UNIVERSITY OF PITTSBURGH

I. PROJECT BACKGROUND
II. ANALYSIS #1: TECHNOLOGY IN THE FIELD
III. ANALYSIS #2: FACADE RE-SEQUENCE
IV. ANALYSIS #3: COMMISSIONING LAB SPACES
V. ANALYSIS #4: GREEN ROOF ADDITION
VI. SUMMARY
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I. PROJECT BACKGROUND

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PROJECT PARTICIPANTS

OWNER | THE UNIVERSITY OF PITTSBURGH
ARCHITECT | WILSON ARCHITECTS
GENERAL CONTRACTOR | BURCHICK CONSTRUCTION
STRUCTURAL ENGINEER | BARBER & HOFFMAN, INC.
MEP/FP | AFFILIATED ENGINEERS, INC.
CIVIL ENGINEERS | THE GATEWAY ENGINEERS, INC.

PROJECT PARAMETERS

PROJECT COST | $25 M
SIZE | 35,000 SF
BUILDING LOCATION | PITTSBURGH, PA
DURATION | NOV. 2009 – SEPT. 2011
PROJECT DELIVERY METHOD | DESIGN-BID-BUILD

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CONSTRUCTION LOGISTICS
2 PHASE PROJECT – RENOVATION & VERT ADDITION

ARCHITECTURE
- 2 CHEMICAL RESEARCH FLOORS
- 1 MECHANICAL PENTHOUSE
- FACADE SYSTEMS
  - TERRA COTTA
  - METAL PANELS
  - LOUVERS
  - GLAZING
- LEED GOLD
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IX. QUESTIONS

BUILDING SYSTEMS

MEP SYSTEMS
- ADDITION SERVICE BY 3 NEW AHU’S
- (3) LABORATORY EXHAUST FANS
- (1) 1500 KW EMERGENCY GENERATOR
- 300 KVA TRANSFORMER
- 1600 A MAIN SWITCHBOARD

STRUCTURAL SYSTEM
- STRUCTURAL STEEL
- STILT-LIKE STRUCTURE SUPPORTED BY PILE CAPS
- BRACED FRAMES TO RESIST SHEAR AND LATERAL LOADS
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RED: Project Site
BLUE: Field Offices & Limited Parking
GREEN: Lay-down/Storage Areas
PROBLEM IDENTIFICATION

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IX. QUESTIONS

CONTRIBUTING FACTORS TO CONTRACTOR REWORK

- **RED:** Project Site
- **BLUE:** Field Offices & Limited Parking
- **GREEN:** Lay-down/Storage Areas
CASE STUDIES

BALFOUR BEATTY

- VELA SYSTEMS & iPADS COMPANY-WIDE
  - PROTECTIVE CASE
  - LOW COST
  - LONG BATTERY LIFE
  - EASE-OF USE
  - REDUCTION IN GENERAL CONDITIONS
  - INCREASED EFFICIENCY
  - REDUCED RISK
CASE STUDIES

PRESENTATION OUTLINE

I. PROJECT BACKGROUND
II. ANALYSIS #1: TECHNOLOGY IN THE FIELD
I. CASE STUDIES
III. IMPLEMENTATION
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IX. QUESTIONS

SUFFOLK CONSTRUCTION

- WASTED TIME COMMUNICATING
- MEETING MINUTES
- INCREASE IN:
  - PERSONAL PRODUCTIVITY
  - PROJECT ACCELERATION
  - RISK REDUCTION
  - COST OF QUALITY
CASE STUDIES

I. PROJECT BACKGROUND
II. ANALYSIS #1: TECHNOLOGY IN THE FIELD
   ➢ COMMISSIONING OF HARVARD LAB
   ➢ ELIMINATED NEED FOR PAPER
   ➢ TABLET PCs:
     ➢ VIEW DRAWINGS
     ➢ MARK UP DRAWINGS
     ➢ PUNCHLIST
     ➢ HANDOVER DOCUMENT SET
III. CASE STUDIES
IV. ANALYSIS #2: FACADE RE-SEQUENCE
V. ANALYSIS #3: COMMISSIONING LAB SPACES
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BENEFITS & SAVINGS

Potential Savings Associated with Technology in the Field

<table>
<thead>
<tr>
<th>Worker</th>
<th>Rate</th>
<th>Hours</th>
<th>Total Cost</th>
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<tbody>
<tr>
<td>Superintendent</td>
<td>$12.03</td>
<td>3.83</td>
<td>48.67</td>
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<tr>
<td>Foreman</td>
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<td>Accountant</td>
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<tr>
<td>Project Manager</td>
<td>$50.00</td>
<td>1.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$16,585.00</td>
</tr>
</tbody>
</table>

Total Costs Associated with Technology without Technology

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPad w/ warranty &amp; camera</td>
<td>$937.00</td>
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<tr>
<td>OtterBox Case</td>
<td>$70.00</td>
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<tr>
<td>Vela Systems</td>
<td>$11,064.00</td>
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<tr>
<td>Vela Training</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>Total</td>
<td>$16,585.00</td>
</tr>
</tbody>
</table>

Potential Savings

Costs without Technology: $160,828.42
Technology Costs: $16,585.00
Potential Savings: $144,243.42

Technology should have been used on the Chevron Annex and future projects.
I. PROBLEM IDENTIFICATION

II. LAST PLANNER INTRODUCTION

III. SWING LOCATIONS

IV. PHASING

V. SUMMARY

IV. ANALYSIS #3: COMMISSIONING LAB SPACES

V. ANALYSIS #4: GREEN ROOF ADDITION

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VIII. QUESTIONS

- SEPARATE PRIME CONTRACTORS
- INTERDEPENDANCY OF FACADE SYSTEMS
- LIMITED NUMBER OF SCAFFOLDING SYSTEMS
- MINIMUM SCOPE MEETINGS & PLANNING SESSIONS
- ARHICTECTURAL EYEBROW
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KEY PRACTICES OF THE LAST PLANNER SYSTEM:

- MINIMIZING WORK VARIABILITY BETWEEN TASKS
- CREATING LOOK-AHEAD PLANS
- PLANNING WORK ON WEEKLY BASIS
- MEASURING PROGRESS AND USING WEEKLY LEARNING TO IMPROVE WORK PRACTICES
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VIII. QUESTIONS

NORTH ELEVATION

WEST ELEVATION
SUMMARY

- Proper planning is essential
- Thorough scope
- Separate primes add additional coordination concerns
- Multiple coordination and scope review meetings
- Get all parties involved in creating the schedule
- Know how a system is installed before project begins
- On-site knowledge to determine activity durations
PROBLEM IDENTIFICATION

- Labs had to be "dust-free" before TAB could begin.
- Chevron Tower was in negative air condition, sucking dirt from the project into the existing building.
- Commissioning agent was contracted directly with the owner.
LAST PLANNER & NEW SCHEDULE

KEY MILESTONES

- AHU DELIVERY DATE
- STROBIC FAN START-UP
- L&I INSPECTIONS
- ABOVE CEILING WORK
- TESTING AND BALANCING
KEY DIFFERENCES

- AHU DELIVERY LATER THAN EXPECTED
- FOOTBALL SHROUDS AT FUME HOODS
- NIPPLE PLENUMS
- STROBIC FAN START-UP
- ARCHITECTURAL MILLWORK & DUST-FREE ACTIVITIES
- ABOVE CEILING WORK
- LABORATORY CASEWORK
### COMMISSIONING AGENT

- Get involved in the project during the design phase
- Require to make visits to the project site regularly
- Same CX agent performing:
  - Submittal & RFI reviews
  - Testing & balancing

- Letter to the owner
- Prefabrication
- Adequate scope information
- Technology in the field
GREEN ROOF TYPES & COMPONENTS

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I. GREEN ROOF TYPES & COMPONENTS
II. STRUCTURAL BREADTH

EXTENSIVE - LIGHTER & LESS EXPENSIVE
NOT FOR HUMAN USE
INTENSIVE - HUMAN USE

EXTENSIVE GREEN ROOF SECTION

INTENSIVE GREEN ROOF SECTION

- LiteTop Lawn
- Aggregate/Drainage
- Roof Membrane
- Growing Media
- Systfoam
- Roof Deck/Slab
ADDITIONAL LOADS

ORIGINAL LOADINGS
- ROOF DEAD LOAD = 30 PSF
- ROOF LIVE LOAD = 30 PSF

NEW LOADINGS
- ROOF DEAD LOAD = 90 PSF
- ROOF LIVE LOAD = 100 PSF

STRUCTURAL BREADTH

REQUIREMENTS
- ADDITIONAL LOADINGS
- COLUMN LOAD CHECKS
- BEAM LOAD CHECKS
- GIRDER LOAD CHECKS

MEMBERS REQUIRING RESIZING
- COLUMNS
  - E.8-2.8
- GIRDER
  - <7.2-8.9>, <E.8>
  - W18X46 → W24X62
  - <0.8-2.8>, <C.3>
  - W18X35 → W21X44
6 COLUMNS TESTED

1 REQUIRED RE-SIZING
- E.8-2.8
- ORIGINAL SIZE: W10 x 60
- ADJUSTED SIZE: W10 x 88
3 TYPICAL BAYS
NO BEAM RE-SIZING NECESSARY
3 GIRDERS TESTED

2 REQUIRED RE-SIZING

- <7.2-8.9>, <E.8>
  - ORIGINAL SIZE: W18 x 46
  - ADJUSTED SIZE: W24x 62

- <0.2-2.8>, <C.3>
  - ORIGINAL SIZE: W18 x 35
  - ADJUSTED SIZE: W21 x 44
GREEN ROOFS REQUIRE ADDITIONAL STRUCTURAL REINFORCEMENT

- GREEN ROOFS ADD A SIGNIFICANT AMOUNT OF LOAD TO THE STRUCTURE
- GREEN ROOFS REQUIRE ADDITIONAL STRUCTURAL REINFORCEMENT
ANALYSIS 1
- Technology should be implemented on the Chevron Annex and future projects

ANALYSIS 2
- Proper planning can lead to an efficient installation process

ANALYSIS 3
- Commissioning is affected by all trades

ANALYSIS 4
- Adding a green roof should be a decision made by the owner
PRESENTATION OUTLINE

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ACKNOWLEDGEMENTS

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AMANDA MYERS

SPECIAL THANKS
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FAMILY & FRIENDS

ACADEMIC
DR. CHIMAY ANUMBA: ADVISOR
PENN STATE FACULTY & STAFF
QUESTIONS?