IDEA2017
Sustaining Our Success
108TH ANNUAL CONFERENCE & TRADE SHOW
June 26-29 | Fairmont Scottsdale Princess | Scottsdale, AZ

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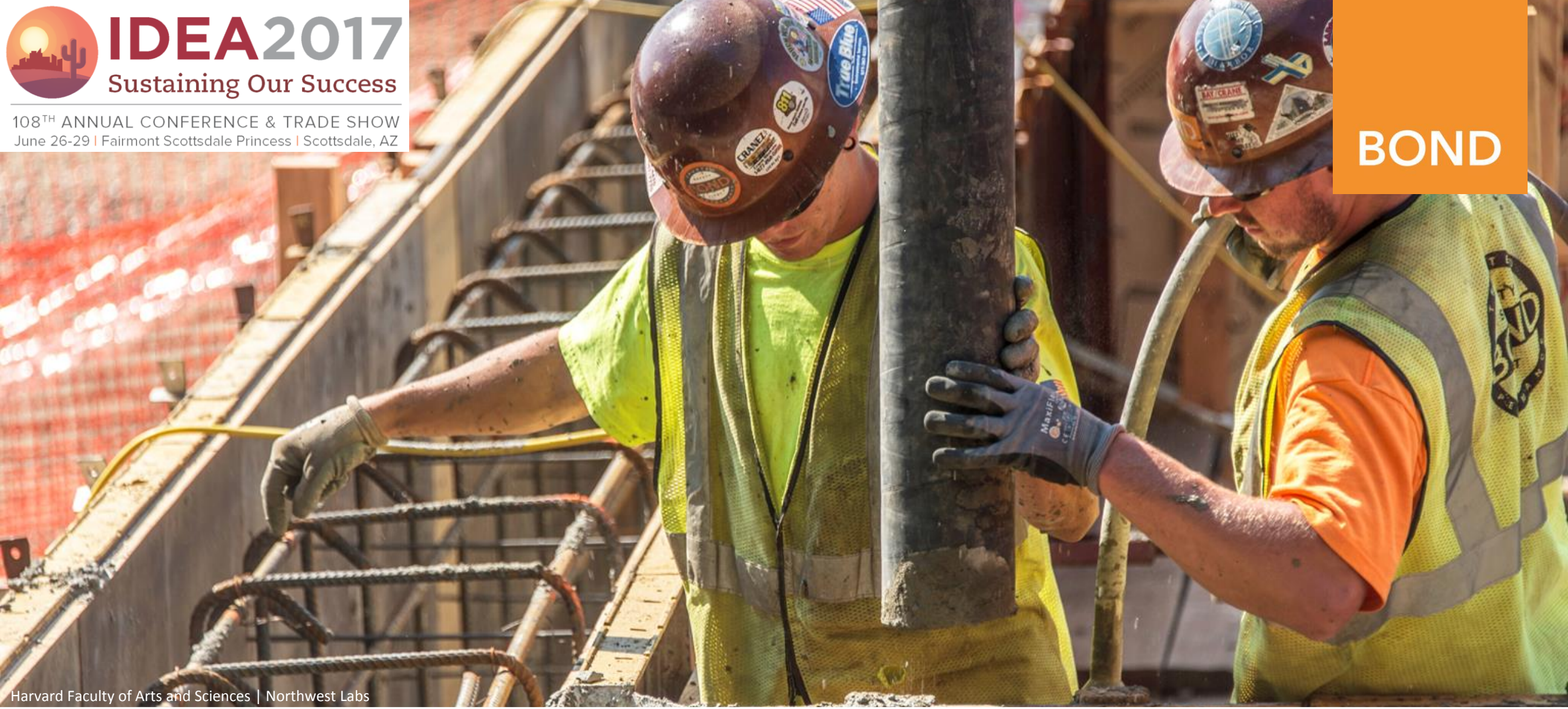


Harvard Faculty of Arts and Sciences | Northwest Labs

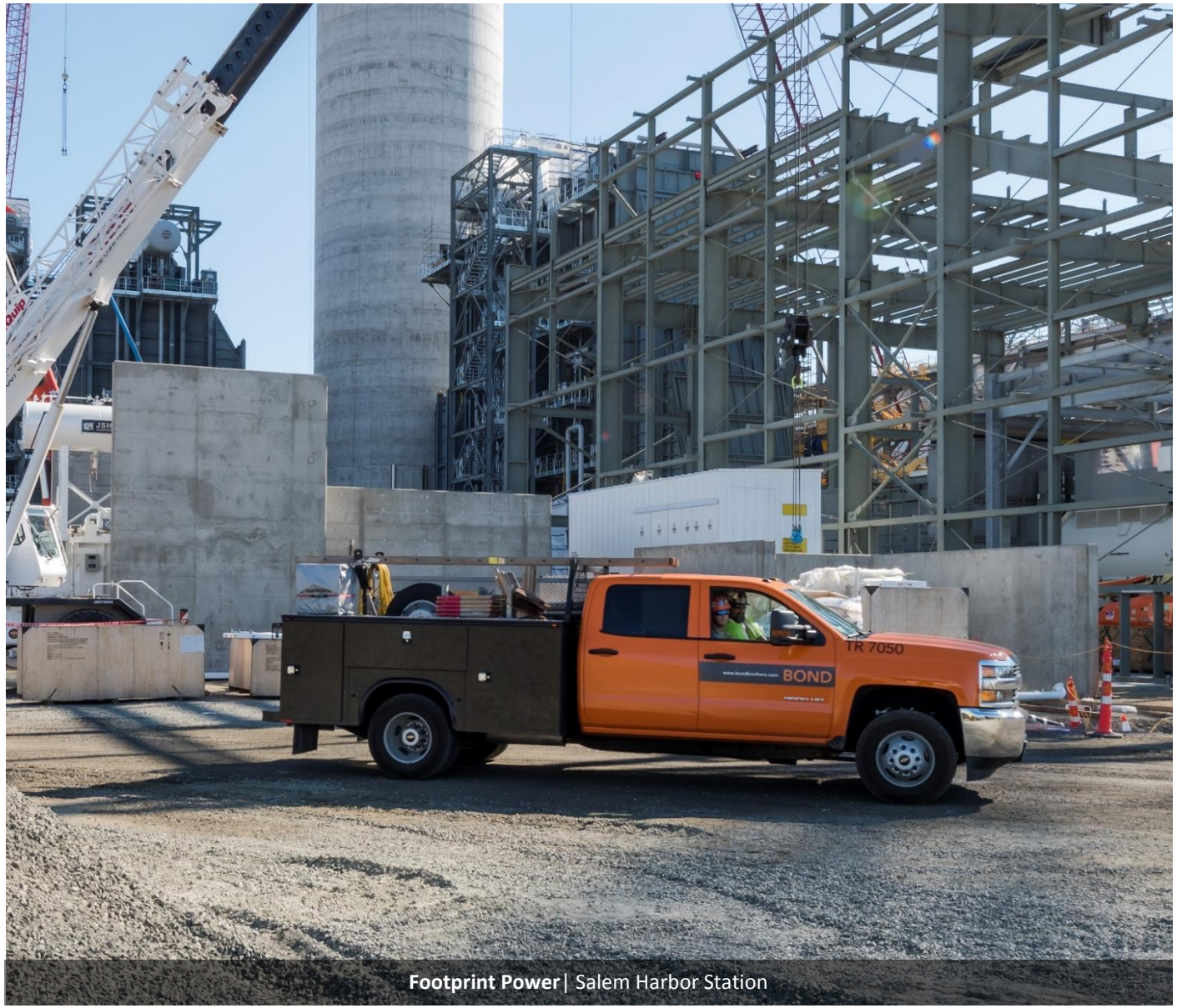
Combined Heat & Power Project Delivery Options

Tim Peer, P.E.
Vice President District Energy

June 28, 2017

Agenda

- Attributes of a successful project
- Overview of project delivery methods
- Planning for a successful project
- Case study examples



Footprint Power | Salem Harbor Station

Attributes of Successful Projects

“A doctor can bury his mistakes but an architect can only advise his clients to plant vines.” - Frank Lloyd Wright

Triple Constraint

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Combined Heat & Power

lower costs, lower emissions, higher resiliency

How would you like your project?

done fast, done right, or done cheap

Priority list

1. CHP configuration (scope) will ultimately dictate the ongoing life cycle performance
2. Budget (cost) is a set number under which the financial proforma will be realized
3. Schedule (time) is critical to meet owner milestones and realize operational savings

Project Risk Breakdown

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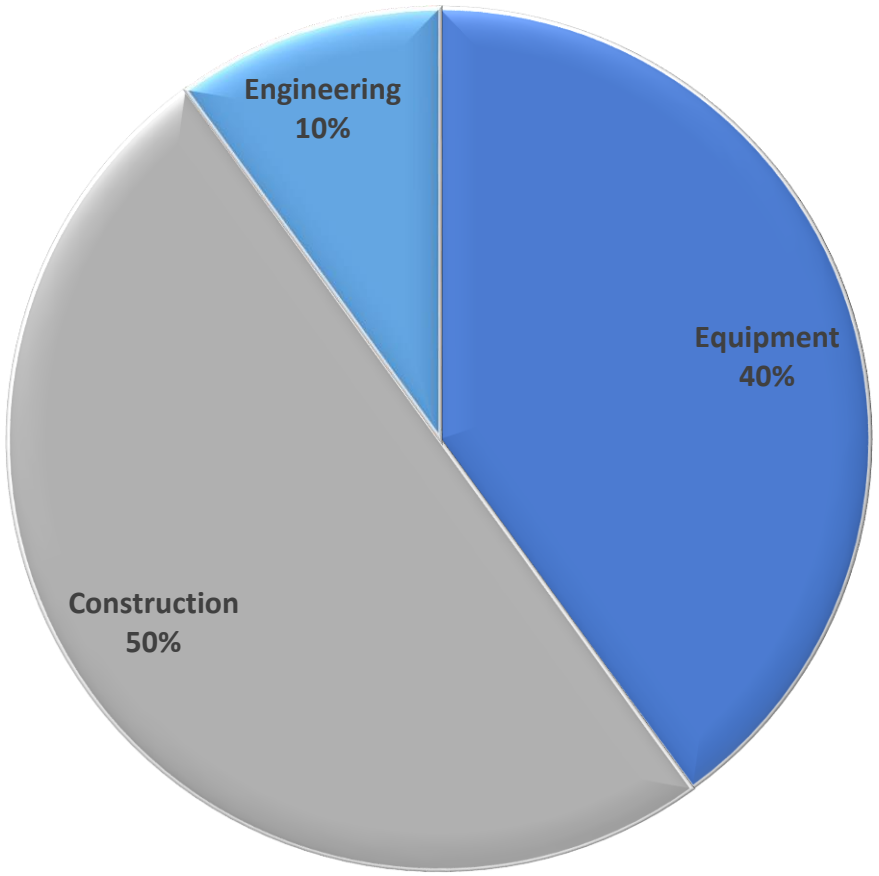
Priority list

1. CHP configuration (scope) will ultimately dictate the ongoing life cycle performance
   - Engineering and design is a good place to invest
2. Budget (cost) is a set number under which the financial proforma will be realized
   - Contractor involvement early will increase budget certainty
3. Schedule (time) is critical to meet owner milestones and realize operational savings
   - Contractor involvement early will result in a better plan

Typical Cost Centers



Decision Gates

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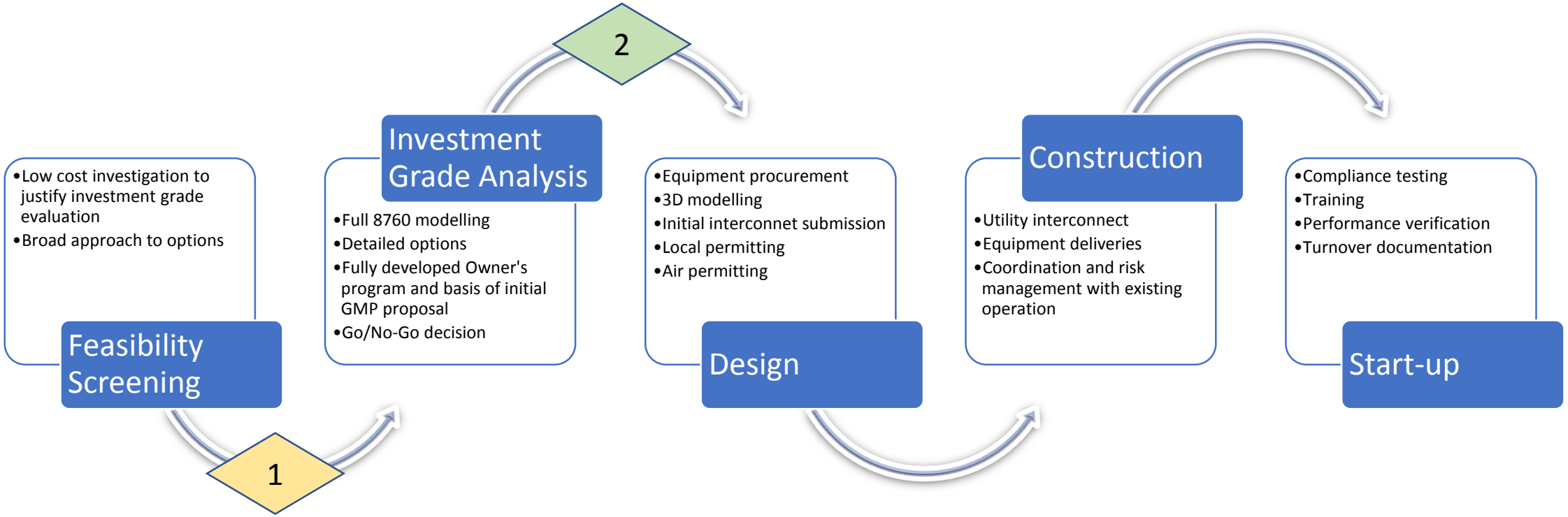

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Overview of Project Delivery Methods

"The road to success is always under construction" – Arnold Palmer

Design-Bid-Build

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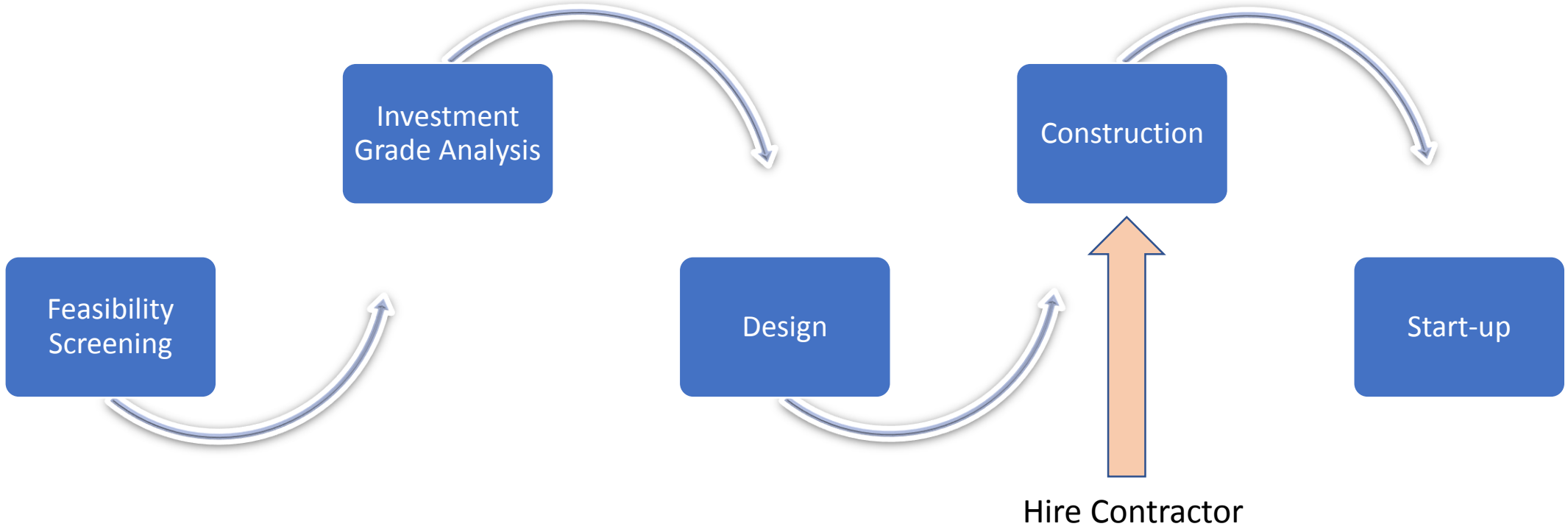
Owner retains design, engineering, permitting, and equipment procurement functions Then bids the construction as a competitive solicitation

- **GC - Traditional general construction which typically involves self-performing trades**
- **CM - Construction specialist that contracts trade subcontractors and suppliers.**



DBB Responsibility Flowchart

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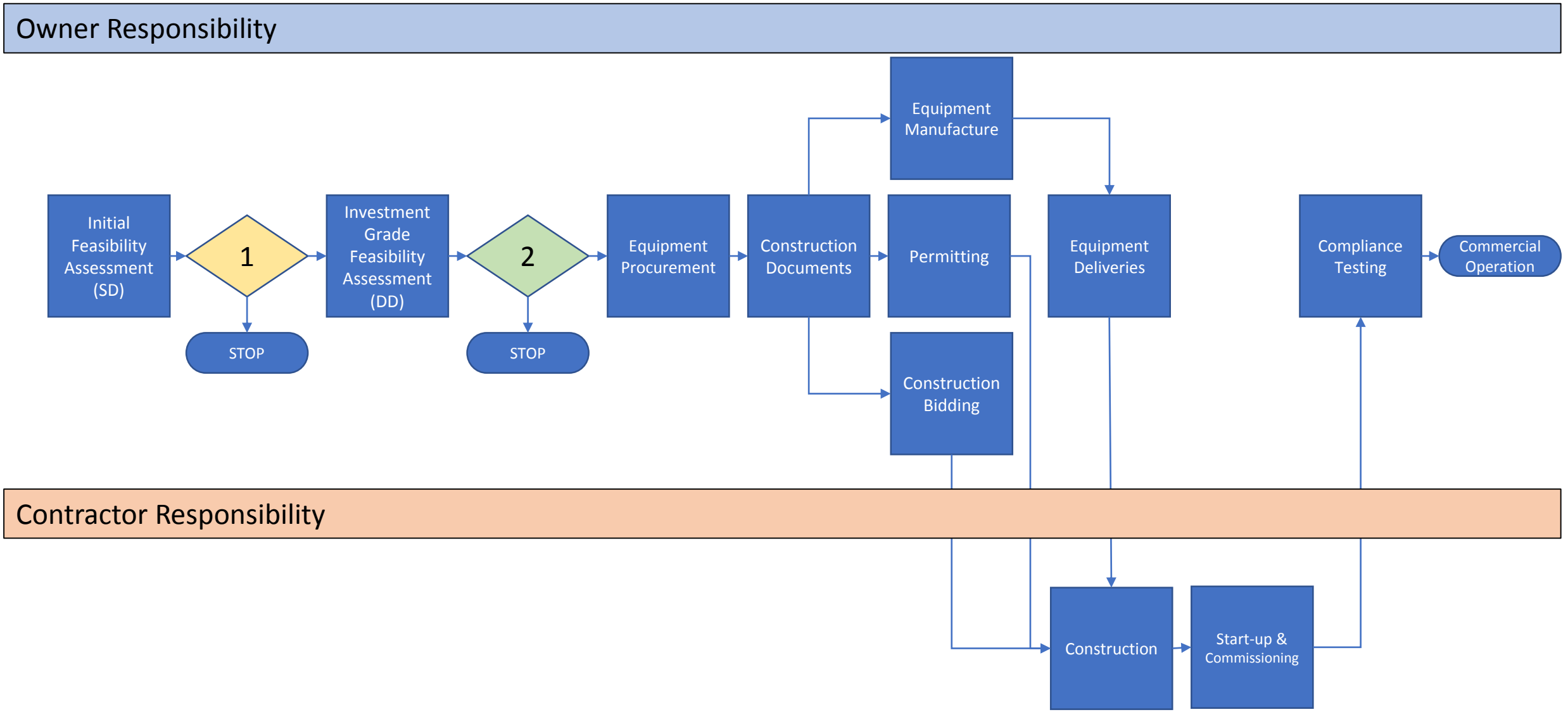

DBB Risk Management

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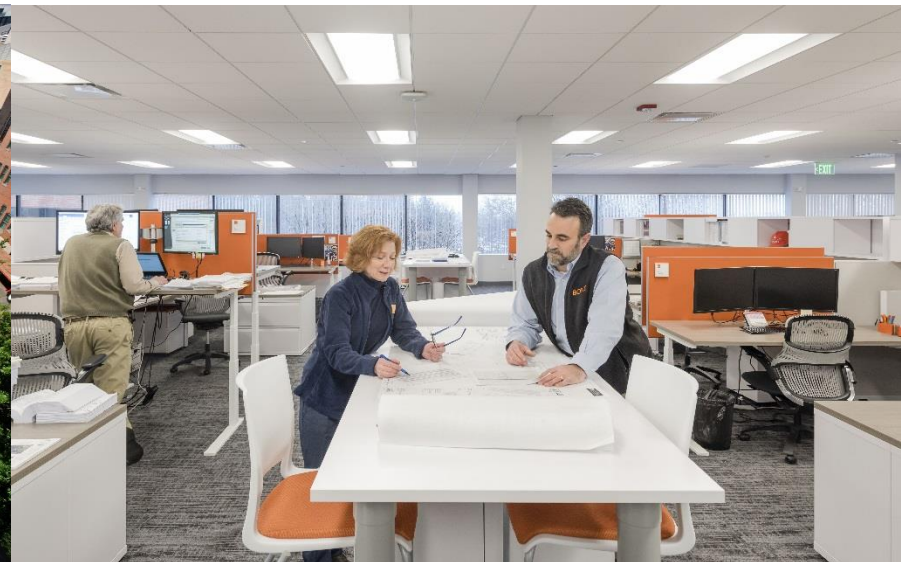
Experience has demonstrated that a comprehensive preconstruction process is essential to the success of the construction and commissioning:

- budget development,
- value engineering,
- Comprehensive scheduling,
- constructability assessments and logistical planning,
- regulatory approvals,
- Development of risk registers, and
- Commissioning, training, and turn-over planning

Should be completed at various stages of the project:

- Conceptual development
- Schematic Design
- Design Development
- 50% Construction Documents
- 90% Construction Documents

MIT| 2nd Century CUP, Work Package #1



DBB Conceptual Schedule

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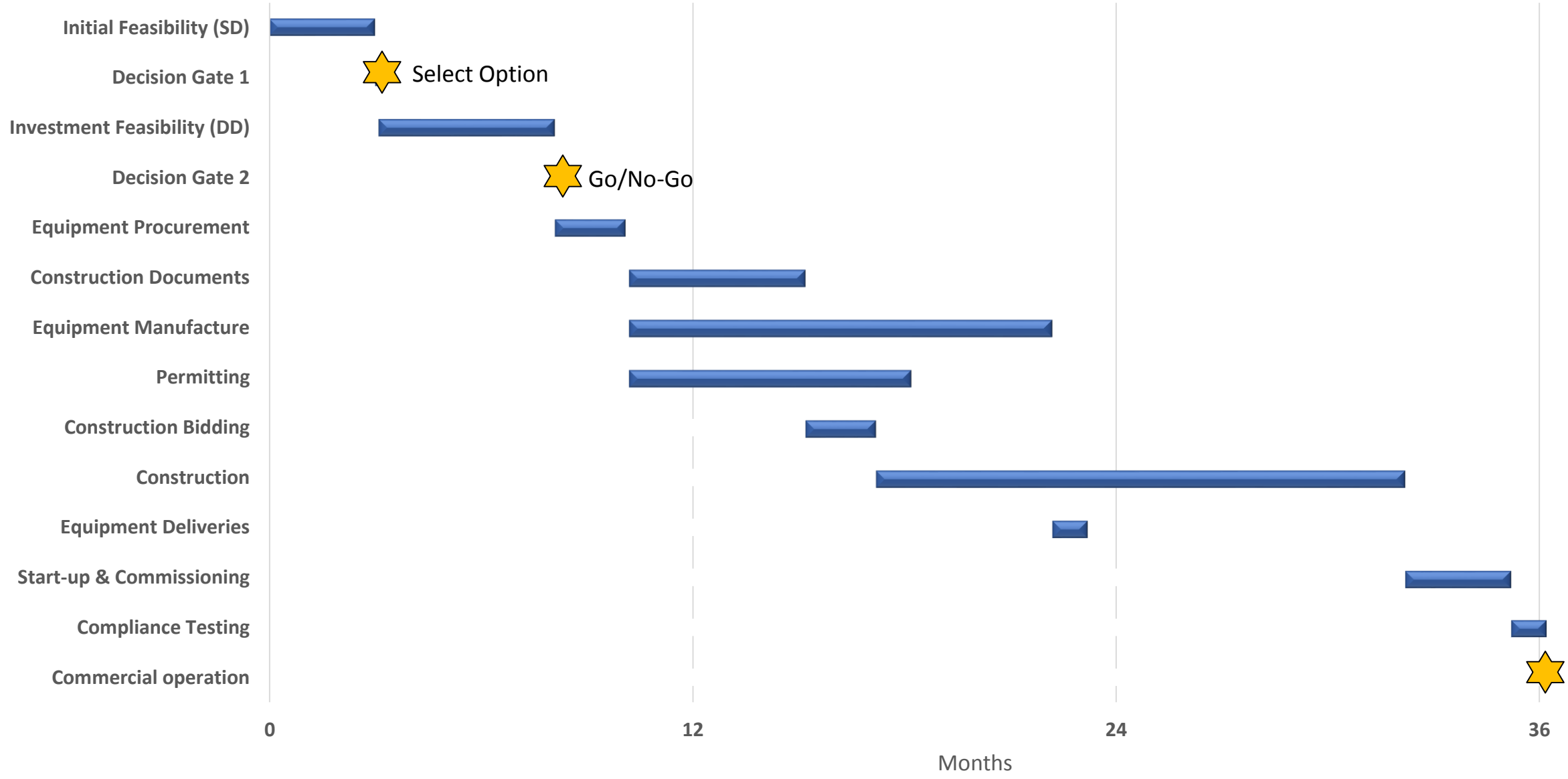

Design-Build

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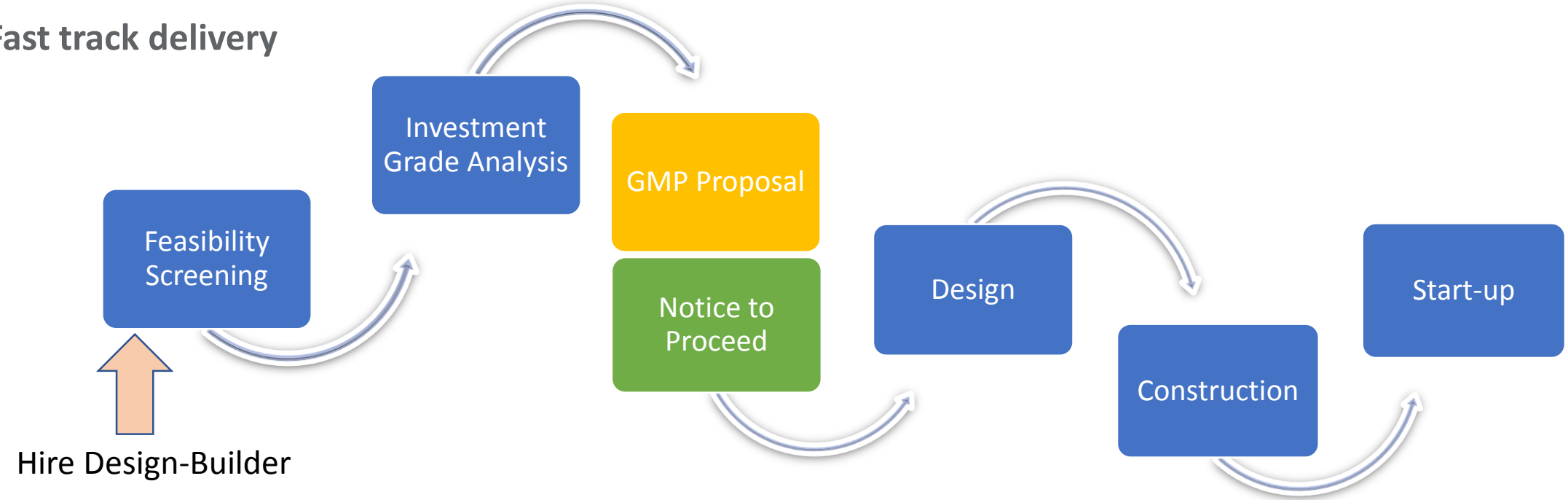
Owner delegates responsibility for entire project delivery

- **Resource constraints**
- **Enhanced project integration**
- **Risk assignment**
- **Fast track delivery**



DB Responsibility Flowchart

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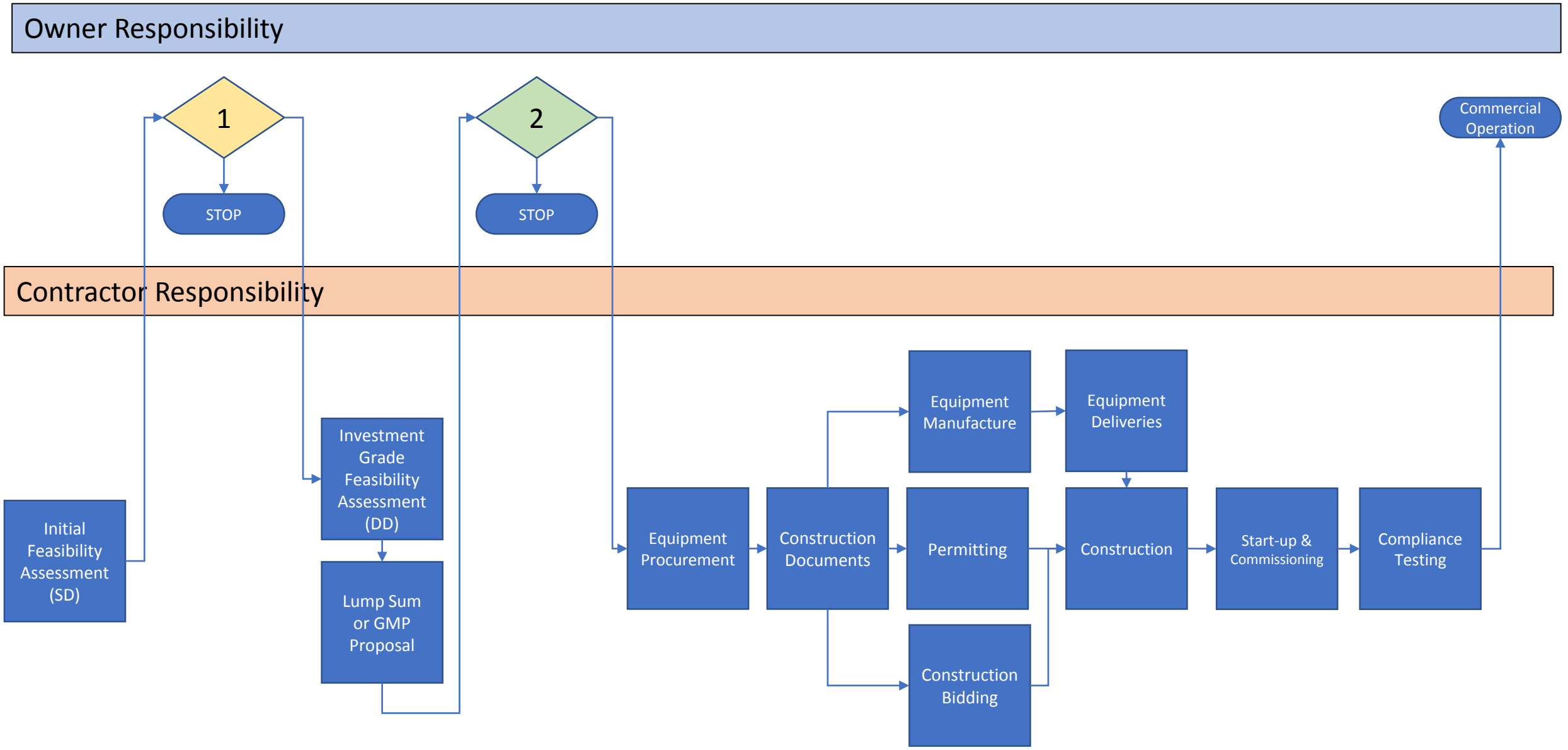

DB Conceptual Schedule

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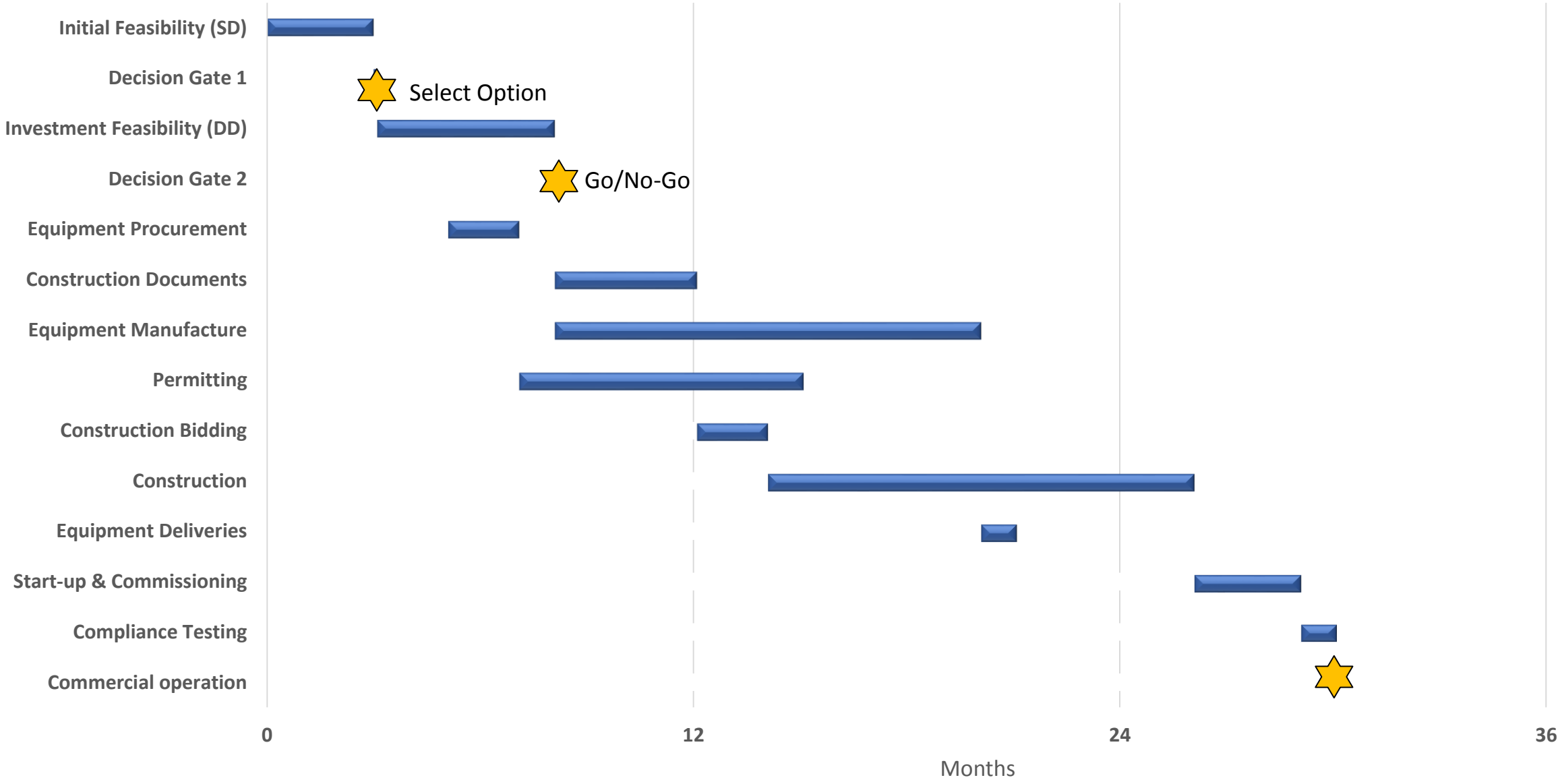

Engineer-Procure-Construct

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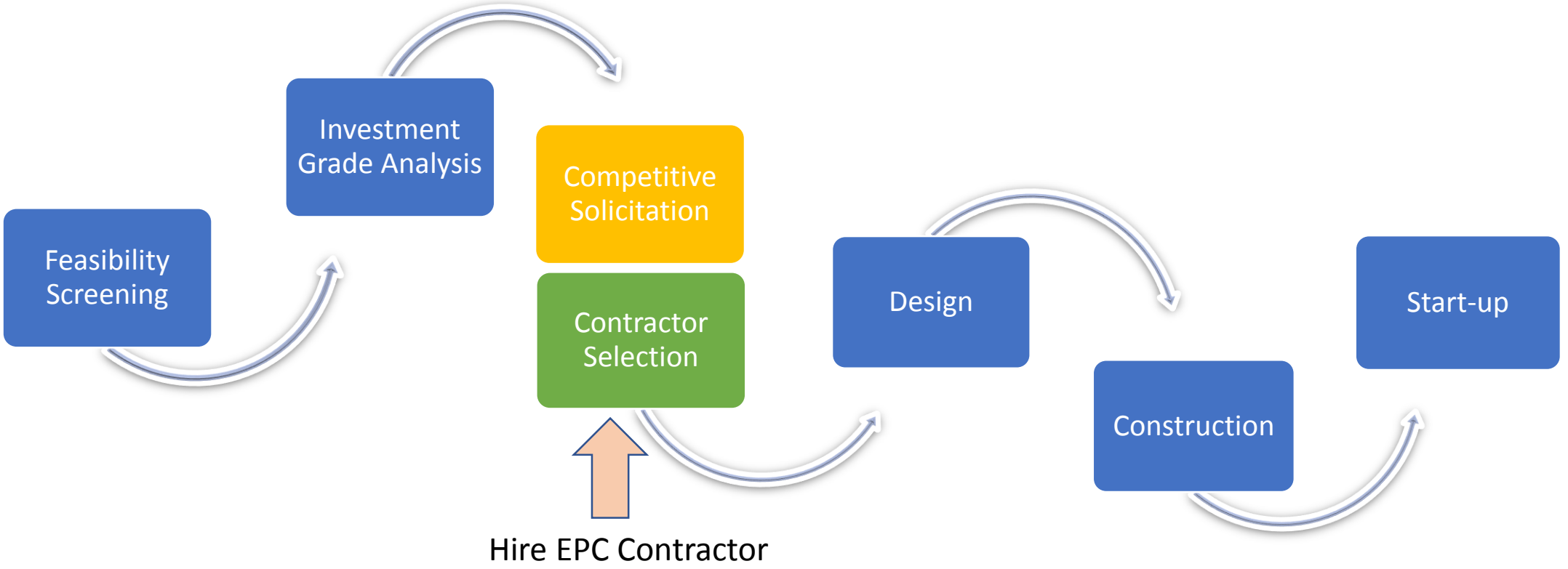
Owner delegates responsibility for project delivery but is directly responsible for project scope

- **Resource constraints**
- **Procurement rules (study consultant cannot participate in design)**
- **Enhanced competitive solicitation**



EPC Responsibility Flowchart

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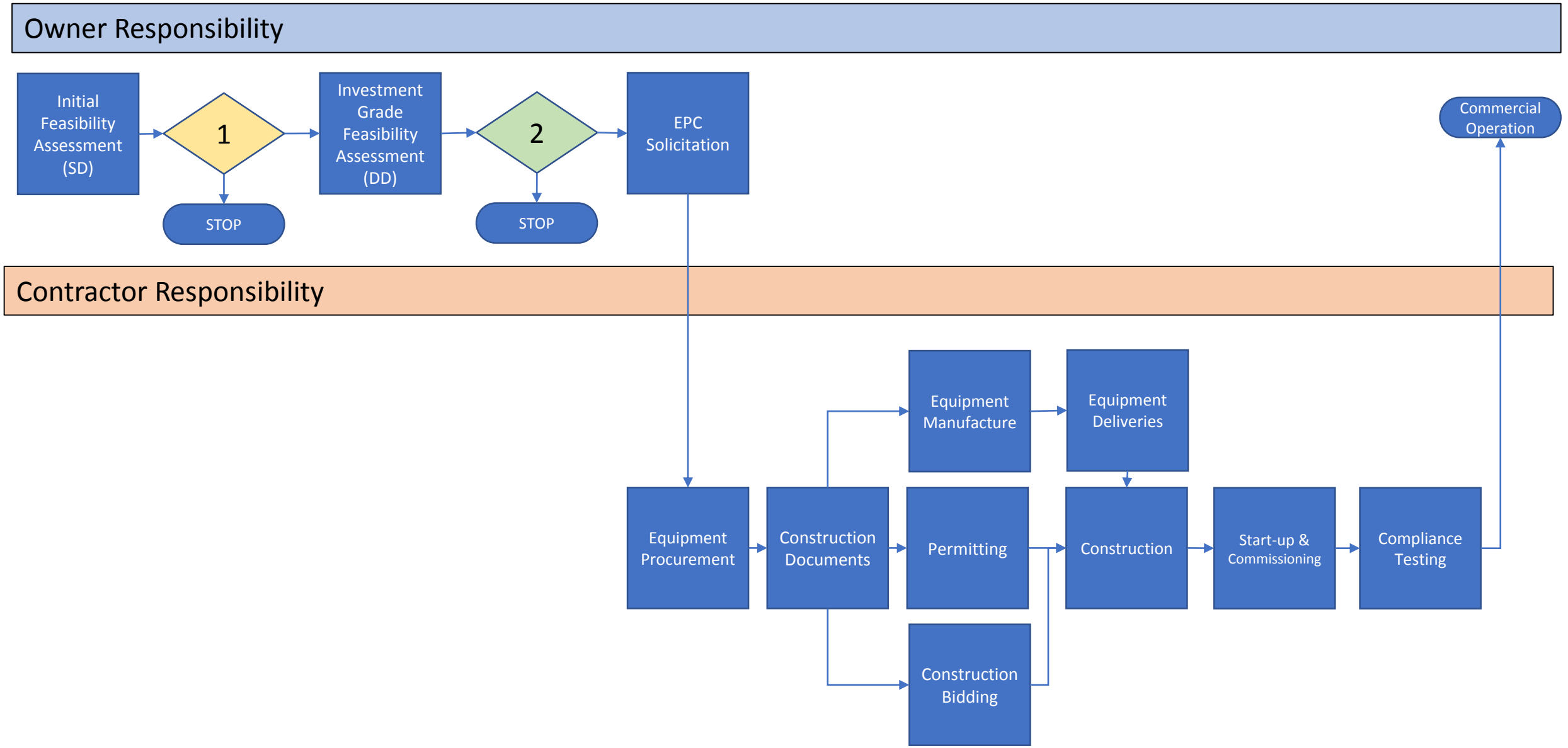
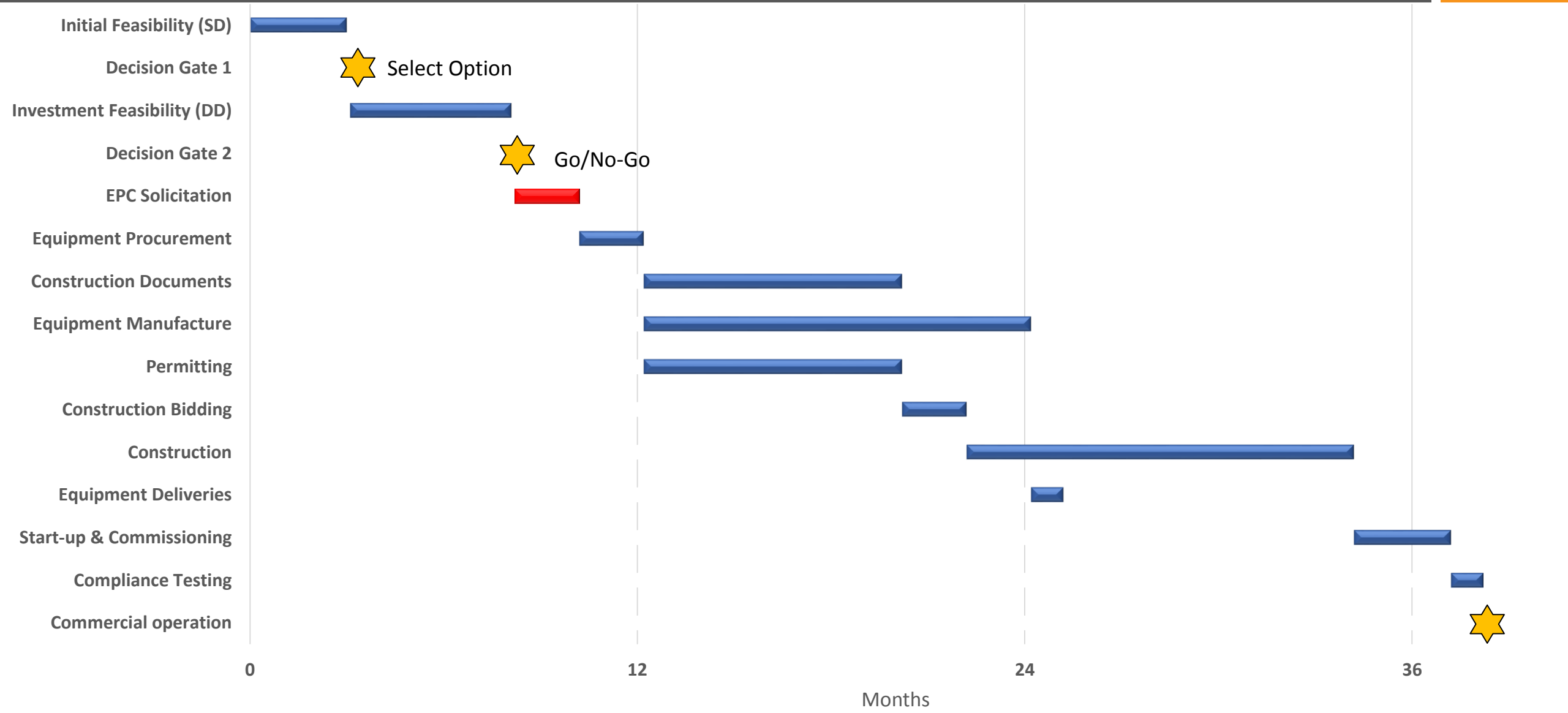


EPC Conceptual Schedule



Planning for a Successful Project

“Experience is what you get when you don’t get what you want.” – Chinese fortune cookie

PLANNING FOR A SUCCESFUL PROJECT

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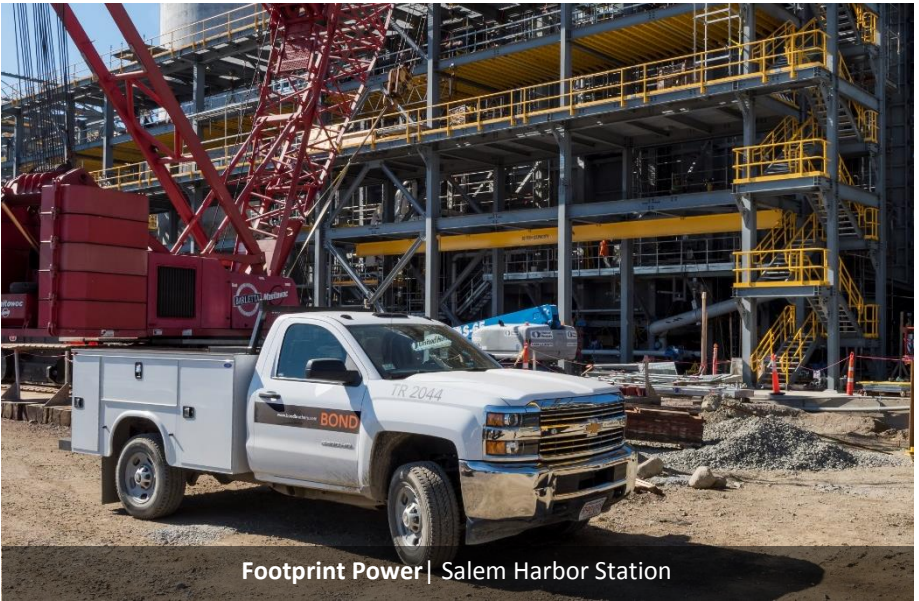
Virtual Design & Construction Team | MEP/FP Coordination



Footprint Power| Salem Harbor Station

- **Experience**
  - Mission critical operations
  - Engineering & technical capability
  - Training & turnover
- **Preparation**
  - Logistics / Schedule
  - Mitigation Plans
  - Enhanced Use of Technology
- **Transparency**
  - Full Open Book Approach
  - Open and Honest Communication
- **Collaboration**
  - Experienced with OEMs and Engineering firms
  - High Integrity
- **Budget Certainty**
  - Estimating Competency
  - Well-Coordinated, Understandable Bid Packages
  - Best-in-Class Project Controls

BUDGET STEWARDSHIP

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BOND Team | Pre-Planning Strategy

BOND Team | Subcontractor Procurement Process

Preconstruction Partnerships

- Feedback to Design Team – Confirm Stakeholder Issues
- Optimize Value to Client
- Constructability of the Details
- Pre-Planning – Single Voice to OEM & Sub Market
- Budget certainty – work to the budget

Inclusion in Procurements

- Review of Subs Invited / Prequalification Process
- Team Descopes to Manage Expectations
- Value Management – Encouraged to Max Value
- Involvement in Lean – Pull Planning to Optimize Delivery

A LEAN APPROACH – REDUCE WASTE, ADD VALUE

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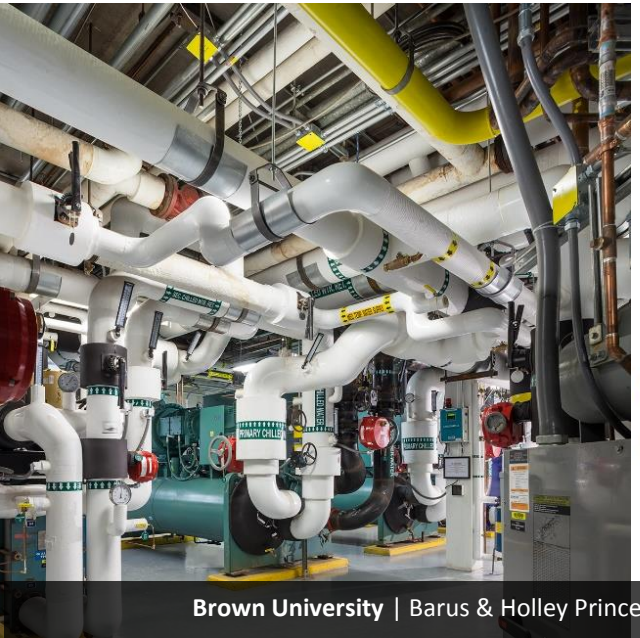
BOND Project Team | Pull Planning Session



Brown University | Barus & Holley Prince Laboratory

LEAN STRATEGY

The team's commitment to collaborative day-to-day planning ultimately resulted in:

20% labor SAVINGS **&** **10% REDUCTION IN THE $12M BUDGET**

which Brown was able to re-invest back into additional scope.

1. Identify Value
2. Organize Work Through A Value Stream
3. Create a Smooth and Continuous Work Flow
4. Pull Planning Sessions
5. Continuous Improvement

PROJECT CONTROLS

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Financial

- Program and Project Budgets
- Cash Flow / Cost Management
- Earned Value Analysis
- Contingency Reporting

Master Schedule

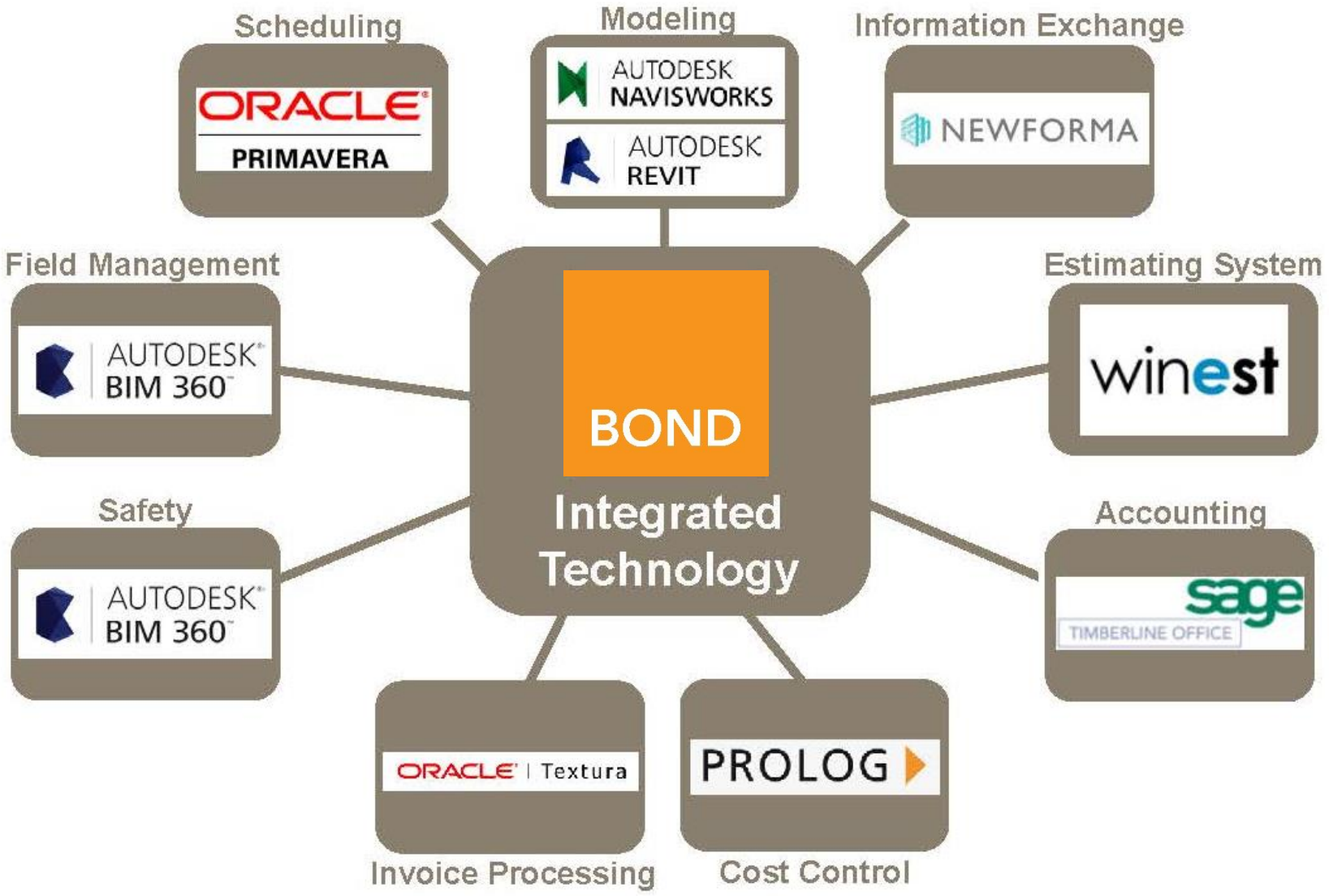
- Integrated Program Master Schedule
- Detailed Project Schedules
- Industry Best Practices for CPM
- "What If" Planning and Resource Optimization

Information / Document Management

- Standardized System Across Program / Used by Project Teams

Reporting

- Monthly Program Reports to Senior Leadership Team
  - Cost / Schedule / Progress / Issues and Challenges
  - Trending and Analysis
- Monthly Detailed Project Reporting



OPERATIONS & MAINTENANCE READINESS PROGRAM

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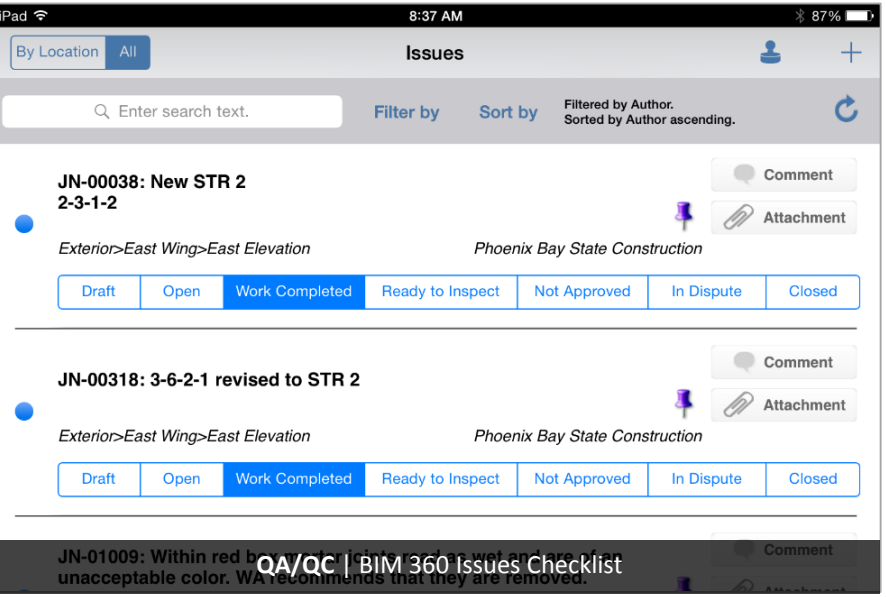

QA/QC | BIM 360 Issues Checklist

BOND Team | Tracking Deficiencies on the Jobsite

The "I" in BIM

- Establish Asset Naming Conventions
- Integrate Client Standards
- O+M Review of Systems
- Preventative Maintenance
- Populate Current CMMS
- Work with Equipment Suppliers on Pre-Commissioning Checklist
- Integrate Staff into Commissioning Process

Start with the end in mind.

QUALITY ASSURANCE / QUALITY CONTROL

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Corporate QA/QC Program

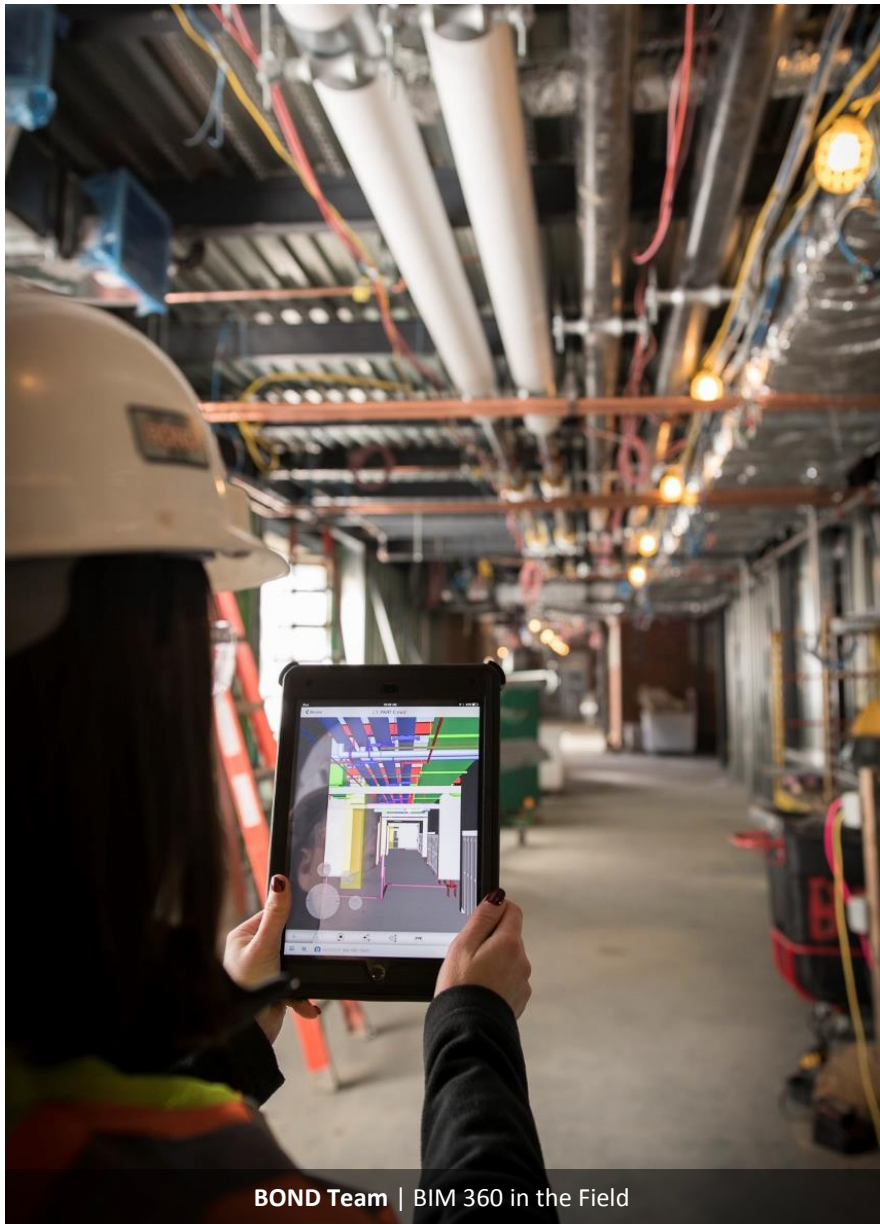
- Database of Checklists for Entire Team's Use

Project Quality Plan

- Specific Project Checklists Tailored to Elements of Project

Application on Your Project

- Superintendent and Field Staff Inspect Installation in Progress / Take Photos / Document in BIM 360
- Subcontractors Use BIM 360 to Document Corrective Work



BOND Team | BIM 360 in the Field

SAFETY

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- "Focus on Today"
- Safety Audits
- Site Specific Safety & Security Plans
- Toolbox Talks
- Technology
- Risk Management

TRUSTED SAFETY BOND FIRST PERFORMANCE

BOND | Safety Dashboard

BOND Superintendents | Daily Site Safety Inspections

BOND Project Team | Weekly Toolbox Session

Case Study Examples

“Knowing what’s right doesn’t mean much unless you do what’s right” — Theodore Roosevelt

Cornell University (Ithaca, NY)

BOND

SCOPE

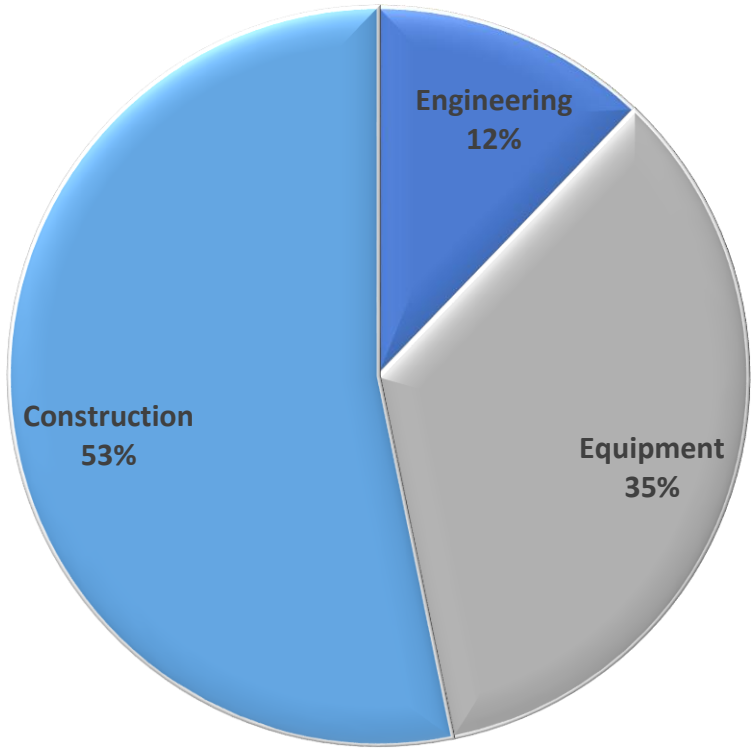
- 2 x 15 MW combustion turbines
- Dual-Pressure Fired HRSGs w/ SCR
- Black start and Islanding capability
- Dedicated HP gas line for plant
- 115/13.2 kV Substation renewal

DELIVERY

- Design-Bid-Build Solicitation
- Construction Manager
- GMP contract

COST

- $83 Million



MIT (Cambridge, MA)

BOND

SCOPE

- 2 x 22MW combustion turbines
- Dual fuel
- Fired HRSGs w/ SCR
- 2MW Black start
- Islanding capability
- Gas compression
- Boiler fuel oil conversion

DELIVERY

- Design-Bid-Build Solicitation
- Construction Manager with precon
- GMP contract

COST

- Not public

Yale University (New Haven, CT)

BOND

SCOPE

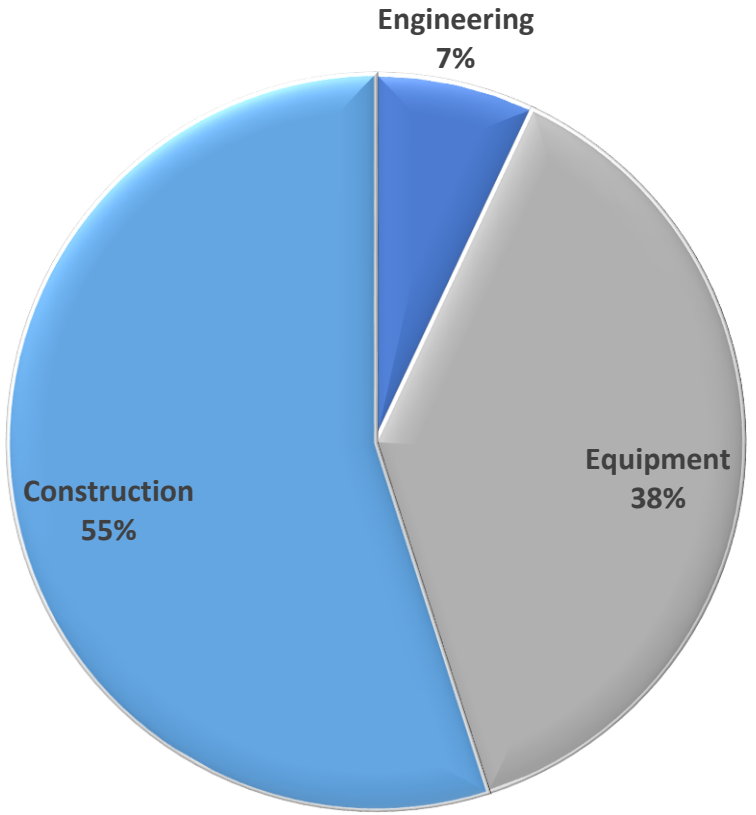
- 2 x 8MW combustion turbines
- Dual fuel
- Fired HRSGs w/ SCR
- Islanding capability
- Gas compression

DELIVERY

- EPC Solicitation
- General Contractor with precon
- Lump sum contract
- Bridging documents

COST

- $50.2M



Lahey Clinic (Burlington, MA)

BOND

SCOPE

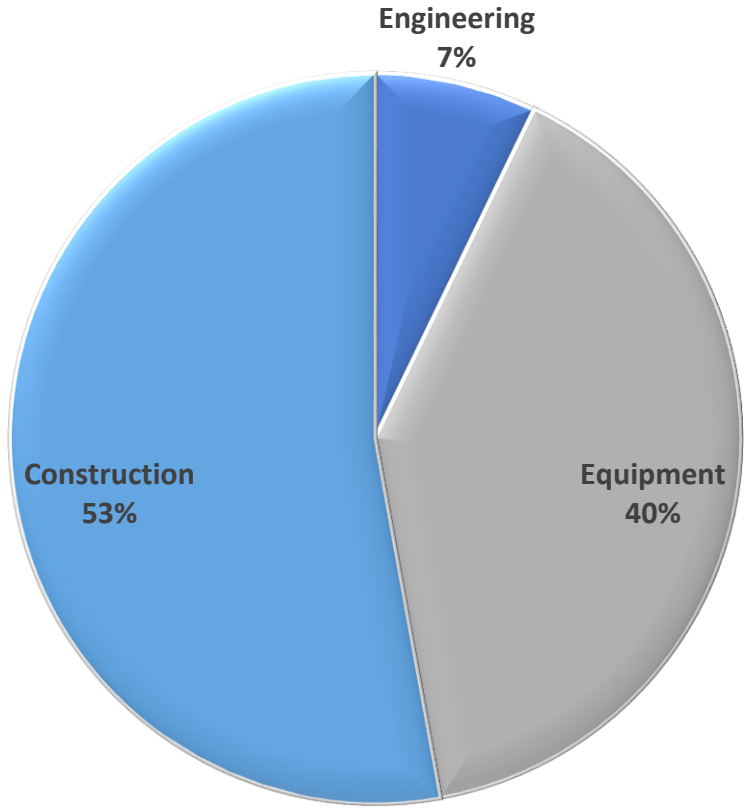
- 1 x 3MW RICE
- 15kV Substation
- Islanding capability
- Steam HRSG with SCR & CEMs

DELIVERY

- EPC Solicitation
- General Contractor
- Lump sum contract
- Bridging documents

COST

- $14 Million



Questions?

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