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

Nathaniel Osgood

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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 suree 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

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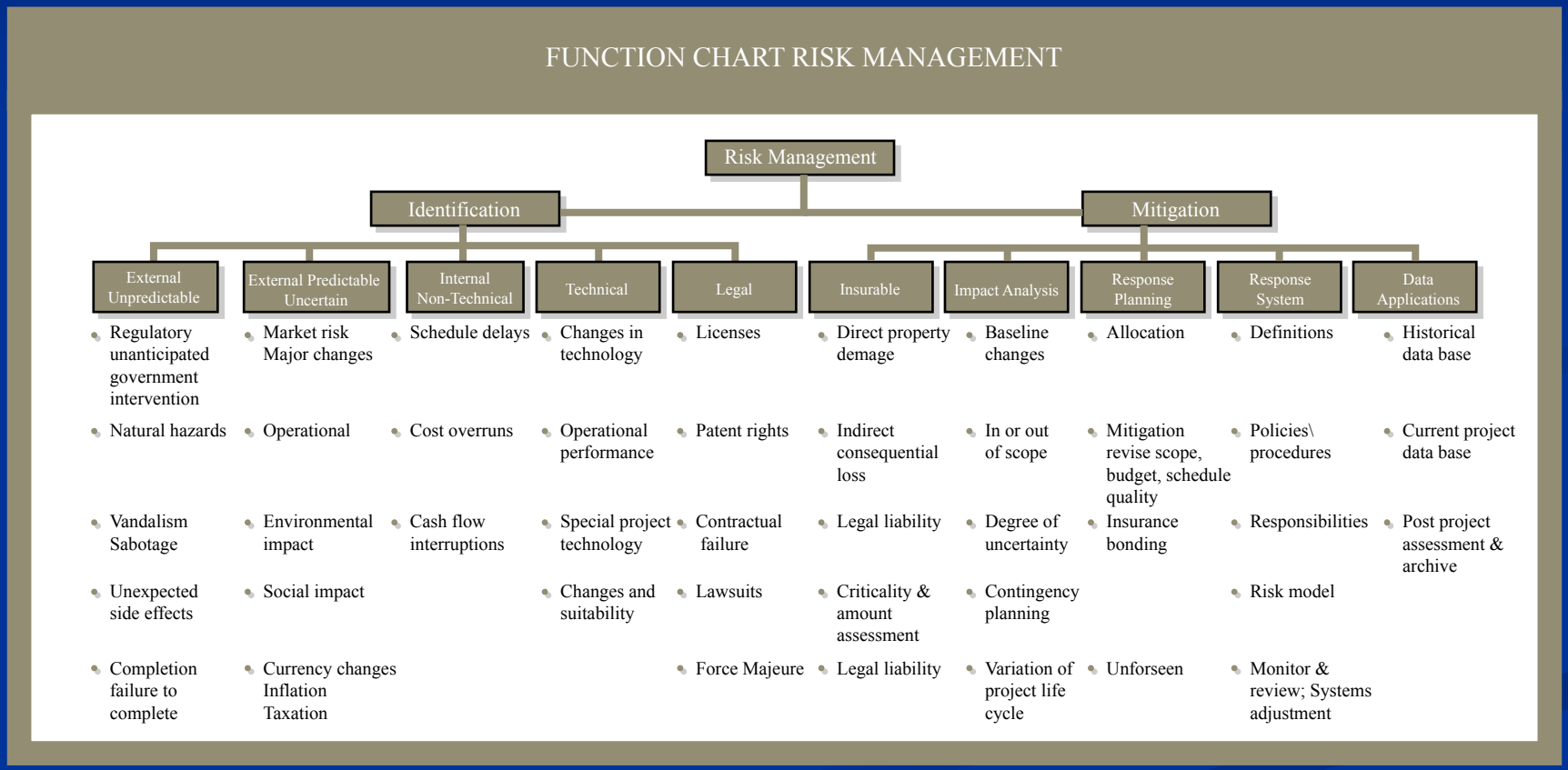
Risk

- 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



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

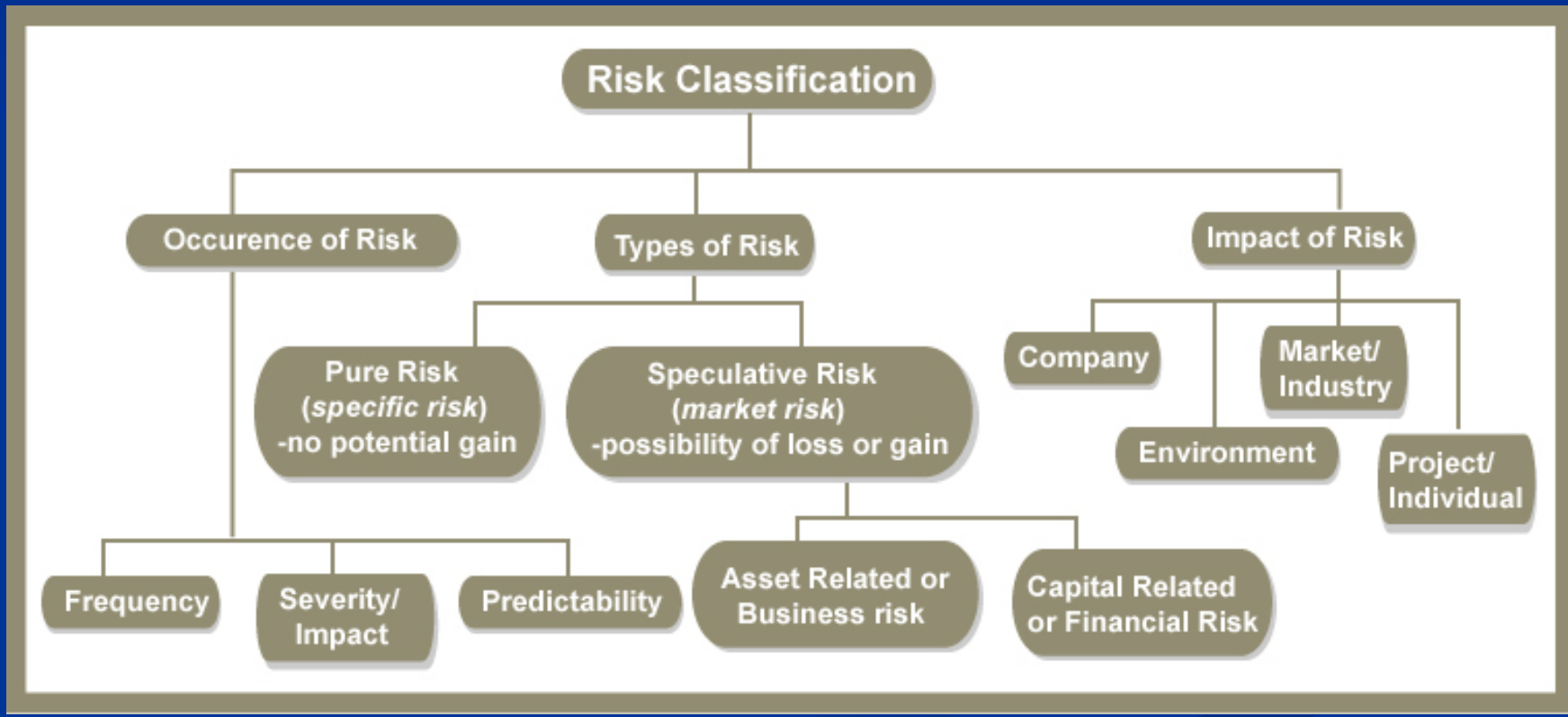
Risk Identification

- 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: Prioritization 1

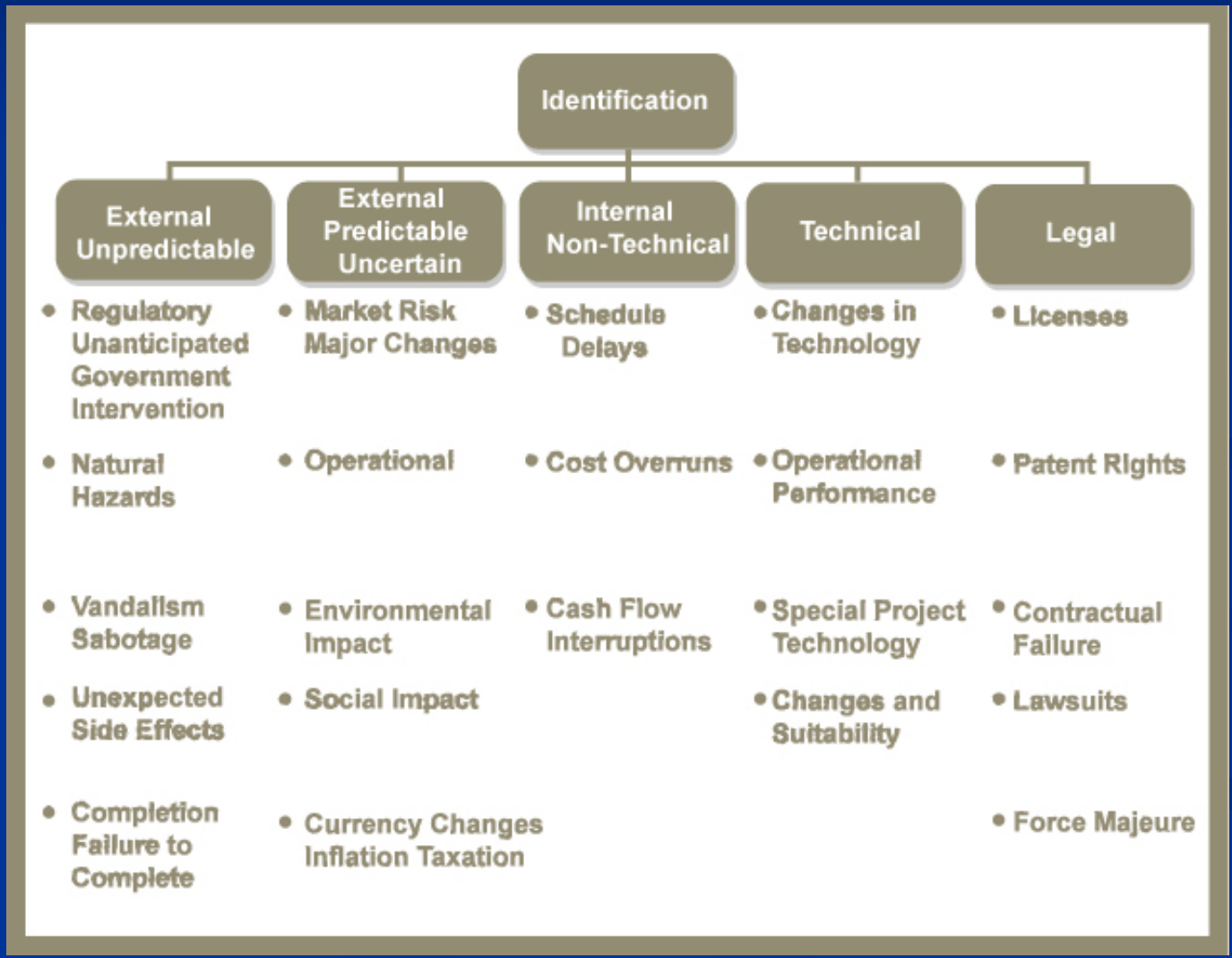
- Estimate two key components
  - Probability of occurrence
  - Level of impact
    - Models may help in assessing this
- Typically not fully sure of either – don't let this stop you from examining it
  - Try to at least examine upper/lower bounds

Risk Classification: Prioritization 2

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

	Urgent	Not Urgent
Important	Rightful attention	Not enough attention
Not Important	Too much attention	Rightful inattention

Example Simple Risk Taxonomy



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 timee
  - 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

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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

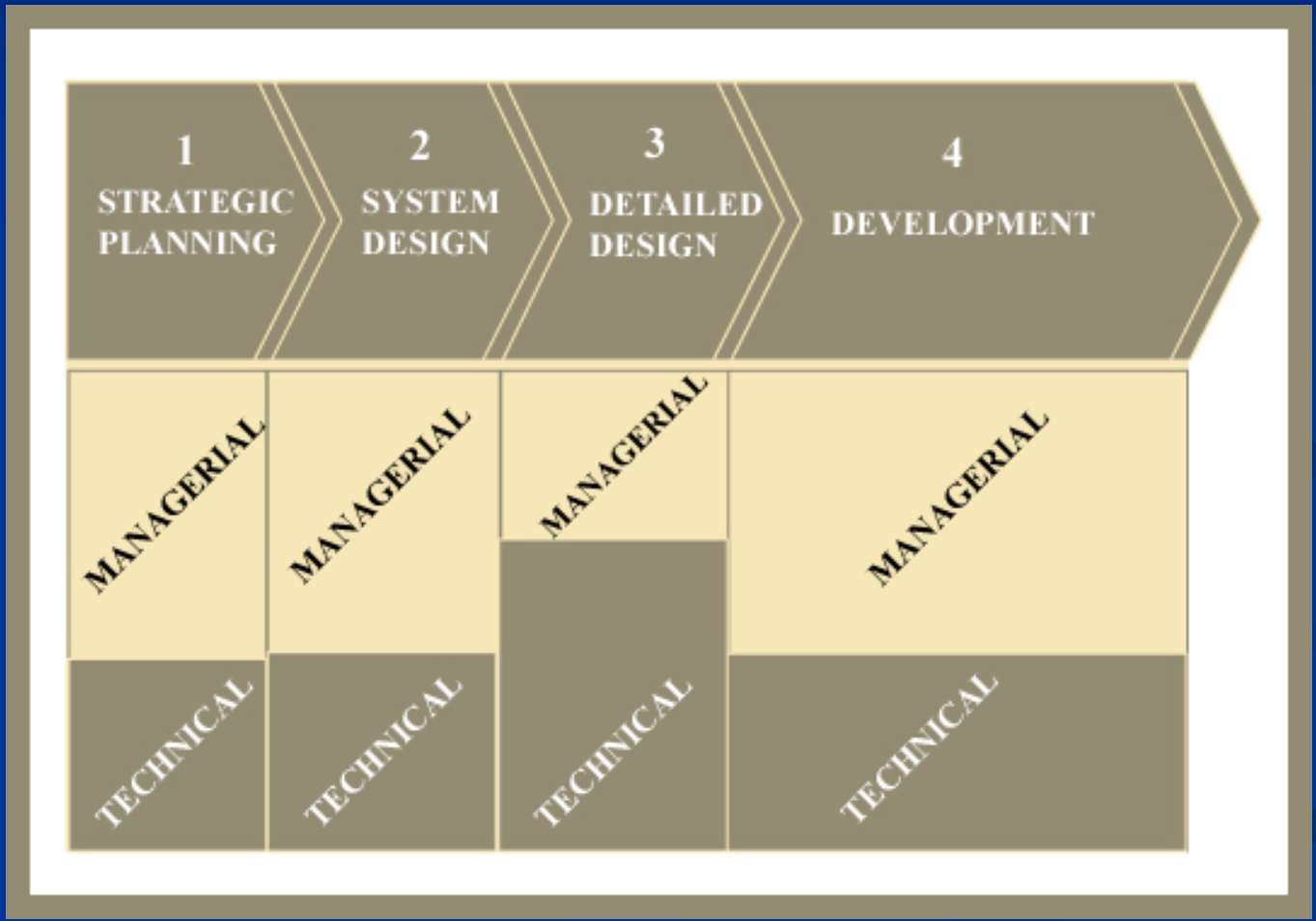
Definitions

- **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

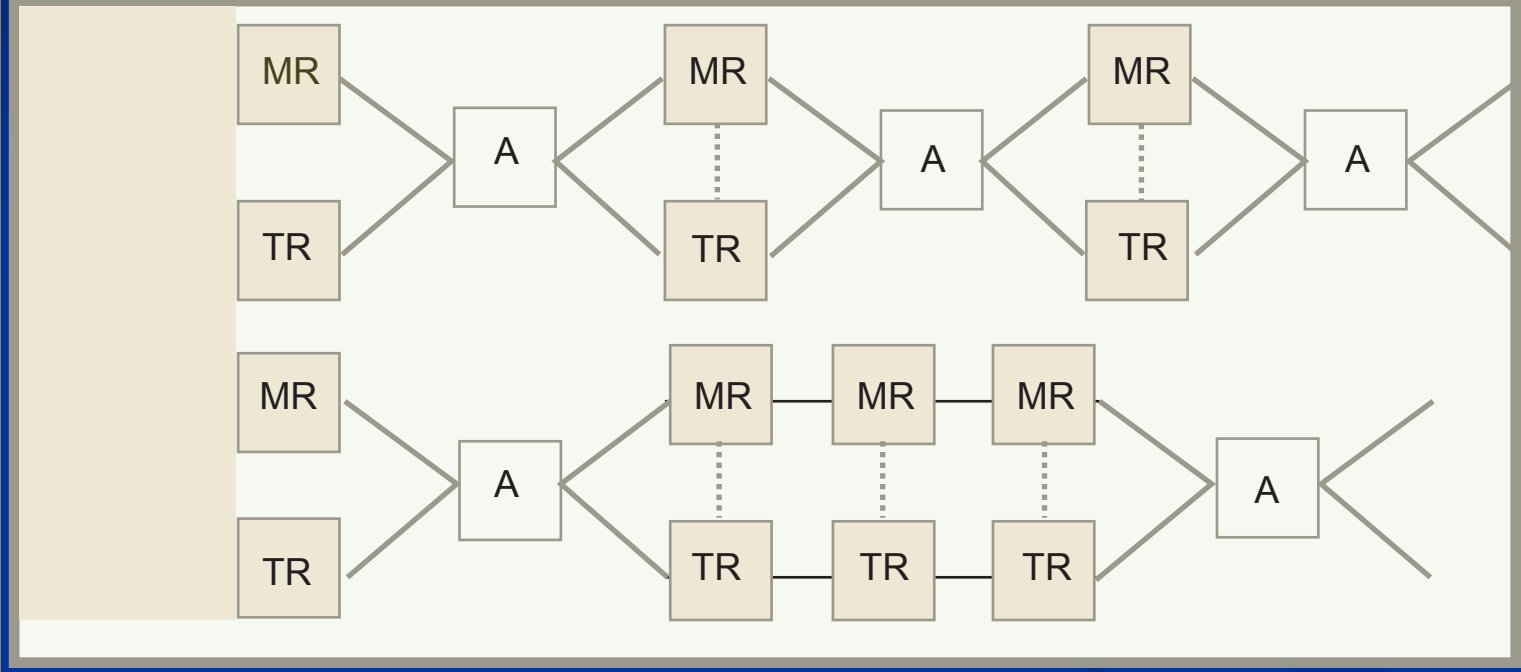
Technical Reviews

- 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