Welcome to Improving Project Delivery Through Effective Teams and Lean Concepts

Moderator: Capt. Michael Blount, USN (Ret.), Balfour Beatty Construction

Speakers: Mr. Andreas Phelps, Balfour Beatty Construction
          Mr. Dick Bayer, Lean Construction Institute
          Mr. Michael St. Clair, Southland Industries
          Mr. George Rogers, RQ Construction, Inc.
Our Mental Models

Selective Perception

Sense making & Interpretation

Decision
Making Sense of the Noise

- **Lean Design**
  Understanding of what we do (process) and why it’s important (value)

- **Integrated Design & Sustainability**
  Understanding the interrelation between specialties and between lifecycle phases

- **BIM & Information Technologies**
  Ability to visualize and analyze information in ways that were never possible before

**Developing a comprehensive and holistic understanding of our industry**
First Things First

Tools/Technology → Process → Behaviors → Results

#humanBIM
Lean Production Management
Lean Framework

Values Definition & Alignment

Exploration Of Options

Plan Development & Production Management
Lean Framework

Values Definition & Alignment

Exploration Of Options

Plan Development & Production Management
Understand “root value” and develop metrics to consistently evaluate that notion of value.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Type</th>
<th>Information Needed</th>
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</thead>
<tbody>
<tr>
<td>Initial cost</td>
<td>Metric</td>
<td>Dollars</td>
</tr>
<tr>
<td>Energy cost (40-year)</td>
<td>Metric</td>
<td>Dollars</td>
</tr>
<tr>
<td>Maintenance Cost (40-year)</td>
<td>Metric</td>
<td>Dollars</td>
</tr>
<tr>
<td>Standardized campus systems</td>
<td>Requirement</td>
<td>Campus standards</td>
</tr>
<tr>
<td>Easy access to components</td>
<td>Consideration</td>
<td>Facilities input</td>
</tr>
<tr>
<td>Open space for flexible layout</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment)</td>
</tr>
<tr>
<td>Allow for future technology</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment)</td>
</tr>
<tr>
<td>Flexible infrastructure (power, AV)</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment)</td>
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<tr>
<td>Accessibility for disabled students/</td>
<td></td>
<td>Input from Wounded Warrior project regarding designing for disabilities (layout,</td>
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<tr>
<td>veterans</td>
<td>Consideration</td>
<td>finishes, etc.)</td>
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<tr>
<td>Gateway to the campus/Integration with the rest</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment)</td>
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<tr>
<td>of the campus (materials, function, views/nature)</td>
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<tr>
<td>Celebrates fitness</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment)</td>
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<tr>
<td>Hub for athletics and faculty</td>
<td>Metric</td>
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<tr>
<td>Meet budget &amp; schedule</td>
<td>Requirement</td>
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<tr>
<td>Meet/exceed program</td>
<td>Consideration</td>
<td></td>
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<tr>
<td>Maintain access/flow/image during construction</td>
<td>Requirement</td>
<td></td>
</tr>
<tr>
<td>Control flow related to Security</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment, input from security)</td>
</tr>
<tr>
<td>Enable easy flow for disabled staff/visitors/students</td>
<td>Metric</td>
<td>0-5 relative ranking (professional judgment, input from Wounded Warrior team)</td>
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<tr>
<td>Separation/distinction b/w fitness and</td>
<td>Metric</td>
<td>Need greater clarity from District related to what this entails</td>
</tr>
<tr>
<td>athletics</td>
<td></td>
<td></td>
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<tr>
<td>Separation/distinction b/w students and</td>
<td>Metric</td>
<td>Need greater clarity from District related to what this entails</td>
</tr>
<tr>
<td>community</td>
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Values Matrix

BACKGROUND: All projects need context and background for determining at the outset why the project is being undertaken. What problems does it solve? What does it mean to represent? Who are the stakeholders and what are their objectives? Development of a values matrix, a representation of the varied values the parties mean for the project to represent, anchors the project in a certain context that allows the parties to work across the creative tensions of varying values and arrive at the best built environment solution.

CURRENT CONDITION: The GPIC is a consortium of Penn State University and a variety of state and federal government entities including E-RIC and the Department of Energy. The goals of the GPIC EEB Hub are to: 1) transform building retrofit industry from serial fragmentation to integrated systems methods; 2) improve design tools, building systems, public policies, market incentives, and workforce skills needed to achieve a 50% reduction of energy use in buildings; and 3) stimulate private investment and quality job creation in Greater Philadelphia and beyond. (www.gpichub.org). The specific project includes the renovation of an existing gymnasium and the construction of a new building. Kieran Timberlake is the project architect and Balfour Beatty is the Contractor.

DEVELOPMENT PROCESS: In order to secure a representative set of agreed values, the stakeholders convened in Philadelphia for a facilitated values development session. Nine categories of values were developed by the group:

- Influence
- Demonstration
- Learning
- Work Management
- Repeatability
- Maximization of Value
- Collaboration
- Regional Optimization
- Systems Integration
- Whole Costing

TARGET CONDITION: The parties agreed to allow Steve DiBartolo, Bevan Mace and Dave Rick to collaborate on a proposed final statement of the Values Matrix.

The team reduced the categories to 7 and developed the following proposed values statements:

Influence: As a regional collaboration creating national energy efficient innovations that foster job growth, economic development we will influence the industry to design, implement and operate integrated energy efficient renovations. We will influence public owners to use integrative project delivery processes.

Repeateable Demonstration: We will demonstrate incorporation of repeatable energy efficient technology, processes and procedures that are affordable, workable and efficient. We will demonstrate that public projects can deliver projects on an integrated basis within the procurement challenges this project faces.

Learning: We will use processes and technologies that allow us to learn and share our learning about the efficacy, affordability, repeatability and constructability of efficient and effective energy retrofits through synergistic integration of dependable components and subsystems.

Collaborative Environment: We will create a collaborative, multi-dimensional and highly functional work environment to serve both short and long term goals and provide a nexus for regional demonstration, learning and influence in accordance with GPIC requirements and Penn State educational goals.

Systems Integration: We will create efficient and effective energy retrofits through synergistic integration of dependable components and subsystems.

Cost Certainty: We will be good financial stewards and will spend all available initial funds to maximize scope, minimize long term facility costs and with constant consideration of premium / affordability.

Time Reliability: We will be a highly reliable team who makes decisions at the most reasonable moment and creates a safe and quality work environment.

IMPLEMENTATION PLAN:
The GPIC team will review the values at the next meeting of the Project Team on February 22.
The values will be reviewed, revised if necessary and adopted by the team.

FOLLOW-UP:
The team will use the values in assessing the inclusion or exclusion of various elements in the project, in developing systems for inclusion, in making design and construction decisions and in implementing and operating the buildings after completion. The values may be revisited from time to time to ensure that they continue to represent the core values of the project. All A-Ts developed for the project will have a legend (as the one on the right) that will reflect how that A-T and its suggestions would advance, retard or have no effect upon the values developed.
Lean Framework

Values Definition & Alignment

Exploration Of Options

Plan Development & Production Management
Target Value Design

1. Brainstorm ideas
2. Rank & prioritize ideas based on values
3. Develop and evaluate design sets
4. Collaboratively make decisions
5. Track team performance against targets
Set-Based Design/Choosing By Advantages

Figure 4: Toyota’s Set-Based Design vs. Traditional Point-Based Design

Traditional Point-Based Design Process

- Multiple iterations
- Few concepts
- Concept selected
- Test
- Detail

Toyota’s Set-Based Design Process

1. Toyota considers
2. Concepts move forward by evaluating against
3. Design teams combine
4. The final concept is assembled

More traditional processes freeze the design early in the process, often resulting in a series of costly and time-consuming iterations further downstream.

Source: Kennedy, Michael, Product Development for the Lean Enterprise
Lean Framework

Values Definition & Alignment

Exploration of Options

Plan Development & Production Management
Pull Planning
Integrated Scheduling

BIM Execution Plan

1. BIM USE:

<table>
<thead>
<tr>
<th>BIM GOAL</th>
<th>PURPOSE</th>
<th>PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAM VALIDATION</td>
<td>Verify design meets program needs with owner</td>
<td>Data and Documents for Proposal and/or bid review, comment and sign off</td>
</tr>
<tr>
<td>DESIGN VALIDATION</td>
<td>Review design models and documentation with the project team during design development</td>
<td>Renderings, simulations, Virtual mock-ups, walkthroughs that confirm inclusion of all elements required by the approving authority</td>
</tr>
<tr>
<td>SUSTAINABILITY</td>
<td>Analyze the model to meet LEED requirements: Lighting, energy, mechanical analysis</td>
<td>LEED calculations/analysis</td>
</tr>
<tr>
<td>DESIGN COORDINATION</td>
<td>Perform systems coordination, quality control</td>
<td>Coordinated model(s), verifying all building systems &quot;tie&quot; into the building as designed</td>
</tr>
<tr>
<td>5D QUANTITY TAKE OFF</td>
<td>Improve take-off capacity; provide material information quicker to estimators, Link cost to quantity items for BIM Estimating as well as track model elements and progress of model development</td>
<td>Materials needed to perform an estimate, QTO, 5D take-off, 3D documentation, Cost data to tie to model elements</td>
</tr>
<tr>
<td>4D SCHEDULING &amp; ANALYSIS</td>
<td>Improve schedule analysis and planning</td>
<td>A combined CPM schedule and 3D model that animates the construction</td>
</tr>
</tbody>
</table>
Off-Site Manufacturing/BiQ
Supply Chain Integration

- Late changes to design criteria
- Design or scope changes
- Unclear BIM coordination and standards
- Dimensional coordination, clash detection and conflict resolution
- Consensus regarding deliverables content
- Poor understanding/definition of budget costs on design concepts
First Things First

Tools/Technology

Behaviors

Process

Results
Increasing Value

- **Values**: why we love/are doing this project
- **Goals**: what we want to accomplish
- **Metrics**: how we measure how well we’re doing
Increasing Value

EE HUB Project

- DOE/Penn State
- Increase energy efficiency in renovations by 50%
- Design, Bid, Build
- Pennsylvania Separations Act

NAVY YARD BUILDING 661
ADVANCED ENERGY RETROFIT LIVING LABORATORY
Both the delivery process and the resulting 661 edifice will serve as examples for future advanced energy retrofit projects in the region.

To this end, the Hub is committed to observing and recording this advanced energy retrofit project, capturing what are considered to be best practices in the field.
Increasing Value
Increasing Value

Project: GPIC Philadelphia Naval Yard  Date: February 20, 2012  A3 No.2012-1

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# Increasing Value

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Increasing Value

Evaluation

• Maintain a record of decisions
• Make sure every decision aligns with values
• Make decisions at last responsible moment
<table>
<thead>
<tr>
<th>Programming</th>
<th>Concept Dvlpmnt</th>
<th>Design Development</th>
<th>Design Coord</th>
<th>Construction Planning</th>
<th>Construction</th>
<th>O&amp;M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Digital Documents</td>
<td>Vela</td>
<td>Coordinating/Clash Detection</td>
<td>FIM</td>
<td>3D/4D/5D Visualization and Analysis</td>
<td>Reality Capture/QA/QC</td>
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<tr>
<td>Program Validation</td>
<td>RAPID Cost &amp; Energy Analysis</td>
<td>Coordination/Clash Detection</td>
<td>FIM</td>
<td>3D/4D/5D Visualization and Analysis</td>
<td>Reality Capture/QA/QC</td>
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<tr>
<td>Reality Capture</td>
<td>Virtual Mockups</td>
<td>Materials Tracking</td>
<td>Site Logistics Planning</td>
<td>Safety Planning/Training</td>
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<tr>
<td>Lean Processes (to enable goals)</td>
<td>Values Definition and Alignment</td>
<td>Target Value Design</td>
<td>Built-In Quality/Safety</td>
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<tr>
<td></td>
<td>Value-Based Design</td>
<td>Pull Planning</td>
<td>Prefabrication/Off-Site Manufacturing</td>
<td></td>
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<tr>
<td></td>
<td>Tacit &amp; Explicit Information Flow Management (Value Stream Mapping)</td>
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<td>Client &amp; Project Goals</td>
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<td>Sustainability</td>
<td>Quality</td>
<td>Image/Impact</td>
<td>Cost</td>
<td>Schedule</td>
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Making Sense of the Noise
Values Definition and Alignment
- Target Value Design
- Set-Based Design
- Pull Planning
- Prefabrication/Off-Site Manufacturing
- Tacit & Explicit Information Flow Management (Value Stream Mapping)

Lean Processes (to enable goals)

Built-In Quality/Safety
<table>
<thead>
<tr>
<th>Programming</th>
<th>Concept Dvlpmnt</th>
<th>Design Development</th>
<th>Design Coord</th>
<th>Construction Planning</th>
<th>Construction</th>
<th>O&amp;M</th>
</tr>
</thead>
</table>

**Lean Processes**
(to enable goals)

- **Values Definition and Alignment**
  - Target Value Design
  - Set-Based Design

- Built-In Quality/Safety
  - Pull Planning
  - Prefabrication/Off-Site Manufacturing
  - Tacit & Explicit Information Flow Management (Value Stream Mapping)
Standard Option Evaluation Process

Hosted by the Society of American Military Engineers HQ and the San Diego Post
Case Study

Standard Decision Making Process

Define Value Setting Aggressive Targets
Create Design Sets
Define Advantages Validation

Hosted by the Society of American Military Engineers HQ and the San Diego Post
Section 1 – Background

The Team has been tasked with validating that all Structural Performance Criteria (SPC) Compliance and Equipment Upgrades can be provided to sustain the Corona Regional Medical Center through 2030 while meeting or beating a target value of $20,500,000. Existing systems are underutilized, decentralized, and in generally poor condition, while the rooftop diaphragm structural system is not compliant with current code requirements.

Additionally, upcoming South Coast Air Quality Management District (SCAQMD) regulations require modification to existing emergency generators. Sets evaluated during this process also need to minimize operational impacts to the facility.

Working as an Integrated Project Delivery (IPD) Team, through the use of Target Value Design (TVD), Solution Set-Based Design (SBD), and a Big Room format that co-located the team weekly, the Team has created multiple schematic design solution sets to validate a path to the target budget.

Section 2 – Problem Statement/Current State

Current status of systems is as follows:

<table>
<thead>
<tr>
<th>System</th>
<th>Condition</th>
<th>Related To</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>Partially Non-Compliant</td>
<td>Senate Bill (SB) 1953 / NPC-3</td>
<td>EXEMPT</td>
</tr>
<tr>
<td>Fire Sprinkler</td>
<td>Breaching Non-Compliant</td>
<td>NPC-3</td>
<td>EXEMPT</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Deteriorating Equipment</td>
<td>Maintenance &amp; Functionality</td>
<td>See Detail</td>
</tr>
<tr>
<td>Plumbing</td>
<td>Deteriorating Equipment</td>
<td>Maintenance &amp; Functionality</td>
<td>See Detail</td>
</tr>
<tr>
<td>Electrical (Normal)</td>
<td>Deteriorating Equipment</td>
<td>Maintenance &amp; Functionality</td>
<td>See Detail</td>
</tr>
<tr>
<td>Electrical (Emergency)</td>
<td>Partially Non-Compliant</td>
<td>AQMD &amp; Associated Upgrades</td>
<td>See Detail</td>
</tr>
<tr>
<td>Fire Alarm</td>
<td>Planned Upgrade</td>
<td>Infrastructure Improvements for Future Retrofit &amp; Expansion</td>
<td>See Detail</td>
</tr>
<tr>
<td>Architectural</td>
<td>Functional</td>
<td>Work Associated with Upgrades</td>
<td>See Detail</td>
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</tbody>
</table>

Section 3 – Future State/Goal

- Integrated team: Maximize value to UHS. Reliable design, cost, schedule = Target Budget of $20,500,000.
- Prioritize system upgrades – building needs to be functional to 2030, minimize impacts to facility, and improve plant conditions.
- Upgrade for current regulatory compliance to 2030. Complete work by applicable deadlines.
- Assures a predictable outcome for all aspects of the project.
- Lean Learning and Value Education to continue through the project. Team members to share Lean Learning within organizations.
- Communication: open dialogue, teamwork, and cooperation. Proactively resolve conflicts.
- All parties will realize a fair and reasonable profit for success. Share profit and loss equally.
- Success factor for the project: Friends at the end.
- Eliminate traditional Request for Information (RFI) process through collaboration.
- Use pull planning for scheduling, to improve schedules for design and construction, and find all avenues to improve productivity for the trades.

Section 4 – Analysis of Mechanical, Electrical, and Structural Sets

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>GOOD (2021)</th>
<th>BETTER (2023)</th>
<th>BEST (2026)</th>
<th>OVERALL CHOICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller</td>
<td>$4,345,169</td>
<td>$1,860,933</td>
<td>$1,904,501</td>
<td>Best = Set 64</td>
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<tr>
<td>Steam Boilers</td>
<td>$1,565,709</td>
<td>$2,655,709</td>
<td>$1,629,153</td>
<td>Best = Set 62</td>
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<tr>
<td>Ice / Thermal Storage</td>
<td>$107,500</td>
<td>$207,500</td>
<td>$107,500</td>
<td>Below the line</td>
</tr>
<tr>
<td>Emergency Power / Generators</td>
<td>$1,459,850</td>
<td>$2,657,450</td>
<td>$3,015,300</td>
<td>Good = Set EMT</td>
</tr>
<tr>
<td>Structural</td>
<td>$1,627,235</td>
<td>$1,627,235</td>
<td>$1,627,235</td>
<td>Set 715</td>
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<tr>
<td>Air Handling</td>
<td>$2,267,124</td>
<td>$2,267,124</td>
<td>$2,746,680</td>
<td>Best = Set 63</td>
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<td>Water Heating</td>
<td>$504,400</td>
<td>$504,400</td>
<td>$412,420</td>
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<tr>
<td>Mest Gas / Air / Vacuum</td>
<td>$443,000</td>
<td>$443,000</td>
<td>$443,000</td>
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<tr>
<td>Fire Alarm</td>
<td>$76,700</td>
<td>$522,426</td>
<td>$995,365</td>
<td>Good = F4 Infrastructure</td>
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<tr>
<td>Bldg Mgmt / Controls</td>
<td>$850,000</td>
<td>$350,000</td>
<td>$888,500</td>
<td>$350,000</td>
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<tr>
<td>OTHER</td>
<td>$500,000</td>
<td>$1,584,400</td>
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<tr>
<td>Column Totals</td>
<td>$11,930,684</td>
<td>$14,540,177</td>
<td>$15,473,894</td>
<td>$9,445,919</td>
</tr>
</tbody>
</table>

Section 5 – Proposal

Path to Target Value of $20,500,000:
- Two new air-cooled Chillers on the roof (Building 1) to upgrade the Chilled Water System.
- Two new Steam Boilers to replace the “albatross” in the existing Central Plant.
- Replace two of the existing three Generators with one 400KW Generator, to comply with State Regulations (SCAQMD).
- Perform required weld repairs for the roof deck diaphragm strength for the SPC upgrades, while strengthening the roof horizontally and vertically to support the new mechanical equipment and associated platforms. These Structural Upgrades necessitate upgrades to existing columns on the top patient floor, and will provide a full replacement of Building 1 roofing.
- The replacement of Air Handlers S1, S2, and S3. Placement of all AHUs on the high roof, with ducting installed through the existing light wells. The elimination of existing AHU’s S1 and S2 from their current locations will free up space in two existing mechanical rooms in the building.
- The Fire Alarm System infrastructure will be upgraded, including a new, expandable panel. Existing devices will be re-connected to communicate with this panel, and allow the facility to upgrade devices as part of future area remodels.
- A new wireless Building Management System will be installed to control the new equipment being installed to serve Building 1.

Additional Recommendations Include:
1. Include Equipment Maintenance scope for high priority maintenance items.
2. Demolish existing Thermal Storage / Chiller (set 6).
3. Replace the Medical Air / Medical Vacuum system equipment (set MAV1 or MAV2).
4. Switch to Emergency / Generator System set EMG = increased redundancy in emergency power and add a portion of the cooling system to emergency power.

Section 6 – Follow-Up

Upon UHS Board approval of this proposal, the team will submit Design Phase proposals (included in the Target Value Estimate) to proceed with design and detailed development for submittal for permitting, and ultimately, construction, of the proposed solution.

Standard Decision Making Process – A3

Hosted by the Society of American Military Engineers HQ and the San Diego Post
Section 1 - Background

The Team has been tasked with validating that all Structural Performance Criteria (SPC) Compliance and Equipment Upgrades can be provided to sustain the Corona Regional Medical Center through 2030 while meeting or beating a target value of $20,500,000. Existing systems are undersized, decentralized and in generally poor condition, while the rooftop diaphragm structural system is not compliant with current code requirements.

Additionally, upcoming South Coast Air Quality Management District (SCAQMD) regulations require modification to existing emergency generators. Sets evaluated during this process also need to minimize operational impacts to the facility.

Working as an Integrated Project Delivery (IPD) Team, through the use of Target Value Design (TVD), Solution Set-Based Design (SBD), and a Big Room format that co-located the team weekly, the Team has created multiple schematic design solution sets to validate a path to the target budget.

Section 4 - Analysis of Mechanical, Electrical, and Structural Sets

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>GOOD</th>
<th>BETTER</th>
<th>BEST</th>
<th>OVERALL CHOICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller</td>
<td>$2,445,766</td>
<td>$1,860,933</td>
<td>$1,500,301</td>
<td>Best = Set C8</td>
</tr>
</tbody>
</table>

Upon LHS Board approval of this proposal, the team will submit Design Phase proposals (included in the Target Value Estimate) to proceed with design and detailed development for submittal for permitting, and ultimately, construction, of the proposed solution.
Define Value and Settings Targets

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Create Design Sets

Hosted by the Society of American Military Engineers HQ and the San Diego Post
Section 1 - Background

The Team has been tasked with validating that all Structural Performance Criteria (SPC) Compliance and Equipment Upgrades can be provided to sustain the Corona Regional Medical Center through 2030 while meeting or beating a target value of $20,500,000. Existing systems are under designed and in generally poor condition, while the rooftop diaphragm structural system is not compliant with current code requirements.

Section 4 - Analysis of Mechanical, Electrical, and Structural Sets

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>GOOD</th>
<th>BETTER</th>
<th>BEST</th>
<th>OVERALL CHOICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chillers</td>
<td>$1,448,766</td>
<td>$1,860,913</td>
<td>$1,900,901</td>
<td>$1,900,901</td>
</tr>
</tbody>
</table>

Section 5 - Proposal

Path to Target Value of $20.5million:

- Two new air-cooled Chillers on the high roof (Building 1) to upgrade the Chilled Water System.
- Two new Steam Boilers to replace the “albatross” in the existing Central Plant.
- Replace two of the existing three Generators with one 400kW Generator, to comply with State Regulations (SCAQMD).
- Perform required weld repairs for the roof deck diaphragm strength for the SPC upgrades, while strengthening the roof horizontally and vertically to support the new mechanical equipment and associated platforms. These Structural Upgrades necessitate upgrades to existing columns on the top patient floor, and will provide a full replacement of Building 1 roofing.
- The replacement of Air Handlers S1, S2, S3 and S11. Placement of all AHU’s on the high roof, with ducting installed through the existing light wells. The elimination of existing AHU’s S1 and S2 from their current locations will free up space in two existing mechanical rooms in the building.
- The Fire Alarm System infrastructure will be upgraded, including a new, expandable panel. Existing devices will be re-connected to communicate with this panel, and allow the facility to upgrade devices as part of future area remodels.
- A new wireless Building Management System will be installed to control the new equipment being installed to serve Building 1.

Additional Recommendations Include:
1. Include Equipment Maintenance scope for high priority maintenance items.
2. Demolish existing Thermal Storage / Chiller (set I5).
3. Replace the Medical Air / Medical Vacuum system equipment (set MAV1 or MAV2)
4. Switch to Emergency / Generator System Set EM6 = increased redundancy in emergency power and add a portion of the cooling system to emergency power.

Section 6 - Follow-Up

Upon UHS Board approval of this proposal, the team will submit Design Phase proposals (included in the Target Value Estimate) to proceed with design and detailed development for submittal for permitting, and ultimately, construction, of the proposed solution.

Validation

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Pull Planning
Integrated Scheduling
Pull Planning Basics

- Milestones
- Phases
- Short-Term Look-ahead
- Weekly Work Plans
- Lessons Learned
Pull Planning Basics

• Scalable Process
  – Entire Projects
  – Specific Disciplines
  – Specific Scopes of Work
  – Any Milestone

• Best for complex interdependencies, but applicable to anything.
## Design for Manufacture/Assembly

### OSM Opportunities Matrix

<table>
<thead>
<tr>
<th>Image</th>
<th>Element</th>
<th>Off-Site Labor</th>
<th>Key Advantages to Amazon Team</th>
<th>Sourcing/Assembly Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Precast Concrete Stairs" /></td>
<td>Precast Concrete Stairs</td>
<td>75%</td>
<td>Onsite labor reduction, finish surface quality control, schedule enhancement, production ready</td>
<td>Local and national, in-situ erection</td>
</tr>
<tr>
<td><img src="image2" alt="Packaged/Modular Plant Rooms" /></td>
<td>Packaged/Modular Plant Rooms</td>
<td>90%</td>
<td>Speed, national assembly, kit of parts, manpower flexibility.</td>
<td>National and local assemblies; fac supplied; in-situ connections</td>
</tr>
<tr>
<td><img src="image3" alt="Air Handling Units" /></td>
<td>Air Handling Units</td>
<td>93%</td>
<td>Factory controlled quality ensures improved commissioning timeline with fewer defects and punch items.</td>
<td>National and local assemblies; fac supplied; in-situ connections</td>
</tr>
<tr>
<td><img src="image4" alt="High Density Multi-Service Filter Modules (MEP multidiscipline)" /></td>
<td>High Density Multi-Service Filter Modules (MEP multidiscipline)</td>
<td>93%</td>
<td>Risers are available in any shape or from up to 40 ft in length, carrying all services from the mesh, elect, and ventilation ranges. They can be split into floor-by-floor sections for ease of lifting and process.</td>
<td>Local interdisciplinary assembly</td>
</tr>
</tbody>
</table>

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Building In Quality/Safety
Quality Control Spectrum

Reactive
- Inconsistent
- Lots of rework
- Missed conditions

Proactive (Random)
- Person dependent
- Inconsistent
- Missed conditions

Proactive (Process)
- More consistent
- Role & program
- More comprehensive

“Built-In Quality”
- Everyone is a part
- Checks are built in
- Comprehensive
Lean Production Planning

a view from a CEO

By George Rogers

RQ Construction, LLC
What’s the Goal?

- Winning

- Lean Construction is not my goal
  Lean Construction is my strategy
What is the importance of the CEO?

• With CEO onboard and committed, the pursuit of lean **may fail**

• Without the CEO onboard and committed, the pursuit of lean **will fail**

• Lean transformation is a long term strategy.
Linear Thinking or System Thinking?

• Projects are production systems

• Define the production system

• Trade workers need to work for the system while the system needs to work for intellectual workers.
What lean production management isn’t

- Lean Production Management is not doing traditional production management better.
Key’s to production Management

• Trust
  – Must Increase the relatedness of the parties
    • There must be an alignment of goals.
  – Must be/act as a team
    • Are we not usually a group working together?
    • Groups working together are not a team.
  – There must be intellectual workers working with “doers”
System thinking, always system thinking

• System "A set of interacting or interdependent components forming an integrated whole“

• Sub-maximization.

• Measurement
  – “How do you know you are doing good, if you don’t know how good you are doing?”
RQ and lean production
ps. It always seems to start with failure

I am here because of perseverance,
not because of great success
System Integration to manage production@ RQ

• In house Architectural design
  – Going from:
    • external silo to
    • internal silo to
    • integration

• Lean Production Management in Design
  – Is it possible?
System Integration @ RQ

• RQ’s “Partners+”
  – Morphing from a grand concept to narrow integrated JV’s

• Learning that production management has to include controlling work at the most fundamental levels.

• Measured results