THESIS PRESENTATION OUTLINE

1. INTRODUCTION (3 SLIDES)
   a. Building Statistics (square footage, schedule, costs, firms involved) – (1 Screen - 1 Slide)
   b. Identifying the Project Team – (2 Screens - 1 Slide)
   c. Building Systems Summary and Construction Phases – (1 Screen - 1 Slide)

2. ANALYSIS#1: Schedule Acceleration Through Multi-Trade Prefabrication (5 SLIDES)
   a. Problem Identification – (1 Screen - 1 Slide)
   c. Impact on Schedule and General Conditions – (2 Screen-1 Slide)
   d. Where to Prefab? How Many Truck Loads Required? Site Logistics? – (2 Screens - 1 Slide)
   e. Recommendations and Conclusions – (1 Screen - 1 Slide)

3. ANALYSIS#2: Eliminating Inefficiency of Cost Estimating Through 3D Modeling (4 SLIDES)
   a. Problem Identification – (1 Screen - 1 Slide)
   b. Experimenting on Structural Steel Take-offs – (2 Screens - 1 Slide)
   c. Analysis of Survey Questions – (3 Screens - 1 Slide)
   d. Guidelines for Implementing 3D Estimation and Conclusion – (2 Screens - 1 Slide)

4. ANALYSIS#3: Viability of Incorporating Solar Photovoltaic Systems (7 SLIDES)
   a. Problem Identification – (1 Screen - 1 Slide)
   b. How PV-System Works and Solar Analysis – (3 Screens - 1 Slide)
   c. PV Panel Manufacturers and Energy Demand (ELECTRICAL BREADTH) – (3 Screens -1 Slide)
   d. Electrical Energy Production (ELECTRICAL BREADTH) – (2 Screens -1 Slide)
   e. Financial Analysis – (5 Screens - 2 Slide)
   f. Recommendations and Conclusions – (1 Screen - 1 Slide)

5. CONCLUSION (1 Screen - 1 SLIDES)
6. ACKNOWLEDGEMENTS (3 Screens - 1 SLIDES)

PRESENTATION OUTLINE SUMMARY

- Total of 22 Slides
- All Analyses will be discussed in fair amount of details
- Only Electrical Breadth will be discussed. The Structural Breadth will be identified but not discussed in the Presentation.
- Image screens were not counted in this outline
Presentation Outline:

I. Project Background

II. Analysis #1: Multi-Trade Prefabrication
   - What to Prefabricate?
   - Schedule and GC Impact
   - Logistics

III. Analysis #2: 3D Estimating
   - Methodology Used
   - Analysis of Survey
   - Guidelines for Implementation

IV. Analysis #3: Solar PV Panels
   - Solar Analysis
   - Manufacturers
   - Electrical Production Calculations
   - Financial Analysis

V. Lessons Learned

VI. Acknowledgements

Project Background

Building Name: Children's Hospital
Occupancy Type: Medical Hospital
Location: 500 University Drive, Hershey, PA 17033
Gross Building Area: 262,587 SF
Number of Stories: 5-Stories + Underground Level
Delivery Method: Design-Bid-Build w/ CM Agency @ Risk

Construction Dates: March 17th, 2010 – August 28th, 2012
Contracted GMP Amount: $115 Million
LEED Certification: Certified
Presentation Outline:
I. Project Background
II. Analysis #1: Multi-Trade Prefabrication
   • What to Prefabricate?
   • Schedule and GC Impact
   • Logistics
III. Analysis #2: 3D Estimating
   • Analysis of Survey
   • Guidelines for Implementation
IV. Analysis of Solar PV Panels
   • Solar Analysis
   • Manufacturers
   • Electrical Production Calculations
   • Financial Analysis
V. Lessons Learned
VI. Acknowledgements

3D ESTIMATING

Methodology Used
- Conduct Manual Quantity Takeoffs of Structural Steel System
- Conduct 3D Based QTO of Structural Steel System
- Determine Time Savings and Accuracy of Each Method

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>RS MEANS COSTWORKS ESTIMATE</th>
<th>ACTUAL COSTS</th>
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<tbody>
<tr>
<td></td>
<td>Traditional QTO</td>
<td>Revit QTO</td>
</tr>
<tr>
<td></td>
<td>$/SF</td>
<td>TOTAL</td>
</tr>
<tr>
<td>Traditional QTO</td>
<td>$20.49</td>
<td>$5,380,000</td>
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<tr>
<td>3D QTO</td>
<td>$19.81</td>
<td>$5,200,000</td>
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SUMMARY OF RESULTS

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<th>Traditional QTO</th>
<th>Revit QTO</th>
<th>LED Contract</th>
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<tr>
<td>Time Required</td>
<td>25 hrs</td>
<td>2 hrs</td>
<td>-</td>
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<tr>
<td>Percentage of Discrepancy</td>
<td>15%</td>
<td>0%</td>
<td>-</td>
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<tr>
<td>Cost of System</td>
<td>$5,380,000</td>
<td>$5,200,000</td>
<td>$5,597,000</td>
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<tr>
<td>% Difference to Actual</td>
<td>-3.87%</td>
<td>-7.1%</td>
<td>0%</td>
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<tr>
<td>Level of Accuracy Achieved</td>
<td>85%</td>
<td>100%</td>
<td>100%</td>
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Electric Demand
- **Annually**: 7,221,143 kWh
- **Monthly**: 601,762 kWh
- **Daily**: 19,784 kWh

More Realistic Approach (Electric Breadth)

Manufacturers and Panels Needed
- **Kyocera (KD235GX-LP)**: 18961 Panels
- **BP Solar (BP3230T)**: 19373 Panels
- **Suntech (STP210-18)**: 21218 Panels

Photovoltaic System Manufacturers and Panels Needed
- **Kyocera (KD235GX-LP)**: 18961 Panels
- **BP Solar (BP3230T)**: 19373 Panels
- **Suntech (STP210-18)**: 21218 Panels

Panels Required Per End Use

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<tr>
<th>DIVISION</th>
<th>End Use Percentage</th>
<th>Watt Hours Per Day</th>
<th># of Panels Req'd</th>
<th>Is it Feasible?</th>
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<td>197840</td>
<td>189.61</td>
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<tr>
<td>Refrigeration</td>
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<tr>
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<td><strong>TOTAL</strong></td>
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<td>19784000</td>
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System Size to be Designed
- **240 Panels @ 4180 SF Roof Space**
- **System Rated at 56.4 kW**