Risk Management II, Quality Monitoring & Control, and Project Learning

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Announcements

- Optional “Skyscraper” video screening
  - Tuesday (5-8pm), Thursday (5-7pm)
  - Follows major project through all phases
  - Extra credit if write 5 page essay analyzing

- Talk on Design-Build-Operate-Transfer projects
  - Who: Robert Band, President & CEO of Perini
  - When: Thursday, 3:30pm

- Recitation Field Trip (Airport T) Tuesday May 4
Topics

- Quality Control
- Risk Management
- Project Reviews
  - Logistics
  - Functions
  - Reviews in Construction
Quality Performance Control

- Quality Control
- Quality Assurance
- Quality Management
- Total Quality Management (TQM)
- Note: Tightly tied in with other factors
  - Cost, schedule depend on quality (rework, …)
  - Lifecycle cost has heavy quality dependence
- Quality becoming increasing focus
- Some contracts (particularly federal contracts) mandate "contractor quality control" regimens
Many Checks on “Quality”

- Local building department (code compliance)
- Utility company inspectors
- Manufacturer’s representatives
- OSHA safety inspectors
- Insurance company inspectors
- Financial institution inspectors
**Quality and Construction Method**

- **Pre-fabricated components: higher quality**
  - Tighter tolerances
  - Manufactured under tightly controlled conditions
  - More rigorous quality control mechanisms
  - Shortcoming: Longer delay if identify problems!

- **Site-created components: generally lower quality**
  - Weather, looser tests, shooting for less accuracy, etc.

- **A major challenge is combining these on site**
  - e.g. combination of pre-cast panels with site-cast concrete
Factory Inspections

- Examples
  - Precast concrete
  - Steel plate fabrication
  - Concrete plants
  - Pump station manifolds
  - Welded steel tanks
  - Large, specialized pieces of equipment

- May also do monitoring during transport
Quality Assurance (QA)

- Usually done by production people themselves (designated ‘QA instructors’), in order to identify and correct quality related problems.
- During the process QA instructors mainly provide guidance and leadership to the production people rather than criticizing their work.
- Increasing amounts by contractor.
Double-Guessing Quality

- Contractors are not really sure of true quality bottom line
  - Often tighter tolerances specified than are really required – just to be sure that meets true spec in case of ‘corner cutting’
- Contractors may propose substitutes at last minute
- Worsened by testing for ‘substantial compliance’
Quality Control (QC)

- Usually done by appointed inspectors of the owner (producer).
- Often at the end of major phases during the production.
- The parties are placed in adversarial positions by the management (although both QC division and production division belong to the same organization).
- The production people tend to cover and hide their mistakes by nature.
- Often just confirm that contractor has checked things.
Quality Management

- Initiated and orchestrated by senior managers
- Involves all parts of the organization
- Through a systematic, comprehensive and well-documented QA process
- Controlling quality helps cost in the long run
- Aiming at ‘Zero Defects’
  - Eschews notion of just ensuring quality by rejecting failures; p. Looks to underlying causes
Total Quality Management (TQM)

- Not just operational strategy – A philosophy
- Aimed at continuous improvement of the organization and personal growth of its individual members
- Quality is viewed in the broadest sense including:
  - Quality of Life (QOL)
    - Well-being and satisfaction of all people Involved
    - Long-lasting relationships with customers and suppliers etc.
- Note: Actions much more important than words!
Forecasting Quality

- Industry and project specific
- Measurement of quality is very dependent on specific operations and products
- Difficult to aggregate quality measures up a work breakdown structure or organizational breakdown structure to develop an overall assessment of quality
- Relatively small quantities of operations and products developed which prevents or challenges the use of statistical quality control methods
Topics

- Quality Control
- Risk Management
- Project Reviews
  - Logistics
  - Functions
  - Reviews in Construction
Risk

- Recall “Risk”: uncertainty about some consequence
- Management of risk of change from schedule, budget is the key job during project control
- Must examine risks in both original plans and change orders
- Myriad causes of risk
- Three key components
  - Risk Identification
  - Risk Classification
  - Risk Response (Mitigation)
Risk Identification and Mitigation

**FUNCTION CHART RISK MANAGEMENT**

- **Identification**
  - External Unpredictable
    - Regulatory unanticipated government intervention
  - External Predictable Uncertain
    - Major changes
  - Internal Non-Technical
    - Schedule delays
  - Technical
    - Changes in technology
  - Legal
    - Licenses
  - Insurable
    - Direct property damage
  - Impact Analysis
    - Baseline changes
  - Response Planning
    - Allocation
  - Data Applications
    - Historical data base

- **Mitigation**
  - Definitions
  - Current project data base
  - Policies/procedures
  - Responsibilities
  - Post project assessment & archive
  - Force Majeure
    - Variation of project life cycle
  - Legal liability
    - Unforeseen
    - Monitor & review; Systems adjustment

- **Risk Management**
  - Planning
    - System
    - Data
  - Impact Analysis
    - Variations
  - Response
    - Mitigation
    - Unforeseen
    - Completion
    - Failure to complete
  - Environmental impact
    - Social impact
    - Inflation
    - Taxation
  - Natural hazards
    - Operational
    - Cost overruns
    - Patent rights
    - Indirect consequential loss
    - In or out of scope
    - Mitigation
    - Revise scope, budget, schedule
    - Quality
    - Insurance bonding
    - Degree of uncertainty
    - Contingency planning
    - Unforeseen
    - Review; Systems adjustment
Example Risks in Case Studies

- Delay, $ from concrete production workers strike
- Slower work due to space constraints imposed by temporary structures
  - Reshoring
  - Scaffolding
- Slower permitting due to
  - Environmental concerns
    - Endangered Bird
  - Community opposition
- Injury to schoolchildren
- Discovery of unanticipated renovation conditions
- Delays due to complications linking w/existing structures
- Change in materials prices
- $ repairs when ball hits sprinkler
- Delays, $ for design changes
  - Tenants’ requests
  - Artist’s aesthetic requests
Risk Identification

- Not all risks can be identified up front – but some can be
  - Experience does assist
  - Just identifying these risks can be most helpful
- Should be conducted throughout project lifecycle
  - Original design & At time of change orders
  - All phases of work
- Common taxonomies can serve as reminder
- Takes time – but lowers top-level crisis mgmt
- Can pursue add’l study before decide on handling
Risk Classification

- Can be helpful in identification as well\
Example Classification

Risk Classification

- Occurrence of Risk
  - Pure Risk (specific risk)
  - Speculative Risk (market risk)
    - Frequency
    - Severity/Impact
    - Predictability
  - Capital Related or Financial Risk
  - Asset Related or Business Risk

- Types of Risk
  - Specific Risk
  - Market Risk
    - Possibility of loss or gain

- Impact of Risk
  - Company
  - Market/Industry
  - Environment
  - Project/Individual
Risk Classification: Prioritization 1

- Estimate two key components
  - Probability of occurrence
  - Level of impact
    - Models may help in assessing this
- Typically not fully sure of either – don’t let this stop you from examining it
  - Try to at least examine upper/lower bounds
**Risk Classification: Prioritization 2**

- Don’t just focus on the most imminent risks!
- Psychological tendency to systematically misplace priorities:

<table>
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<th></th>
<th>Urgent</th>
<th>Not Urgent</th>
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<tbody>
<tr>
<td><strong>Important</strong></td>
<td>Rightful attention</td>
<td>Not enough attention</td>
</tr>
<tr>
<td><strong>Not Important</strong></td>
<td><strong>Too much attention</strong></td>
<td>Rightful inattention</td>
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Example Simple Risk Taxonomy

Identification

External Unpredictable
- Regulatory Unanticipated Government Intervention
- Natural Hazards
- Vandalism Sabotage
- Unexpected Side Effects
- Completion Failure to Complete

External Predictable Uncertain
- Market Risk Major Changes
- Operational
- Environmental Impact
- Social Impact
- Currency Changes Inflation Taxation

Internal Non-Technical
- Schedule Delays
- Cost Overruns
- Cash Flow Interruptions

Technical
- Changes in Technology
- Operational Performance
- Special Project Technology
- Changes and Suitability

Legal
- Licenses
- Patent Rights
- Contractual Failure
- Lawsuits
- Force Majeure
Forms of Risk Response

- Assume the Risk
- Attempt to Avoid the Risk
- Attempt to Control the Risk
- Attempt to Transfer the Risk
- Ongoing examples
  - Risk of pile driving disturbance of adjacent structures
  - Risk of heavy rain/temperature delaying pouring concrete slabs, cols
  - Risk of high electric heating costs for school
  - Risk of subcontractor failure to deliver
Risk Assumption

- Recognize and accept risk
- May hedge risk through
  - Buffer
    - Cost *(contingency buffer)*
    - Time
  - Anticipate managerial response if risk materializes
- Examples
  - Adjacent structures: Photos, work w/neighbors to guarantee quickly hear complaints, choose drive time
  - Rain/Temperature: Extra time for slab, column pours
  - Heating cost: Higher electric heating in lifecycle cost
  - Market conditions: Budget hotel unpopular
  - Subcontractor: Understand contract, contingency
Risk Avoidance

- Seeks to change practice or environment to avoid risk; e.g. change
  - Requirements
  - Practices/process
  - Design/specification
- Often costs $ or time in short run, save in long run
- Examples
  - Adjacent structures: Vibratory piles, slurry wall, relocate
  - Rain/Temp: Use precast or steel construction methods
  - Heating cost: Use gas- or oil-based HVAC instead
  - Market conditions: Mixed executive/basic floors
  - Subcontractor: Use a different subcontractor!
Risk Control

- Put contingency plan in place
  - Monitor closely
  - Choose different course if problem arises

- Key components
  - Minimizing *delay* until recognize, act on a problem
  - *Flexibility*: Ability to act when need arises

- Examples
  - Adjacent structures: Alt Equip. ready, schedule contigency
  - Rain/Temp: Use tent, heating equipment
  - Heating cost: Install radiant heat system; use if costs favorable
  - Market conditions: Design w/big clearspan; upgrade to larger rooms if market favors higher-end hotel
  - Subcontractor: Monitor carefully; use on-call contractor for chgs
Risk Transfer

- **Strategy:** Transfer risk to
  - Another party (e.g. via insurance)
  - Another set of risks

- **Examples**
  - Adjacent structures: Insurance coverage for claims
  - Rain/Temp: Insurance coverage for claims
  - Heating cost: Use gas system (depends on gas $)
  - Market conditions: Combine with high-end health club
  - Subcontractor: Impose contract risks on subcontractor
Static vs. Adaptive Strategies

- As described, all but risk control represent static strategies.
- Risk control is adaptive – choose course of action to deal with situation once it shows signs of materializing.
- Benefits: Greater information, less waste.
- Cost: Cost of flexibility, risk that delay may hamper efforts.
Mitigation Escalation

- Often we escalate risk mitigation strategies as possible events are considered
  - More severe
  - More likely

- Typical sequence
  - Risk acceptance
  - Risk control
  - Risk transfer
  - Risk avoidance
Models and Risk

- Models of many sort help represent
  - Uncertainties and contingencies
    - Decision trees
    - Some simulation models
  - “What if” scenario analyses
    - Risk occurrence
    - Risk response
    - Simulation models help compute consequences
- Can help in risk identification and response
- Often want to combine a decision tree with consequences computed by other models
Topics

✓ Quality Control
✓ Risk Management

■ Project Reviews
  ■ Logistics
  ■ Functions
  ■ Reviews in Construction
Project Learning and Reviews

Note: Some content in this section is based on F. Pena-Mora 2003

- Transience of project teams complicates accumulation of institutional knowledge

- Already discussed: Use of models to capture understanding about a project
  - Any sort of model – CPM, WBS/OBS/CBS, fishbone, etc. help capture information

- Also critical: Constant monitoring for learning opportunities
  - “Learning organizations” seen as having edge
  - *Project meetings* play critical role here

- Role of external parties (e.g. consultants)
Project Meetings

- Discussed here: 3 types of project meetings
  - Reviews
  - Audits
  - Inspections
Reviews

- **Purposes**
  - Bridging Gaps
  - Validation of Work Done
  - Quality Assurance
  - Learning

- **Review Configurations:**
  - Peer Reviews
  - Walkthroughs
  - Inspections

- **Established Processes in the Construction Industry:**
  - Value Engineering Review
  - Construction Review
  - Substantial Completion Inspection
Definitions

- **WHAT**
  - Tools for “Gate-passing”, Quality Assurance and Learning During Project Development
  - Means for Problem Solving and Learning Opportunity

- **WHO**
  - Informal Reviews Performed on a Regular Basis among Co-workers
  - Formal Reviews with Explicit Participants’ List

- **WHY**
  - Feedback Process and Coordination
  - Result: Scaling Down Rework, Reducing Friction Between Participants, Accelerating Schedule, Cutting Down on Costs

- **WHEN**
  - Continuous process but trade-offs between costs and benefits (after milestones common)

- **HOW**
  - Focus on Project Development, Learning and Critic of the Review Process Itself
  - Achieved Through Meetings, Reports and Lessons Assimilation
Introduction

- Reviews in the Design and Construction Industry are Underdeveloped, Compared to Reviews in Product Development Industries (e.g. Software Development)

- Why the Need for a Formal Review Process in the Construction Industry?
  - Design and Planning Phase Generating 75% of the Problems Encountered in the Construction Site ⇒ Need for Understanding and Coordination of Contract Documents and Technical Specifications
  - Errors More Likely in current Fast-paced Construction Processes (errors 10-20% of total cost)
  - Rising Requirements for High Quality and Corporate Effectiveness
Technical and Managerial Reviews
Outline

- Introduction
  - Technical Reviews
    - Project Management Reviews
- The Logistics of Reviews
  - The Peer Review
  - The Walkthrough
  - The Inspection
- The Functions of Reviewing
  - Work Unit Validation-Passing Gates
  - Quality Assurance
  - Knowledge Transfer and Teambuilding
- Construction Reviews
  - Value Engineering
  - Constructability Reviews
  - Substantial Completion Inspection
- The Case of Twin Shopping Centers
Technical Reviews

Focus on
- Technical Problems
- Life-Cycle Economics of Project
- Interdependencies Between Design and Construction Methods

Typical Technical Review Program at Project Start-up
- System Requirements Review (SRR)
- System Design review (SDR)
- Preliminary Design Review (PDR)

Typically reviews become more technical over time
Project Management Reviews

Focus on:
- Cost
- Quality
- Safety
- Performance
- Communication Channels
- Information Coordination
- Teamwork Effectiveness
- Client Relationships
- Supervision Efficiency
- Reliability
- Contract Management
- Learning Programs
Reviews in Parallel

Keys:
A  Audit, comprising both technical and management function
MR Management Review, incorporating technical input
TR Technical Review, incorporating project management input
Role of the Outsider

- Can provide new perspective, outside of politics
- Often courted by different factions
- Helps employees think through issues
- May generate hostility
  - Can lead to “Closing the wagons” against outsiders
Work vs Process-Oriented Reviews

- **Work-oriented reviews**
  - Seek to identify issues with completed work
  - Primarily focused on shorter-term issues

- **Process-oriented reviews**
  - Seek to identify problems with processes
  - Tend to be focused on longer-term
  - Can recurse to higher-order reviews

- Can have mixture