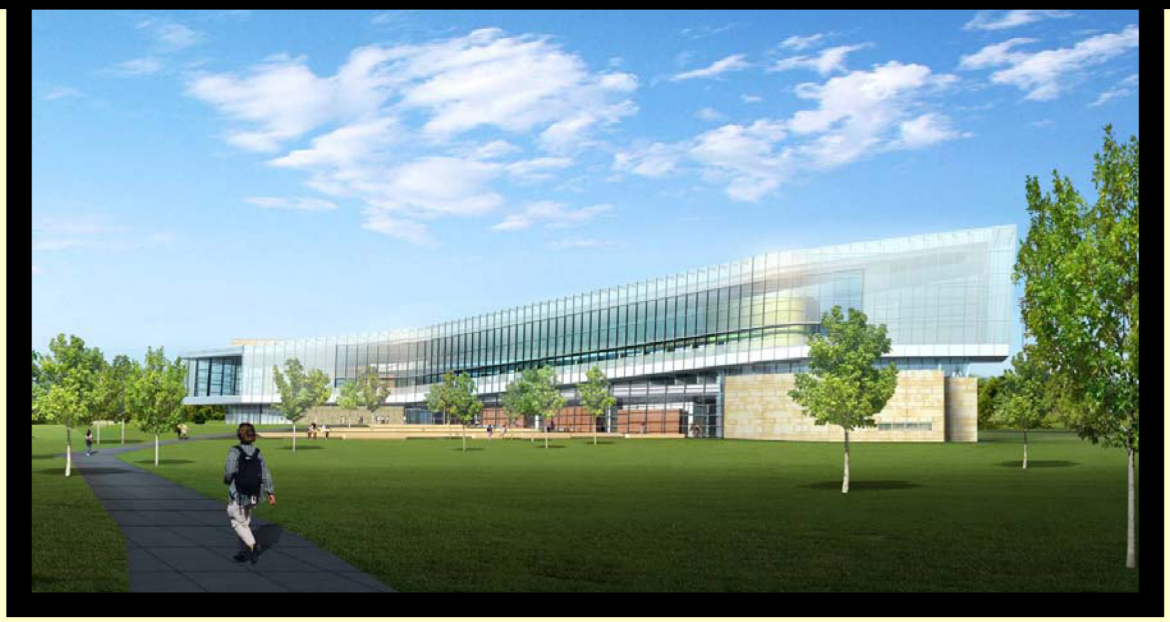
·THE NEW DICKINSON SCHOOL OF LAW·

University Park, PA
Steve Ayer
Construction Management Option



Technical Assignment No. 3

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Faculty Consultant: Dr. Messner

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EXECUTIVE SUMMARY:

This Technical Assignment begins to look at possible areas of study for future research of the new Dickinson School of Law located in University Park, PA. The following specific areas were examined for this project:

- **Critical Industry Issues:** This section looks specifically at the issues discussed at the Partnership for Achieving Construction Excellence (PACE) roundtable. It looks at how each issue discussed may play a role in the construction process for the Law School project.

- **Critical Issues Research Method:** This section looks at the topic of Building Information Modeling (BIM). It examines a potential research topic related to the use and implementation of this new technology.

- **Problem Identification:** There are numerous areas on this project that could be considered problematic. This section discusses some of these specific areas related to this project.

- **Technical Analysis Methods:** For future research a few specific areas of study will be looked at. This section indicates which analyses will be performed in the upcoming weeks.

- **Weight Matrix:** This matrix suggests the amount of effort that will go into each analysis and research method listed in prior sections.

In looking at these different elements related to future research, a few conclusions were drawn:

- The topics discussed and the contacts made at the PACE roundtable event this year may prove to be very applicable to my future research efforts.

- I have determined a number of questions that may be appropriate to ask to determine potential problems related to BIM implementation.

- There are numerous problematic features of this project. Some of these features may prove to be good areas of study.

- The specific areas of study to look at in the future will be BIM modeling, Life cycle cost analysis, architectural redesign of key elements, and strategic rescheduling of utility work at Park Avenue.

- The focus of my efforts will be mainly on architectural redesign issues, with some emphasis on the other issues indicated as well.

CRITICAL INDUSTRY ISSUES:

At the pace roundtable, there were a few key issues that were discussed. The focus of the first session was the topic of prefabrication. Then a discussion on the uses and implementation strategies of Building Information Modeling (BIM) was held. Finally, the topic of work force development was discussed. Some of these issues will directly tie in to the Dickinson School of Law project and others play a more minor role in affecting the project.

The first discussion was related to prefabrication. Prefabrication involves constructing or partially constructing building elements before they are placed in the building. They may be built on or off site depending on the specific building element of interest and the specific project site. The number and variety of projects where prefabrication can be used was surprising. There were clearly many benefits that were discussed for prefabrication.

One of the prefabrication techniques being employed on the Dickinson School of Law project relates to the water lines that run to all toilet and sink fixtures. There is a frame that supports and aligns all of the pipes for a row of sinks or toilets. These pipes are installed in this frame prior to construction. This assembly is then hoisted into place in the all of the bathrooms in the core. This allows for less congestion and less time needed in the core bathrooms during construction.

The second topic discussed at the PACE Roundtable conference was related to Building Information Modeling (BIM). BIM is the latest buzzword in the building industry. Some companies have already begun using BIM for numerous applications. Other companies have heard of the new technology, but have yet to incorporate it into their business practices.

BIM can be used for coordination of trades, 4-D construction scheduling, estimating, visualization, record drawings, etc. There were anecdotes told about specific difficulties and success stories that were encountered through utilizing BIM technology. The potential advantages of using BIM are evident from the stories told by companies that were experienced with the technology. From other discussions I had with people who have had little or no experience with BIM, there are still some major hurdles to overcome before they will buy in to this technology. Because it is a relatively new technology, many industry professionals do not yet know what software they would have to purchase and who would have the know-how to operate the software to effectively use the technology.

The topic related to Building Information Models was very applicable to this project. BIM modeling is currently being utilized on the Dickinson project as a method of coordination of trades. This may prove to be an interesting method of study. As mentioned earlier, BIM is a relatively new technology and therefore, there is a substantial learning curve to get over for many contractors. Some of the contractors on the DSL project had never submitted coordination drawings in 3-D format before this project. It

could be useful to survey some of the contractors on this project and hear their opinions on BIM and the advantages and disadvantages of using this coordination method.

The final topic discussed at the roundtable discussion was related to the labor shortage in the construction industry. This is a topic that many students are not exposed to in the classroom, but it remains a large problem in the real world. Without competent and skilled workers, how can any construction get done? The reasons mentioned for the diminishing workforce varied greatly, but the concern about this problem remained constant.

Someone mentioned that workers who are currently in the industry do not like their jobs. They leave work everyday with no feeling of pride or accomplishment. Consequently, they tell their sons and daughters to pursue careers other than construction trades. Somehow, this system needs to be changed. Workers should drive by their buildings years after completion and feel a sense of pride as they tell their children and grandchildren how they helped to build those buildings.

Recently, there has been a shift towards using Mexican immigrant laborers as a method of dealing with the labor shortage. While a good portion of these people are skilled in their crafts, many more are not. Furthermore, many carpenters in the Mexican labor force do not speak English, which makes communication very challenging. To deal with this problem many American workers are learning Spanish as a second language.

This is an interesting issue because different people have very different views on this topic. Some feel that to hire a worker to work in America, they should have to speak English. Others feel that because of the shortage of skilled American labor it makes sense to learn Spanish and hire a Mexican workforce.

From what I have seen on the DSL jobsite, there has not been a substantial amount of immigrant laborers working on the project. Having a skilled, English speaking labor force helps greatly for communication. That being said, it may not have been easy for some of the subcontractors to obtain enough laborers for certain trades. This could be an interesting topic to discuss with some of the different contractors on site in the weeks to come.

At the PACE roundtable I made a few different contacts with industry professionals. I met Mike Grobaski of Gilbane's Mid-Atlantic office who is a project manager in Laurel, Maryland. I also met Jeremy Sibert from Hensel Phelps. He is a project manager with HP in Baltimore. In addition to some of the contacts I met for the first time at the PACE roundtable, I saw some former Penn State students including Kurt Maldovin and Alex Zolotov who may be able to help me with some BIM/Visualization questions I may have.

CRITICAL ISSUES RESEARCH METHOD:

While it seems that the construction industry is often criticized for being slow to change and that we, as an industry, are set in our ways, the industry is indeed changing. One of the critical areas where change is rapidly being adopted is in the area of Building Information Modeling. BIM seems to be the new buzzword in the industry and some people are quick to tell of their success stories from using the technology while others are quick to use some different choice words to describe the technology that involve them getting headaches and frustrations from it.

It seems that the problem with BIM is related to a lack of understanding. This lack of understanding starts with the word BIM itself. To some people BIM means modeling what would be a 2D drawing in 3 dimensions. Others feel that this would not technically be embedding any information into the model and is therefore, not a true BIM. Some people feel that a true BIM should include every piece of information that could be found in a set of drawings and specs. It is still uncertain at this point if this is realistic or effective.

The misunderstandings related to BIM also span to the lack of understanding of how to use the software necessary to obtain value from BIM. Many people in industry today have never had a reason to model standard 2D coordination drawings in 3D, let alone embedding information into the model geometry. As a result many people are reluctant to give up the standard 2D drawing process.

More in-depth research should be done to determine more specifically what areas of the BIM process require more clarification for industry professionals. The goal of this research would be to determine which trades are typically at the back of the pack in understanding BIM and determine what it is that they lack in understanding of the process. From the contacts I made and spoke to at the PACE roundtable, AE career fair, and project jobsite, it is apparent that BIM is here to stay so ignoring it is not an option. As a future construction manager, it would be advantageous to learn now which trades will likely need the most help with utilizing BIM in construction and what areas will likely be the source of misunderstanding.

To properly conduct this research, it will be necessary to assess what all of the possible uses for BIM are. This can be accomplished through interviews with faculty and industry members as well as reading engineering and construction documents. It will then be necessary to speak to some people in the real world who have dealt with this technology and ask for their thoughts about it. It would be valuable to document their trade, prior coordination experience, and comments. This could be accomplished through informal interviews with people on the site of the new Dickinson School of Law. Questions should be asked such as:

- Did you see value in the BIM coordination process?

- How much experience had you had with 2D and 3D coordination efforts prior to this effort?

- Did you view the BIM coordination model to visualize specific areas in the building where you would have otherwise looked at a set of paper plans?

- Are there any other uses for BIM that should have been used on this project?

- Would you welcome another opportunity to work with BIM?

PROBLEM IDENTIFICATION:

There are several features of the Dickinson School of Law project that could potentially be done differently and yield a more positive outcome for the project. One of these problematic elements relates to the architectural features of the building. Another relates to running the utilities to the building under Park Avenue. Another interesting problem relates to ordering of the long lead items like the electrical switchgears and mechanical equipment. Finally, a study could be done to look into the potential problem with the current double pane glass specified in the curtain wall and the potential benefit to using a 3 pane system to lower lifecycle costs.

Architecturally this building makes a bold statement. There is no doubt about that. What this building could potentially benefit from, however, is a more critical analysis to determine where the building's modern aesthetics should be understated in the interest of cutting costs. Some of the areas that could fall into this category are the curved and tilted interior walls in the building. These walls will require extra labor hours to construct and also will be more difficult to finish. Perhaps these walls could have been straight, vertical walls. This could potentially allow for a large savings and only minimal loss in building aesthetics.

Going along with the previous problem, another area where an alternative design should be analyzed is related to the main curtain wall on the building (CW-4). This curtain wall curves, tilts, and rises as it wraps the front of the building façade. The curve of the curtain wall follows the curve of the building footprint. This feature of the building makes a big architectural impact on the overall building aesthetic and it would probably not make sense to eliminate or redesign the curve of the curtain wall as a whole. While the curve of the curtain wall does make a great architectural impact on the look of the building, the tilt of the curtain wall mentioned earlier arguably will not. The tilt on the curtain wall changes along the curve of the building. It tilts from a minimum of -3.5° from vertical to +3.5° from vertical. This seems like a very subtle change. It may prove to be an interesting study to speak to industry professionals to assess the potential cost savings if the curtain wall was made vertical the entire length of the building.

In addition to the study on the tilt of the curtain wall, it would also be interesting to look at the glass that is currently specified for the curtain wall. As of now the glass is supposed to be curved glass. Perhaps flat glass panes could be used instead. This could potentially save money, not skew any views from inside the building, make replacing broken panes easier, but still not noticeably affect the view of the building from any reasonable distance away.

Clearly there is a substantial amount of glass in this project design. Double paned glass is currently being used on the project. Because there is so much glazing on the building façade, it might be an interesting study to determine how long it would take for a triple pane glass system to pay for itself by saving money on energy. This life-cycle cost could indicate that a triple pane glazing system should be used for future projects like this one.

Another architectural feature that could potentially save some construction costs on the project is the interior finish materials. There are three materials in particular that come to mind that add substantial costs; slate wall panels, and Anigre and European Red Elm millwork and finishes. The slate wall panels add a substantial amount of weight which needs to be accounted for in the design of the interior walls. In addition to the increased structural loads this type of accent requires, the shear cost of the material adds a staggering figure to the building construction. In addition to the slate accents in the building the two wood species mentioned earlier also contribute to added costs. Anigre is a rainforest wood that is quite exotic and expensive. European Red Elm also provides a challenge for contractors because it is extremely difficult to locate a wood supplier who can obtain the necessary quantities of the wood. Both of these woods are not easy to locate and will not help in receiving any LEED credits during their long transit to site. Perhaps these materials could have been replaced by local materials that could be cheaper and more readily available to contractors.

Another problematic feature on this project was related to running the campus utilities under Park Ave. This might seem like a relatively easy task, but what made this job difficult was the fact that Park Ave is a state road. Therefore, the construction manager could not simply contact Penn State, let them know of the dates they would complete the work and shut down the road accordingly. As a result, the state had to be contacted and permits had to be issued. One of the stipulations in the permit was that westbound traffic had to be allowed to maintain use of the road during construction. This meant that half of the road could be demolished and the underground tunnel could be constructed while traffic was routed to the other side of the road. Then, after one half was built, the traffic would be redirected to that side of the road while the utility tunnel on the other side was constructed. The idea of boring under the road was proposed to try to avoid this whole process. Essentially, a tunnel would be bored under the road, the soil would be braced during construction, and the utility tunnel would be built while Park Avenue remained open.

An additional feature of the construction process that could have been done differently is related to some of the Mechanical and Electrical long lead items. Because of the complexity of this project, design revisions and changes are constantly being made. One of the design elements that was decided early in the process was that a series of roof gardens would sit on top of the building. These roof gardens would require a substantial amount of roof area. Therefore, the vast majority of the building's mechanical equipment would have to be in the lower level. As steel is erected over the building substructure it becomes more and more difficult to have large openings to the lower level where large equipment can be placed. As a result, it was necessary to leave a bay open on the north side of the building to allow for some of the Mechanical and Electrical equipment to be placed. A potential way to avoid this problem would be ordering the large, long lead items earlier in the process. This would have required the construction manager to put pressure on the architects and engineers to fully design the necessary building equipment to allow for the contractors to place the orders in time.

TECHNICAL ANALYSIS METHODS:

One of the analyses that could be interesting for this project are related to the building's architecture. As mentioned above, there are several areas in the building where some simple changes could provide significant potential costs savings. First it would be interesting to look at an analysis where the finish materials in the building would be changed. The purpose of this study would not be to completely redesign the interior of the building, but to look at how to make the building finishes look like they are currently designed to look, but with lower costs and local materials.

This analysis would involve doing some research on the materials that were originally specified by the architect and also doing some research on some local materials to determine which may be the closest match to the original finishes. To affectively complete this study, it would be necessary to contact some people in industry and determine costs of the proposed materials, time savings due to shorter transportation and lead times, and potential benefits related to ease of construction. Also it would be a good side study for this research to analyze how many LEED points could be obtained based on the travel distances from the wood suppliers. This analysis would involve a fairly substantial amount of architectural breadth study.

An additional study related to the architecture of the building was mentioned in the Problem Identification section. The glass on the exterior of the building is primarily double paned glass. It would be a potentially viable alternative to install triple pane glass. This would involve a mechanical breadth study of determining the amount of heat loss through the standard two pane glass and determining how much would be lost if three pane glass was installed. When the heat loss figures were determined, a per-year price would have to be determined for savings with the three pane glass system. The price would also have to be determined for the three pane glass material. These two figures would then need to be considered in a life cycle cost analysis to see how long it would take for the savings to equal the increased cost of glazing.

A third analysis that could be examined would be related to the utility tunnel that was placed under Park Avenue. It would be interesting to examine the feasibility of boring under the road to place the tunnel instead of digging up the road and closing down all eastbound traffic. This study would be accomplished through obtaining information from the construction manager, engineer, and site work contractor. First and foremost, it would help to ask if it would indeed be possible to bore the hole, place the tunnel (using precast or cast-in-place concrete), and still abide by all OSHA guidelines. When a possible method for this type of construction is determined, it would be necessary to look at the cost of this procedure as compared to the cost of digging up the road as it had been done in reality. Because of the permitting requirements of closing Park Avenue, this method may also help in reducing the schedule for running the utilities to the building.

WEIGHT MATRIX:

The weight matrix in Figure 1 below indicates the amount that my proposed analyses will touch on the prescribed topics listed.

Description	Research	Value Engineering	Constructability Review	Schedule Reduction/ Acceleration Proposal	Total
BIM Survey	20%	-------	-------	-------	20%
Architectural Redesign	10%	20%	10%	-------	40%
Exterior Glazing Alternative	-------	10%	-------	10%	20%
Utility Tunnel Construction Process	-------	-------	-------	20%	20%
Total	30%	30%	10%	30%	100%

Figure 1: **Weight Matrix**