. Robert Amor's presentation on *Life after the BIM Revolution* centered on his belief that the technology to improve the construction industry is there, the industry just needs to determine the best methods for implementing these technologies. He began his presentation by summarized many of the technologies available including virtual reality, game platforms, augmented reality, social communication, wireless connections, and 3D printing capabilities. However, throughout his presentation he also noted the short comings of the many BIM technologies. Dr. Amor presented the Gartner Research Hype Cycle Diagram shown in Figure 1 that demonstrates where many of these BIM technologies are in the construction industry. The Gartner Hype Cycle illustrates that when a new technology is released there are inflated expectations of what the technology can do. When these expectations are not met, it falls into a trough of disillusionment. Upon re-evaluating when that technology can do, it rises on the slope of enlightenment followed by a plateau of maximum productivity.

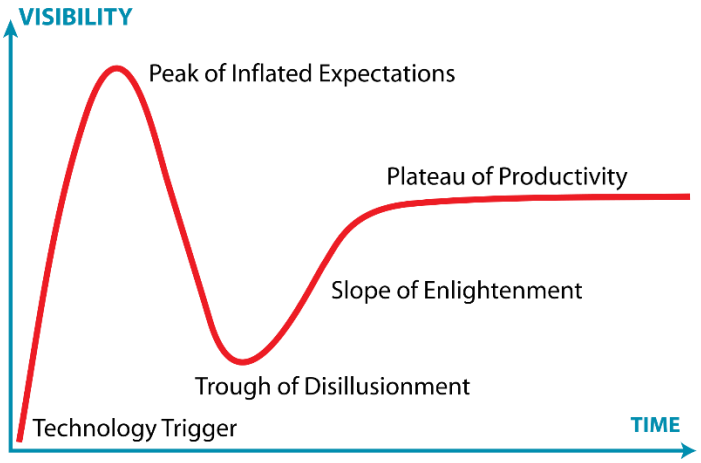


Figure 1 – Gartner Research Hype Cycle Diagram

Photo Credit: https://commons.wikimedia.org/wiki/File:Gartner_Hype_Cycle.svg

In this presentation, Dr. Amor outlined many of the benefits and shortcomings of current BIM technologies in the construction marketplace. I found it surprising that he believed that the technologies to improve the industry were already available, that the industry just had to discover and better utilize the technologies available. Unfortunately, my thesis project did not use any BIM modeling beyond the original design model. I found this as an example of Dr. Amor's claim that while technologies are available they are often underutilized. I am interested to investigate how the usage of BIM implantation on my thesis project could potentially reduce the amount of constructability issues found during construction. By comparing the costs of implementing BIM to the costs of changes that occurred to fix the issues during construction, I could better determine if implementing BIM could have reduced change order costs associated with constructability. Additionally in terms of research topics, I think it would be interesting in looking into augmented reality as a way to reduce owner driven changes,

which contributed to a significant amount of change orders on my thesis project. I would further investigate the types of change orders and which could have been caught through virtual walkthroughs. I could utilize my contacts with DPR Construction, Mortenson, John Messner, and Robert Amor to further look into these topics.

Distributed Leadership vs. Centralized Decisions

Facilitated by Dr. Robert Leicht

This session further developed what distributed leadership meant to the individuals attending the session. The session found that most people associated distributed leadership with the ideas of shared risk and resources, trust and accountability, and designating decisions to the most informed party versus those highest in power. Ultimately, distributed leadership practices are a balancing act between risk and associated cost versus the added benefits and value it could provide. What deters most owners are the associated risks, but those who do take this risk recognize the potential for added value. It was discussed that distributed leadership had both its benefits and downfalls, but the group seemed to agree that in order to have success in this area, the team need to be highly collaborative and high performing. While more collaborative contract types may help stimulate this team integration, ultimately, the team dynamic will drive collaboration.

I found it interesting that in contract terms, the construction manager is responsible for team integration. One of topics in this conversation was that teams need practice or training in collaborative teams in order to perform highly when faced with these practices during construction. It lead me to question, what goes into training individuals in collaborative practices? Does the individual need to experience a highly collaborative environment or can training be administered? Further, is there a way of accelerating this learning experience earlier on in a project before construction even begins, so these collaborative teams can hit the ground running? I would like to evaluate how collaborative my thesis's project team is since team members were located offsite. I could further interview and poll my project team; also I could discuss these ideas with Dr. Rob Leicht for research tools and John Bechtel for experience in IPD.

Enabling the Workforce: Hiring and Retaining Young Leaders

Facilitated by John Bechtel, Panelists include Sue Klawans, John O'Keefe, Jessica Baker, & Abigail Kreider

The panel discussion focused heavily on selecting the right company for the individual and setting oneself up for success during the first few years working. Finding the right company fit is critical to ultimately liking the company. The right company will have a culture and values that align with the individual's preferred culture and values. In the first few years working for a company, new employees should be sure to establish a network of mentorship both with people who will provide good advice along with someone else who will be their "champion," or the person who will pull strings for them. Both formal and informal mentorship exists and value can be found in utilizing both opportunities for advice and direction. The panel highlighted the importance of not moving up to quickly as to make sure

to try out different positions to help discover the best fit in the company. I found this conversation intriguing since most graduates including myself are so focused on moving up quickly. I know that both my peers and I are more interested in becoming leaders fast and getting promoted quickly rather than exploring different opportunities to improve our overall understanding.

Driving Collaboration into the Field

Facilitated by Dr. Robert Leicht

This session looked at improving collaboration amongst the field and entire project team to provide benefits and even value to the client. The industry members expressed that some ways they drive collaboration is by collocating and utilizing the last planner method. A big component for this collaboration was getting the right people that breed this type of atmosphere, otherwise known from Jim Collin's book *Good to Great*, "Get the right people on the bus." Without buy in from the project team and all of the trades, techniques to improve team integration will be unsuccessful. A major theme in this conversation was also potential benefits from selecting trade partners instead of awarding contracts to the lowest bidder. This idea helps to once again get the right people, for example, the trades that will add value beyond cost savings.

This conversation lead me to think further into potential ideas for better filtering trades and prequalifying them based on their experience or feelings on collaboration. I found it surprising that trades would be disinterested in being more involved in decision making. However, I understand that if those trades had a smaller stake in that particular project they would probably not want to invest as much time as other key players. For my project I could look further into costs associated with handholding low bid subcontractors versus spending additional money to select the right subcontractors. I would best analyze these methods using sister projects to draw comparisons. I could contact many different companies in search of a similar sister project for comparison.

Feedback From PACE Industry Roundtable

My feedback session was held with Jerry Shaheen from Gilbane. Our discussion looked at potential thesis construction depths including alternative delivery methods and different levels of prefabrication or modularization. My thesis building has a significant amount of change orders associated with both constructability issues and owner driven changes. I suggested possibility re-evaluating the delivery method of Construction Manager at Risk and potentially swapping to a more collaborative approach such as Design Build or Integrated Project Delivery. However, since the construction manager was brought on so early in the project, Jerry did not believe that changing the method would necessarily drive down the change order costs. Instead he suggested looking further into whether or not the current practice of building medical office facilities by a developer is really the best method in which to build these facilities. He recommending speaking further with developers and tenants of these spaces to get a better understanding of why they build this way.

My thesis building is a fairly simple and traditional way of building. I proposed the idea to prefabricate or modularize different aspects of my project to Jerry. Jerry thought this was a good topic to look into and pushed me to further investigate what degree of prefabrication or modularization I would want to analyze. He recommended that I needed to narrow down my topic further. He also encouraged me to look into modularization as a means to improve facility management. He told me that historically these medical office suits need to be renovated every ten years either because of a new tenant or because the space has become outdated. He suggested that I look further into ways of easily and less expensively swapping out different parts of the building during renovation.

Leading Industry Practice Evaluation

Building Information Modeling Usage Evaluation

Besides the design authoring of the architectural and systems models of the building for the creation of the drawings, the Community Healthcare project did not utilize any other BIM efforts for this facility. However, by implementing additional BIM uses not only in planning and design but also in construction, the project could benefit from these additional planning methods and analyses.

To begin analyzing which BIM uses could be implemented, the project goals were identified using the BIM Goals Worksheet from Penn State's BIM Execution Planning Guide. Many of the major project goals were described, then potential BIM uses were paired with these goals. These goals were then ranked from one to three with one being the most important to three being the least. Table 1 shows the results of this goal identification exercise, which can also be found in Appendix C.

Table 1 – Goal Identification

Priority (1-3)	Goal Description	Potential BIM Uses
1- Most Important	**Value added objectives**	
1	Reduce constructability issues	Develop Virtual Prototypes
1	Reduce design related change orders	Design Review
1	Accurate budget for the project	Perform Cost Estimate
3	Effective use of the site	Site Utilization Plan
1	Remove field conflicts	Perform 3D Coordination
2	Maintaining effective flow of the trades	4D Modeling
2	Select the most effective MEP systems for the building's lifecycle	Perform Engineering Analysis
2	Accurate layout	Layout Control & Planning
3	Value adding model to turn over for facilities mgmt.	Record Modeling

1	Improve the functionality of the facility	Design Review, Design Authoring

These BIM uses were then analyzed using the BIM Use Analysis worksheet, which can be found in Appendix C as well. Through this worksheet it was found that in addition to the authoring that was used that use on this project, the project could have also benefit from 3D coordination, design reviews, cost estimation, engineering analysis, and virtual prototyping. These uses are summarized in Table 2 below. All of these uses were then incorporated into the BIM process map in Appendix C. 3D coordination is especially valuable to a project such as this one with a significant amount of MEP to support the various medical equipment spaces. With cost being a major goal for the developer of this project, cost estimates could have benefitted from the aid of the models. For the sake of cost and performance, the systems could have been further investigated not only to benefit the project now but also for the life-cycle of the building following this tenant. Virtual prototyping of the façade could have helped to catch many of the issues found in the field during construction. Design reviews could have better caught these issues as well. These reviews also could help to better illustrate the design to the tenant who has made several late design changes to improve the function of their facility.

Table 2 – BIM Uses

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
X	DESIGN AUTHORING	X	DESIGN AUTHORING	X	DESIGN AUTHORING		BUILDING MAINTENANCE SCHEDULING
	PROGRAMMING	X	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
	SITE ANALYSIS	X	3D COORDINATION	X	3D COORDINATION		ASSET MANAGEMENT
X	STRUCTURAL ANALYSIS	X	STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
X	LIGHTING ANALYSIS	X	LIGHTING ANALYSIS		3D CONTROL AND PLANNING		DISASTER PLANNING
X	ENERGY ANALYSIS	X	ENERGY ANALYSIS		RECORD MODELING		RECORD MODELING
X	MECHANICAL ANALYSIS	X	MECHANICAL ANALYSIS		SITE UTILIZATION PLANNING		
X	OTHER ENG. ANALYSIS	X	OTHER ENG. ANALYSIS				
			SUSTAINABLITY (LEED) EVALUATION				
		X	VIRTUAL PROTOTYPES	X	VIRTUAL PROTOTYPES		
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
X	COST ESTIMATION	X	COST ESTIMATION		COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

Ultimately, this project is constructible without the additional BIM uses since it is under construction currently. BIM was been greatly underutilized because the goal to keep the cost down far outweighed the added benefits according to the project team. However, the cost of the tenant interiors package has increased due to a large amount of change orders from late design changes. The tenant would benefit from having more comprehensive design reviews that better illustrate the layout and function of the different interior spaces. Besides that, the cost and coordination is running smoothly. Instead virtual mockups could have helped to understand the exterior wall assembly and the relation between the slab

and other components. This assembly has been the subject of the majority of the construction issues. So while this project could be built only with design authoring, there is added value from implementing other BIM uses, the difficultly is foreseeing while uses will add value to the project without knowing the problems that will come up.

Sustainability Implementation

The Community Healthcare team chosen not to go for LEED certification in order to avoid the paying fees to become certified. While the Community Healthcare facility is not going for any kind of LEED certification, since projects today are environmentally conscious, the project meets many of the credit already. To score this project, the scorecard provided by the USGBC for the most current version of LEED v4 was used. LEED v4 for BD+C: Healthcare was used to score this project since medical offices can be included in this rating system. The scorecard and the resulting credits can be found in Appendix D. This project was able to achieve thirty-eight credits and potentially achieve thirty-five other credits. There were only about thirty-two credits that the Community Healthcare project probably would not be able to achieve. The Community Healthcare project could gain points in the following categories: location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation, and regional priority.

Location and Transportation

This category was the most difficult for the Community Healthcare project to achieve points in. Since this site does not qualify for the LEED for Neighborhood Development Location credits, the project would need to achieve other credits in this category. The project would be able to receive the Sensitive Land Protection credit because while to site is not on previously developed land, it also does not violate any of the protected lands included in this credit. Since this project is in a dense enough and well inhabited town in the mid-Atlantic region, it achieves the Surrounding Density and Diverse Uses credit as well. Unfortunately, this project will not be able to achieve credits for Access to Quality Transit or consequently Reduced Parking Footprint. However, despite not currently achieving these credits, with additional costs, the project could implement the necessary design changes to achieve credits for Bicycle Facilities and Green Vehicles.

Sustainable Sites

The Community Healthcare building would attain credits for Site Assessment, Rainwater Management, Heat Island Reduction, and Light Pollution Reduction based on the design choices made for the project. Additionally, this project could fairly easily make changes to reach the requirements to obtain credits for Site Development, Open Space, Places of Respite, and Direct Exterior Access. These credits are achievable since the project sits on a large site, significantly larger than the footprint of the building itself. Generally, with the addition of garden spaces, Community Healthcare could gain up to four more LEED credits.

Water Efficiency

The water efficiency credits depended greatly on the specified building systems and fixtures. Currently, the project could receive some credits for Indoor Water Use Reduction based on the fixtures specified; however, there are still many additional credits that could be gained by swapping out some of the plumbing fixtures. Regardless there are some fixtures that probably would not be worth switching out due to the added cost. The Outdoor Water Use Reduction credit would be obtained since most of the plants are native to the area and do not need additional watering. Water Metering and the Cooling Tower Water Use credits could also be received from either adding or switching out building systems, but once again being that cost is the driving factor for the developer of this project, these changes may not be worth the added cost.

Energy and Atmosphere

The majority of the credits for this category are classified as potential credits; however, ultimately, most of these credits would be too expensive to implement on a project of this size. These credits include Demand Response, Renewable Energy Production, and Advanced Energy Metering. While all of these could be for the most part implemented with a cost, the credits for Enhanced Refrigerant Management and Green Power and Carbon Offsets are too unrealistic to use on a small medical office building such as this one. Energy savings is not a major goal for this project so it would be difficult to persuade the client to pay additional to obtain any of these credits. However, since the facility is a medical office building, the project could probably obtain around half of the Enhanced Commissioning and half of the Optimize Energy Performance credits.

Materials and Resources

The credits in this category were difficult to determine if they were achieved since the product data for the specified building materials has yet to be fully submitted because the project is still under construction. Therefore, all credits related to Building Product Disclosure and Optimization are maybes for now. Since construction is not completed, Construction and Demolition Waste Management is currently tracking towards achieving this credit; however, since the project team is not required to fulfill this credit, the project may not meet the criteria to make this credit by project completion. The current architectural design does not account for the Design for Flexibility credit because there are not enough movable partitions; however, the building does have enough area to grow with time so with some design considerations this credit may be achievable as well. The only credits that will not be met by this facility are the credits for Building Life-Cycle Impact Reduction since the primary tenant of this facility could change in ten years and the next tenant has the potential to completely renovate the space.

Indoor Environmental Quality

Many of these credits were relatively easy for this project to obtain since most responsible designers and owners would require these for the health of the occupants. Especially being that this facility is a medical office building and outpatient cancer treatment center, the indoor environmental quality is of high priority. The Community Healthcare facility would be able to get credits for Enhanced Indoor Air Quality Strategies, Low-Emitting Materials, Construction Indoor Air Quality Management Plan, Indoor Air Quality Assessment, and Thermal Comfort. Currently the lighting design would not get the Interior Lighting credits because the lighting controls do not have dimming capabilities. This project also would not be able to receive credits for Daylight because of the portion of private examine rooms in the interior of the building. For this same reason, this medical office building would not be able to earn credits for Quality Views. However, the project could earn credits for Acoustical Performance. In the original design this credit would have been achieved, but the acoustical performance of the wall partitions were value engineered out besides the partitions for examine rooms.

Innovation and Regional Priority

Innovation credits would be difficult for this project to achieve due to the nature of the project being a medical office facility. This project would be able to achieve another two credits for regional priority since Sensitive Land Protection and Rainwater Management are priority credits for the location of this project. Ultimately, while the Community Healthcare project is not pursuing LEED certification, since the facility is environmentally conscious and fairly efficient, it could easily gain the accreditation of Certified by making minor design changes. The project is only two credits away from becoming certified, and it has thirty-five credits that it could potential obtain. The project could easily get these two credits by creating garden space that meets the requirements of the sustainable sites category and putting in bike racks. Ultimately though, gaining a LEED certification is not one of the project goals while cost is a major goal for the developer of the project. Therefore, paying the additional costs to make the necessary changes and paying the certification fees outweighed any values from gaining LEED certification.

APPENDIX A

The interview below was conducted Tuesday, November 3, 2015 with Bill Hahner of DPR Construction for Community Healthcare Project. The answers below are paraphrased from the responses of the DPR team and are not directly quoted from the subjects, however, they do reflect the intended content of their answers.

DATE: Tuesday, November 3, 2015 5:30 PM
NAME: Bill Hahner, Project Manager
LOCATION: Phone Interview

Q1: Describe the project management services, such as preconstruction services, provided to the client. What are the biggest challenges or constraints for the client, such as financing, phasing, or quality drivers?

A1: The DPR Construction team provided preconstruction services to the project as early as schematic design. The schedule and finishing on time is of most importance for the tenant while cost is the driver for the developer of the building.

Q2: What were some of the challenges that your team faced throughout construction in terms of design, schedule, or cost?

A2: Client driven design changes were the biggest challenge for the team. There are have many late design changes that drove the cost for change orders.

Q3: Your field team spoke a lot about the issues with the design. What would you have recommended to catch these issues earlier? Were most of these changes made in change orders or did DPR have to cover these costs?

A3: The majority of the changes were due to design issues; therefore, DPR did not have to front these additional cost instead they were lumped into a change order. Potentially these issues could have been caught through modeling certain areas for constructability; however, this would come at the cost of a superintendent for a month and month of a BIM guy for a month.

Q4: Do you think the delivery of this project was effective or would you consider changing the approach?

A4: Changing the delivery method would not reduce the amount of change orders because the change orders were owner driven changes late in design.

Q5: Follow-up on that, many medical office building as built this way (as in by a developer core and shell then TI), do you think there is better model for building these?

A5: Yes, because this method is more beneficial tax wise for the financing of the project due to tax implications.

Q6: Describe key areas of value engineering that were implemented on the project. How did these correlate/detract from the goals of the owner?

A6: The main goal for the developer was to get the cost down. Additionally, the primary tenant was mostly concerned with the function of the space not and less so the appearance. Perkins +Will, the architectural firm, was the main driver for keeping architectural features. DPR Construction and the design team did multiple skin studies to find the most cost effective system. Despite Perkins +Will's desire to have a larger portion of the building façade to metal panels and curtain, after four studies, the façade was finalized to the current design, which saved $160,000 and eliminated a sun shading component.

Originally, all of the walls backed up to the deck and were insulated all the way up for the purpose of sound insulation. Most of these acoustical measured were also value engineered out, leaving only these acoustical wall for the patient care areas. This saved anywhere from $25,000-$50,000.

The initial design called for solid surface countertops everywhere. However, these were value engineered as well, leaving only solid surface for wet areas and plastic laminate for the remaining countertops.

Q7: What ideas for value engineering were considered but not implemented?

A7: None

Q8: For thesis we are asked to consider changing or altering different construction means and methods, techniques, or systems. What would you recommend looking further into?

A8: You could look into resequencing the civil work. Currently the plan calls for 95% of the site to be stabilized before beginning work on the pond. Due to the schedule delay, planting is now occurring during the off season, which is costing the project. The civil schedule should have been reworked to better account for the schedule delay before being submitted to the county.

Virtual reality could be looked further into for the sake of your thesis. While the cost will probably outweigh the benefits, the use of virtual reality for design reviews from the owner could potentially reduce the amount of late design change orders.

The slope of the skylight design has led to major constructability issues. Potentially looking into other designs or construct methods for the skylight could be a topic for your thesis.

APPENDIX B

Project Team Integration - Session 1-C:

Distributed Leadership vs. Centralized Decisions

Facilitator: Dr. Robert Leicht **Ballroom DE**

Questions

- What comes to mind when you hear the term "Distributed Leadership" ?
- To what extent are we seeing leadership roles distributed within teams?
- How are these interactions, particularly in integrated teams, changing from traditional leadership models in construction?
- What opportunities do the use of distributed leadership models in design and construction teams offer?
- What challenges are emerging in the sharing of information, clarity of roles and responsibilities, and process for meeting commitments?
- How does the shift to building integrated teams influencing the process for making decisions in the design and construction phases of projects?
- What tensions need to be balanced to enable distributed teams and leadership to function effectively, while still maintaining the appropriate involvement and input from key stakeholders and overall project leaders?

Notes

DISTRIBUTED LEADERSHIP → "SHARED RISK", RESOURCES, DESIGNATED DECISIONS TO MOST INFORMED PARTY, TRUST/ACCOUNTABILITY

WHERE?

OWNERS PERSPECTIVE: [redacted]

↳ MORE COLLABORATIVE CONTRACTS [redacted] SHOWS THE DECISION MAKING PROCESS

↳ HURTS VETO POWER OF OWNER-PROJECT TEAM BECOMES STAKEHOLDER

↗ EMPOWERMENT

EVERY TEAM MEMBER HAS A SAY IN THE PROJECT → FOCUS ON ORGANIZING + BUILDING SUCCESSFUL TEAMS

TEAM INTEGRATION FALLS BACK ON CONSTRUCTION MANAGER CLEARLY DEFINING ROLES

WHAT IS APPEALING ABOUT DISTRIBUTED LEADERSHIP?

OWNER → FUND BENEFITS IN SAVINGS → COST, SCHEDULE, QUALITY

↳ FULL BENEFITS NEED TO CHANGE CONTRACTS

→ B/C CONTRACTUALLY NEED TO REPLICATE RISK MODEL

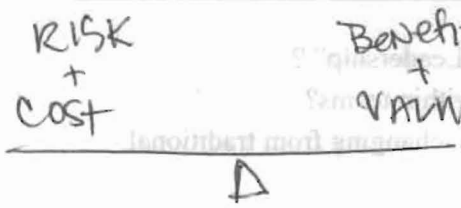
HIGH PERFORMING TEAMS EVEN INFORMAL NATURALLY OFTEN LEAD TO COLLABORATION

↳ LOOK @ SOCIAL [redacted] PSYCHOLOGY OF BUILDING TEAMS

TRAINING IN WORKING IN COLLABORATIVE TEAMS
PRACTICE/REHEARSAL

FUNDAMENTAL DRIVERS OF
- RISK
- BALANCE RISK + VALUE

PEOPLE MAY NOT BE WILLING TO TAKE RISK
BUT WE ARE DOING IT TO PROVIDE VALUE



(PERCEIVED RISK)

IS FAILURE OKAY FOR LEARNING OUTCOMES?
CALCULATED RISK
"FAIL FORWARD VS FAIL FAST"

RESEARCH QUESTIONS:

"DECISION" MAKING PROTECT ON PROTECT VS. OTHERS
+ TIME FOR MAKING THOSE

WHAT DECISION MAKING FRAMEWORKS
HOW LONG DO DECISIONS TAKE TO MAKE BASED ON FLOW

↳ RFIs "CONFIRMING"
HOW MANY DECISIONS ARE MADE OBJECTIVELY OR CONSENSUS

KEYS TO SUCCESS + GOALS + TRACKING (GOAL ALIGNMENT?)
HOW DID YOUR TEAM ESTABLISH TRUST

Project Team Integration - Session 2-C:

Driving Collaboration into the Field

Facilitator: Dr. Robert Leicht **Ballroom DE**

Questions

- What is the current model, or level, of collaboration we see amongst field personnel?
- To what extent, and in what ways, do we expect to see field personnel sharing information and working collaboratively?
- Do we know of any examples of teams or projects that were able to create a high performing collaborative field team?
- What benefits do we expect from having our foremen and field personnel working more collaboratively?
- What challenges or limitations are limiting the current levels of collaboration in the field?
- How could greater levels of collaboration for field staff be enabled?
- What barriers, contractual or behavioral, are creating these limitations?
- How does technology influence the sharing of information and collaboration amongst field personnel (e.g. mobile devices, modeling, etc.)

Notes

- TRYING TO SEE THINGS THROUGH THE IDEAS of OTHERS BY HAVING KEY PLAYERS
- ALIGN GOALS IN THE MORNINGS OR OFTEN
- COLOCATION ↑ COLLABORATION
  - ↳ GOES BACK TO LEADERSHIP + TEAM PLAYERS
- BUY IN → TO HAVE ACCOUNTABILITY NEED TO UNDERSTAND WHAT TO PLAN + TRUSTING THE CM
- HAVING THE RIGHT PEOPLE B/C THE PLAN ISN'T GOOD THEN IT WON'T HAPPEN
- SETTING UP THE RIGHT ATMOSPHERE THAT BREEDS LESSONS NOT FINGER POINTING
  - ↳ HOW CAN WE AS CM'S EMPOWER THE TRADES TO COMPLETE THE WORK → HOW DO WE REMOVE ROAD BLOCKS
- MAKING SURE TO GET THE INFORMATION TO THE PEOPLE WHO NEED IT
- CREATE TRANSPARENCY
- PROJECT DELIVERY METHODS CAN ENABLE COLLABORATION
- BRING IN FIELD EARLY TO BUILD COLLABORATION → BUILDS LEVELS OF TRUST
- SELF SELECT TRADE PARTNERS VS. LOWEST BIDDER
- GET TRADES TO BUY INTO WHAT OTHER TRADES ARE DOING

- DEFINING FIELD: SUPER, FOREMAN, CREW?
  DIFFERENT LEVELS OF BUY IN
- WHAT HAS BEEN EFFECTIVE TO FREE UP BARRIERS
  INVOLVING FOREMAN INTO CRITICAL DECISIONS
  ↳ ATTITUDE TRANSLATES DOWN INTO CREW
- "GET THE RIGHT PEOPLE ON THE BUS"

TECHNOLOGY + INFORMATION SHARING

TRAINING IN TOOLS + APPLICATIONS

RESEARCH TOPICS

TOOLS FOR SUPER PROTECTS

HOW TO MEASURE/IDENTIFY TRADES
↳ PREQUAL/COLLABORATIVE TRADES
/LESSONS LEARNED
BUY OUT W

COST TO HANDHOLD SUBS VS. QUALIFIED SUBS

ANYONE OFF OF SISTER PROJECTS

INCENTIVISE WORKS FOR MEETING GOALS

STUDENT FORM

Student Name KENNA MARKEL

Session 1: Topic: ENABLING THROUGH TECHNOLOGY

Research Ideas:

1) THE USAGE OF AUGMENTED REALITY TO DRIVE DOWN POTENTIAL CHANGE ORDERS

2) SUCCESS of BIM TECHNOLOGIES TO IMPROVE SAFETY

Session 2: Topic: DISTRIBUTED LEADERSHIP VS. CENTRALIZED DECISIONS

Research Ideas:

1) HOW EMOTIONAL INTELLIENCE AND SOFT SKILLS AFFECTIVE COLLABORATIVE TEAMS AND SUCCESSFUL DECISION MAKING?

2) IF THE CURRENT PRACTICE of USING A DEVELOPER TO BUILD MEDICAL OFFICE FACILITIES THE BEST WAY TO BUILD THESE FACILITIES

Session 3: Topic: DRIVING COLLABORATION INTO THE FIELD

Research Ideas:

1) HOW COULD COLOCATION POTENTIALLY ACCELERATE THE SCHEDULE OR IMPROVE CRITICAL DECISIONS?

2) HOW CROSS FUNCTIONAL TEAMS COULD REDUCE CHANGE ORDERS?

STUDENT FORM

Industry Member: JERRY SHAHEEN (GILBANE)

Key Feedback:

Which research topic is most relevant to industry? What is the scope of the topic?

AUGMENTED REALITY IS A TOPIC IN THE INDUSTRY THAT HAS YET TO FULLY PROVE IF IT IS VALUE ADDING. ADDITIONALLY THE QUESTION OF WHEN IS AUGMENTED REALITY IS WORTH THE COST AND TO WHAT EXTENT IS ONE THAT COULD BE FUTHER INVESTIGATED. THE SCOPE OF THIS TOPIC WOULD INVOLVE LOOKING AT THE BENEFITS VERSUS COST OF AUGMENTED REALITY AND DETERMINED AT WHAT POINT THE BENEFITS OUTWEIGH THE COSTS.

Suggested Resources:

What industry contacts are needed? Is the information available?

I NEED TO COMMUNICATE WITH LEADERS IN AUGMENTED REALITY. I COULD WORK WITH ROBERT AMOR SOME ON THIS ISSUE AS WELL AS JOHN MESSNER. FORTUNATELY, OTHER CONTACTS IN THE INDUSTRY WITH EXPERIENCE IN THIS COMES FROM DPR, A COMPANY I INTERNED WITH. OTHER PEOPLE WHO WOULD BE HELPFUL TO CONTACT WOULD BE MORTENSON OR DISNEY TEAM MEMBERS.

APPENDIX C

BIM Goals Worksheet

Priority (1-3)	Goal Description	Potential BIM Uses
1- Most Important	**Value added objectives**	
1	Reduce constructability issues	Develop Virtual Prototypes
1	Reduce design related change orders	Design Review
1	Accurate budget for the project	Perform Cost Estimate
3	Effective use of the site	Site Utilization Plan
1	Remove field conflicts	Perform 3D Coordination
2	Maintaining effective flow of the trades	4D Modeling
2	Select the most effective MEP systems for the building's lifecycle	Perform Engineering Analysis
2	Accurate layout	Layout Control & Planning
3	Value adding model to turn over for facilities mgmt.	Record Modeling
1	Improve the functionality of the facility	Design Review, Design Authoring

BIM USE ANALYSIS
Version 2.0

BIM Use*	Value to Project	Responsible Party	Value to Resp Party	Capability Rating			Additional Resources / Competencies Required to Implement	Notes	Proceed with Use
	High / Med / Low		High / Med / Low	Scale 1-3 (1 = Low)					YES / NO / MAYBE
				Resources	Competency	Experience			
Develop Virtual Prototypes	Med	DPR Construction	Med	2	2	2			**Yes**
		Perkins +Will	Med	2	2	3			
Record Modeling	Med	Facility Manager	Low	1	1	1	Requires training to receive benefits		**No**
		Developer	Med	1	1	2	Requires training to receive benefits		
		Perkins +Will	Low	3	3	3			
Cost Estimation	High	Perkins +Will	Low	2	2	2			**Yes**
		DPR Construction	High	3	3	3		Brought on during schematic	
4D Modeling	Med	DPR Construction	High	3	3	3			**No**
		Trades	High	2	1	1			
Site Utilization Planning	Med	DPR Construction	Med	3	3	3		Not challenging enough to model	**No**
		Trades	Med	3	3	2		Not challenging enough to model	
Layout Control & Planning	Med	DPR Construction	Med	2	2	2			**No**
		Trades	Med	3	3	3			
3D Coordination (Construction)	High	DPR Construction	High	3	3	3			**Yes**
		Trades	High	2	2	3	Training depends on subcontractor		
Engineering Analysis	Med	AHA Engineers	Med	2	2	3			**Yes**
		Perkins +Will	Med	3	3	3			
Site Analysis	Low	DPR Construction	Low	3	3	3		Not challenging enough to model	**No**
		Perkins +Will	Low	2	2	3		Not challenging enough to model	
Design Reviews	Med	Perkins +Will	High	3	3	3			**Yes**
		AHA Engineers	Med	3	3	3			
3D Coordination (Design)	High	DPR Construction	High	3	3	3		Brought on during schematic	**Yes**
		AHA Engineers	High	2	3	3			
		Cagley & Associates	High	2	3	3			
Design Authoring	Med	Perkins +Will	Med	3	3	3			**Yes**
		AHA Engineers	Med	3	3	3			
		Cagley & Associates	Med	3	3	3			

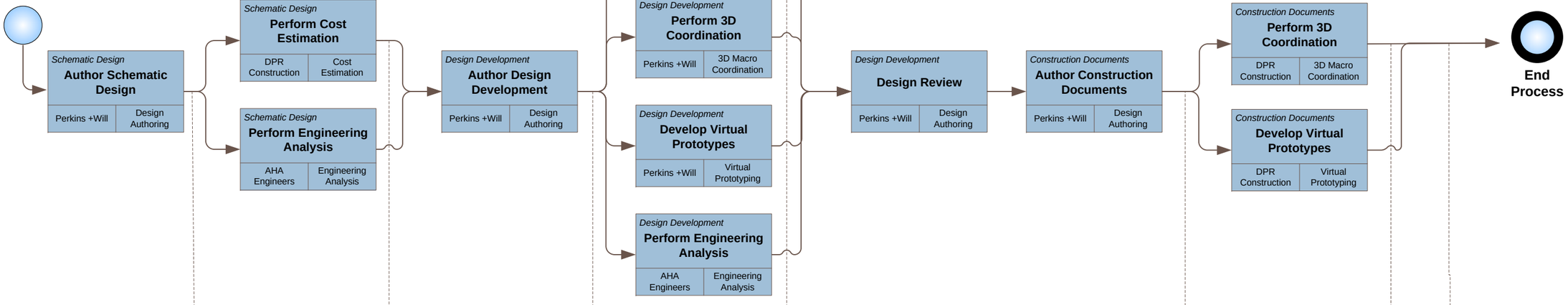
* Additional BIM Uses as well as information on each Use can be found at http://www.engr.psu.edu/ae/cic/bimex/

Level 1: BIM Execution Planning Process

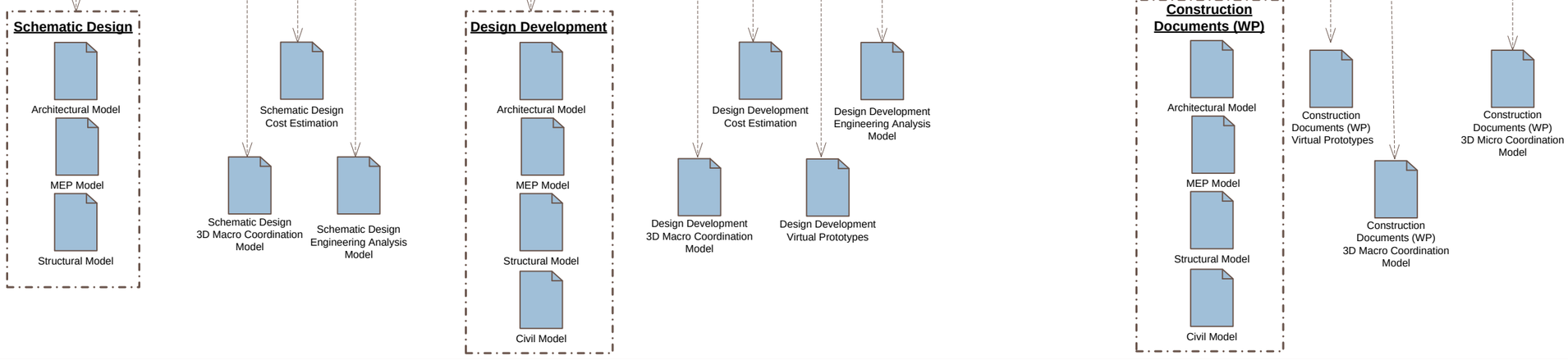
Community Healthcare

Developed with the BIM Project Execution Planning Procedure by the Penn State CIC Research Team.
http://www.engr/psu.edu/ae/cic/bimex

BIM USES



INFO. EXCHANGE



APPENDIX D

LEED v4 for BD+C: Healthcare

Project Checklist

Project Name: Community Healthcare
Date: 11/11/2015

Y	?	N			
Y			Prereq	Integrative Project Planning and Design	Required
Y			Credit	Integrative Process	1

Y	?	N		Location and Transportation	9
		0	Credit	LEED for Neighborhood Development Location	9
1			Credit	Sensitive Land Protection	1
		2	Credit	High Priority Site	2
1			Credit	Surrounding Density and Diverse Uses	1
		2	Credit	Access to Quality Transit	2
	1		Credit	Bicycle Facilities	1
		1	Credit	Reduced Parking Footprint	1
	1		Credit	Green Vehicles	1

Y	?	N		Sustainable Sites	9
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	Environmental Site Assessment	Required
1			Credit	Site Assessment	1
	1		Credit	Site Development - Protect or Restore Habitat	1
	1		Credit	Open Space	1
2			Credit	Rainwater Management	2
1			Credit	Heat Island Reduction	1
1			Credit	Light Pollution Reduction	1
	1		Credit	Places of Respite	1
	1		Credit	Direct Exterior Access	1

Y	?	N		Water Efficiency	11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
1			Credit	Outdoor Water Use Reduction	1
2	3	1	Credit	Indoor Water Use Reduction	7
	2		Credit	Cooling Tower Water Use	2
	1		Credit	Water Metering	1

Y	?	N		Energy and Atmosphere	35
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
3	3		Credit	Enhanced Commissioning	6
10		10	Credit	Optimize Energy Performance	20
	1		Credit	Advanced Energy Metering	1
	1	1	Credit	Demand Response	2
	3		Credit	Renewable Energy Production	3
		1	Credit	Enhanced Refrigerant Management	1
		2	Credit	Green Power and Carbon Offsets	2

Y	?	N		Materials and Resources	19
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
Y			Prereq	PBT Source Reduction- Mercury	Required
		5	Credit	Building Life-Cycle Impact Reduction	5
	2		Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
	2		Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
	2		Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1			Credit	PBT Source Reduction- Mercury	1
1			Credit	PBT Source Reduction- Lead, Cadmium, and Copper	2
2			Credit	Furniture and Medical Furnishings	2
	1		Credit	Design for Flexibility	1
	2		Credit	Construction and Demolition Waste Management	2

Y	?	N		Indoor Environmental Quality	16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
3			Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
2			Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
	1		Credit	Interior Lighting	1
	2		Credit	Daylight	2
		2	Credit	Quality Views	2
	2		Credit	Acoustic Performance	2

Y	?	N		Innovation	6
		5	Credit	Innovation	5
	1		Credit	LEED Accredited Professional	1

Y	?	N		Regional Priority	4
1			Credit	Regional Priority: Specific Credit	1
1			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

38	35	32	TOTALS	Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110