Week 4

Pre-Project Planning

457.307 Construction Planning and Management

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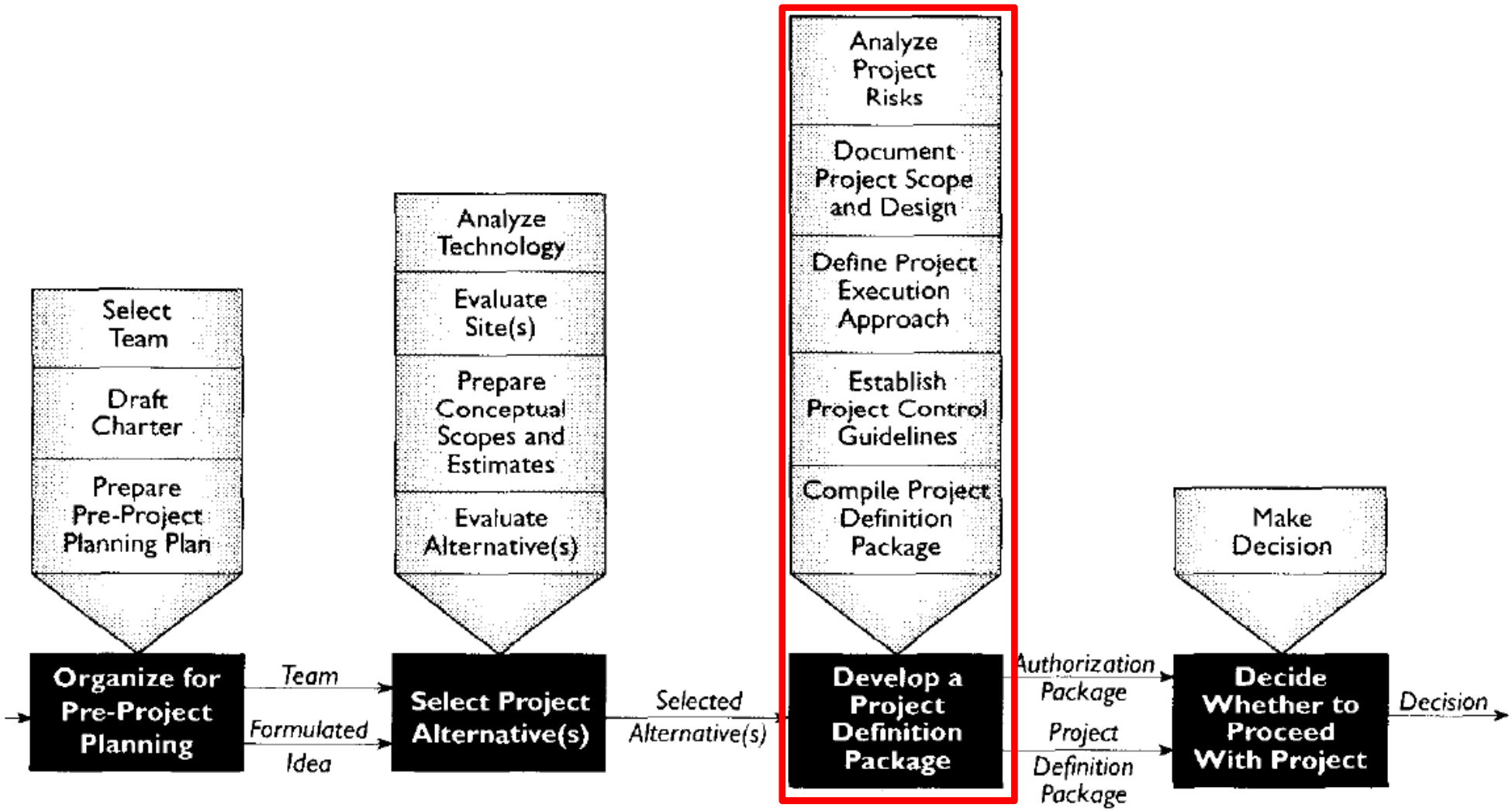
PPP Process


Select Team
Draft Charter
Prepare Pre-Project Planning Plan
Organize for Pre-Project Planning
Team
Formulated Idea
Analyze Technology
Evaluate Site(s)
Prepare Conceptual Scopes and Estimates
Evaluate Alternative(s)
Select Project Alternative(s)
Selected Alternative(s)
Analyze Project Risks
Document Project Scope and Design
Define Project Execution Approach
Establish Project Control Guidelines
Compile Project Definition Package
Develop a Project Definition Package
Authorization Package
Project Definition Package
Make Decision
Decide Whether to Proceed With Project
Decision

Develop a Project Definition Package

- **Analyze Project Risks**
  - Uncertainties produce severe losses
  - Identify, measure and manage project risks on cost, schedule, and technical performance
  - Mostly subjective and qualitative
    - Experience of key project personnel
    - Input from stakeholders is critical.
  - Financial, business, technology, regulatory, operational, environmental, permitting + construction-related risks

Develop a Project Definition Package

- **Two critical risk considerations:**
  - Which risks may produce severe losses?
  - Which risks may occur frequently?

- **Key things**
  - Capture risk issues in a risk matrix or "risk register"
  - Begin as early as possible
  - Develop mitigation strategies
    - Accept, shift through contract, design solutions, apply contingency $ or plans, or insure
  - Track over time

Measuring PPP (PDRI)

- **Project Definition Rating Index (PDRI)**
  - Simple, easy-to-use tool for measuring the degree of scope development
  - 3 sections
    - Section I: Basis of project decision
    - Section II: Basis of design / Front End Definition
    - Section III: Execution approach
  - How does the PDRI work?
    - Rate each of the 70 elements to obtain a project definition score of up to 1,000 points
    - Lower score = Better scope definition

Building : 11 categories 64 Elements
Industrial : 15 categories 70 Elements
Infrastructure : 13 categories 68 Elements

SECTION I - BASIS OF PROJECT DECISION

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
A. MANUFACTURING OBJECTIVES CRITERIA (Maximum Score = 45)							
A1. Reliability Philosophy	0	1	5	9	14	20	
A2. Maintenance Philosophy	0	1	3	5	7	9	
A3. Operating Philosophy	0	1	4	7	12	16	
CATEGORY A TOTAL							
B. BUSINESS OBJECTIVES (Maximum Score = 213)							
B1. Products	0	1	11	22	33	56	
B2. Market Strategy	0	2	5	10	16	26	
B3. Project Strategy	0	1	5	9	14	23	
B4. Affordability/Feasibility	0	1	3	6	9	16	
B5. Capacities	0	2	11	21	33	55	
B6. Future Expansion Considerations	0	2	3	6	10	17	
B7. Expected Project Life Cycle	0	1	2	3	5	8	
B8. Social Issues	0	1	2	5	7	12	
CATEGORY B TOTAL							
C. BASIC DATA RESEARCH & DEVELOPMENT (Maximum Score = 94)							
C1. Technology	0	2	10	21	39	54	
C2. Processes	0	2	8	17	28	40	
CATEGORY C TOTAL							
D. PROJECT SCOPE (Maximum Score = 120)							
D1. Project Objectives Statement	0	2				25	
D2. Project Design Criteria	0	3	6	11	16	22	
D3. Site Characteristics Available vs. Req'd	0	2				29	
D4. Dismantling and Demolition Req'mts	0	2	5	8	12	15	
D5. Lead/Discipline Scope of Work	0	1	4	7	10	13	
D6. Project Schedule	0	2				16	
CATEGORY D TOTAL							
E. VALUE ENGINEERING (Maximum Score = 27)							
E1. Process Simplification	0	0				8	
E2. Design & Material Alts. Considered/Rejected	0	0				7	
E3. Design For Constructability Analysis	0	0	3	5	8	12	
CATEGORY E TOTAL							
Section I Maximum Score = 499	**SECTION I TOTAL**						

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION II - FRONT END DEFINITION

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
F. SITE INFORMATION (Maximum Score = 104)							
F1. Site Location	0	2				32	
F2. Surveys & Soil Tests	0	1	4	7	10	13	
F3. Environmental Assessment	0	2	5	10	15	21	
F4. Permit Requirements	0	1	3	5	9	12	
F5. Utility Sources with Supply Conditions	0	1	4	8	12	18	
F6. Fire Protection & Safety Considerations	0	1	2	4	5	8	
CATEGORY F TOTAL							
G. PROCESS / MECHANICAL (Maximum Score = 196)							
G1. Process Flow Sheets	0	2	8	17	26	36	
G2. Heat & Material Balances	0	1	5	10	17	23	
G3. Piping & Instrumentation Diagrams (P&ID's)	0	2	8	15	23	31	
G4. Process Safety Management (PSM)	0	1	2	4	6	8	
G5. Utility Flow Diagrams	0	1	3	6	9	12	
G6. Specifications	0	1	4	8	12	17	
G7. Piping System Requirements	0	1	2	4	6	8	
G8. Plot Plan	0	1	4	8	13	17	
G9. Mechanical Equipment List	0	1	4	9	13	18	
G10. Line List	0	1	2	4	6	8	
G11. Tie-in List	0	1	2	3	4	6	
G12. Piping Specialty Items List	0	1	1	2	3	4	
G13. Instrument Index	0	1	2	4	5	8	
CATEGORY G TOTAL							
H. EQUIPMENT SCOPE (Maximum Score = 33)							
H1. Equipment Status	0	1	4	8	12	16	
H2. Equipment Location Drawings	0	1	2	5	7	10	
H3. Equipment Utility Requirements	0	1	2	3	5	7	
CATEGORY H TOTAL							
I. CIVIL, STRUCTURAL, & ARCHITECTURAL (Maximum Score = 19)							
I1. Civil/Structural Requirements	0	1	3	6	9	12	
I2. Architectural Requirements	0	1	2	4	5	7	
CATEGORY I TOTAL							
J. INFRASTRUCTURE (Maximum Score = 25)							
J1. Water Treatment Requirements	0	1	3	5	7	10	
J2. Loading/Unloading/Storage Facilities Req'mts	0	1	3	5	7	10	
J3. Transportation Requirements	0	1				5	
CATEGORY J TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION II - FRONT END DEFINITION (continued...)

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
K. INSTRUMENT & ELECTRICAL (Maximum Score = 46)							
K1. Control Philosophy	0	1	3	5	7	10	
K2. Logic Diagrams	0	1				4	
K3. Electrical Area Classifications	0	0	2	4	7	9	
K4. Substation Req'mts Power Sources Ident.	0	1	3	5	7	9	
K5. Electric Single Line Diagrams	0	1	2	4	6	8	
K6. Instrument & Electrical Specifications	0	1	2	3	5	6	
CATEGORY K TOTAL							

Section II Maximum Score = 423 **SECTION II TOTAL**

SECTION III - EXECUTION APPROACH (continued...)

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
P. PROJECT EXECUTION PLAN (Maximum Score = 36)							
P1. Owner Approval Requirements	0	0	2	3	5	6	
P2. Engineering/Construction Plan & Approach	0	1	3	5	8	11	
P3. Shut Down/Turn-Around Requirements	0	1				7	
P4. Pre-Commiss. Turnover Sequence Req'mts	0	1	1	2	4	5	
P5. Startup Requirements	0	0	1	2	3	4	
P6. Training Requirements	0	0	1	1	2	3	
CATEGORY PTOTAL							

Section III Maximum Score = 78 **SECTION III TOTAL**

SECTION III - EXECUTION APPROACH

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
L. PROCUREMENT STRATEGY (Maximum Score = 16)							
L1. Identify Long Lead/Critical Equip. & Mat'ls	0	1	2	4	6	8	
L2. Procurement Procedures and Plans	0	0	1	2	4	5	
L3. Procurement Responsibility Matrix	0	0				3	
CATEGORY L TOTAL							
M. DELIVERABLES (Maximum Score = 9)							
M1. CADD/Model Requirements	0	0	1	1	2	4	
M2. Deliverables Defined	0	0	1	2	3	4	
M3. Distribution Matrix	0	0				1	
CATEGORY M TOTAL							
N. PROJECT CONTROL (Maximum Score = 17)							
N1. Project Control Requirements	0	0	2	4	6	8	
N2. Project Accounting Requirements	0	0	1	2	2	4	
N3. Risk Analysis	0	1				5	
CATEGORY N TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

PDRI TOTAL SCORE

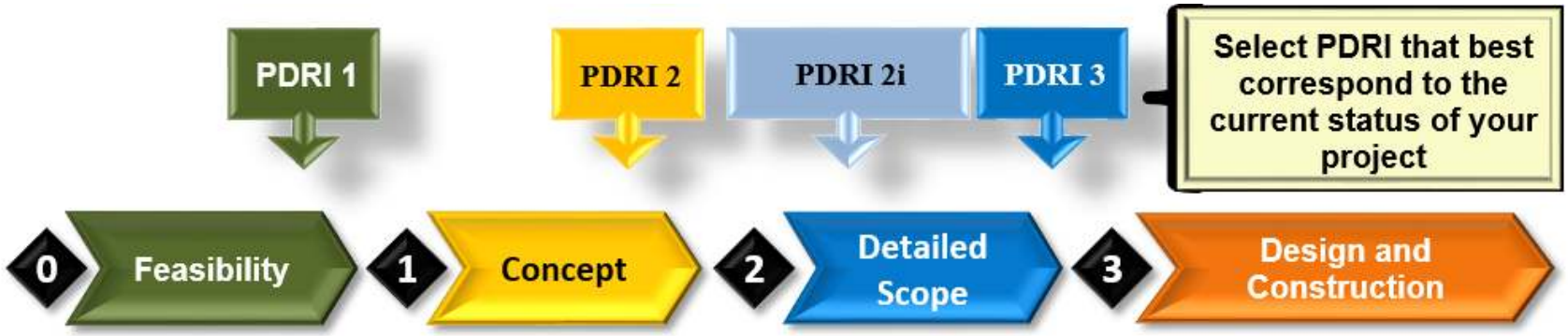
(Maximum Score = 1000)

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Measuring PPP (PDRI)

- **Project Definition Rating Index (PDRI)**



- CII
  - PDRI 1 : 550 ~800 point
  - PDRI 2 ~2 i : 300 ~450 point
  - PDRI 3 : ~ 200 point

Measuring PPP (PDRI)

EXAMPLE:

Consider, for example, that you are a member of a pre-project planning team responsible for developing the scope definition package for a retrofit to an existing chemical plant. Your team has identified major milestones throughout pre-project planning at which time you plan to use the PDRI to evaluate the current level of "completeness" of the scope definition package. Assume that at the time of this particular evaluation the scope development effort is underway, but it is not yet complete.

Your responsibility is to evaluate how well the project infrastructure requirements have been identified and defined to date. This information is covered in Category J of the PDRI as shown below and consists of three elements: "Water Treatment Requirements," "Loading / Unloading / Storage Facilities Requirements," and "Transportation Requirements."

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
J. INFRASTRUCTURE (Maximum Score = 25)							
J1. Water Treatment Requirements	0	1	3	5	7	10	
J2. Loading / Unloading / Storage Facilities Req'mts	0	1	3	5	7	10	
J3. Transportation Requirements	0	1				5	
						CATEGORY J TOTAL	

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Measuring PPP (PDRI)

J1. Water Treatment Requirements

Items for consideration should include:

- Wastewater treatment
  - Process waste
  - Sanitary waste
- Waste disposal
- Storm water containment & treatment

J2. Loading / Unloading / Storage Facilities Requirements

A list of requirements identifying raw materials to be unloaded and stored, products to be loaded along with their specifications, and Material Safety Data Sheets. This list should include items such as:

- Instantaneous and overall loading / unloading rates
- Details on supply and / or receipt of containers and vessels
- Storage facilities to be provided and / or utilized
- Specification of any required special isolation provisions
  - Double wall diking and drainage
  - Emergency detection (e.g. hydrocarbon detectors / alarms)
  - Leak detection devices or alarms

J3. Transportation Requirements (Y/N)

Specifications identifying implementation of "in-plant" transportation (e.g. roadways, concrete, asphalt, rock, etc.) as well as methods for receiving / shipping of materials (e.g. rail, truck, marine, etc.).

Measuring PPP (PDRI)

To fill out Category J, Infrastructure, follow these steps:

Step 1: Read the description for each element in Appendix C (page 58). Some elements contain a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists.

Step 2: Collect all data that you may need to properly evaluate and select the definition level for each element in this category. This may require obtaining input from other individuals involved in the scope development effort.

Step 3: Select the definition level for each element as described below and shown on the next page.

Element J1: Requirements for treating process and sanitary wastewater have been well defined. However, procedures for handling storm water runoff and treatment have not been identified. You feel that this element has some *minor deficiencies* that should be addressed prior to authorization of the project. **Definition Level = 2**.

Element J2: Your team decides that this element is *not applicable* to your particular project. **Definition Level = 0**.

Element J3: Although your team plans to specify methods for receiving and shipping materials within the plant, it has not yet been done. This element is to be evaluated on a Yes/No basis. It is *incomplete*. **Definition Level = 5**.

Measuring PPP (PDRI)

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
J. INFRASTRUCTURE (Maximum Score = 25)							
J1. Water Treatment Requirements	0	1	(3)	5	7	10	3
J2. Loading / Unloading / Storage Facilities Req'mts	(0)	1	3	5	7	10	0
J3. Transportation Requirements	0	1				(5)	5
						CATEGORY J TOTAL	8

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Step 4: For each element, write the score that corresponds to its level of definition in the "Score" column. Add the element scores to obtain a category score. In this example, Category J has a total score of 8.

PDRI

- **Instructions for Scoring**

  File 1: PDRI for Buildings_PDRI Matrix

  File 2: PDRI for Buildings_Score Example

Example Project

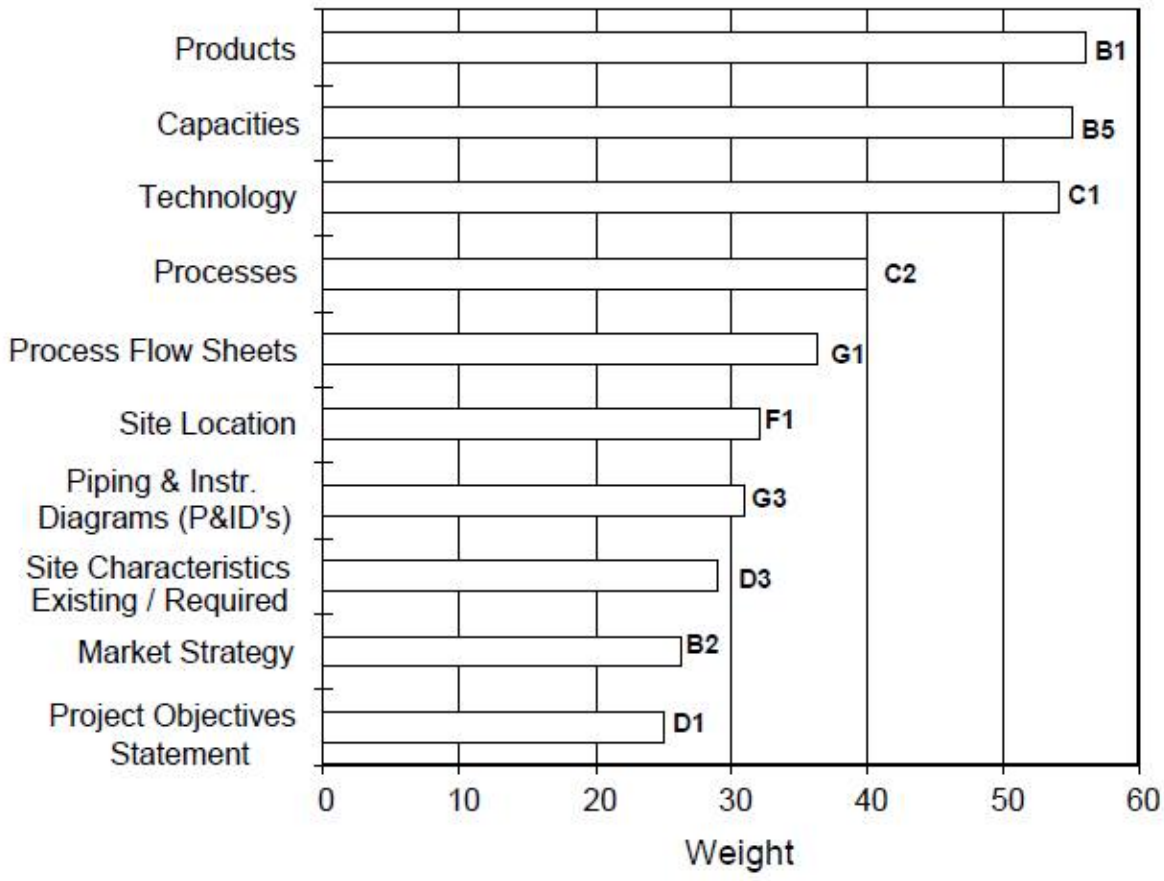
Project Type:	Dormitory-Student Housing Project
Facility Uses:	Lodging, food service, meeting rooms, computer facility
Budget:	Approximately $52 million
Scheduled Completion:	December 2000
Date Scored:	November 11, 1998, 2:40 p.m. – 4:50 p.m.
Objectives of the Meeting:	Define potential problems using the PDRI Define current project status
Methodology:	Individuals evaluated each element Discussed each element as a group Reached a common (consensus) definition level for each element
Project Status:	100% complete with Programming 30% complete with Schematic Design Scoring session took place at the kickoff meeting of the design/build project team — five attendees.

Major Findings/Areas for Further Study:

Problems with site analysis (Category D-project was sited in a flood plain and other site problems); existing facilities not evaluated (C3); confusion over facility capacity (A5); no owner approval process (L2);

Measuring PPP (PDRI)

- **Project Definition Rating Index (PDRI)**
  - All 70 elements not equally important (different weights)
  - 54 project managers and estimators from 31 companies
  - Top 10 Elements:



Projects With PDRI Scores Above and Below 200

	PDRI Score		
Performance	**< 200**	**> 200**	**△**
Cost	-5%	+14%	19%
Schedule	-1%	+12%	13%
Change Orders	+2%	+8%	6%
	(N=20)	(N=20)	

Measuring PPP (PDRI)

- **Instructions for Scoring**
  - The maximum score possible is 1000 (poor) and the minimum is 70 (good)
  - A total PDRI score of 200 or less improves a project's chances of successful performance
  - Hence, each category should strive for a category score that is 20% or less of the maximum category score
  - Take actions for low-level definition elements and continuously monitor to achieve a project goal

Measuring PPP (PDRI)

- **Benefits**
  - Checklist
  - Standardized scope definition terminology
  - Risk assessment
  - Monitor progress
  - Communication and promotes alignment
  - Reconcile differences
  - Training tool
  - Benchmarking tool

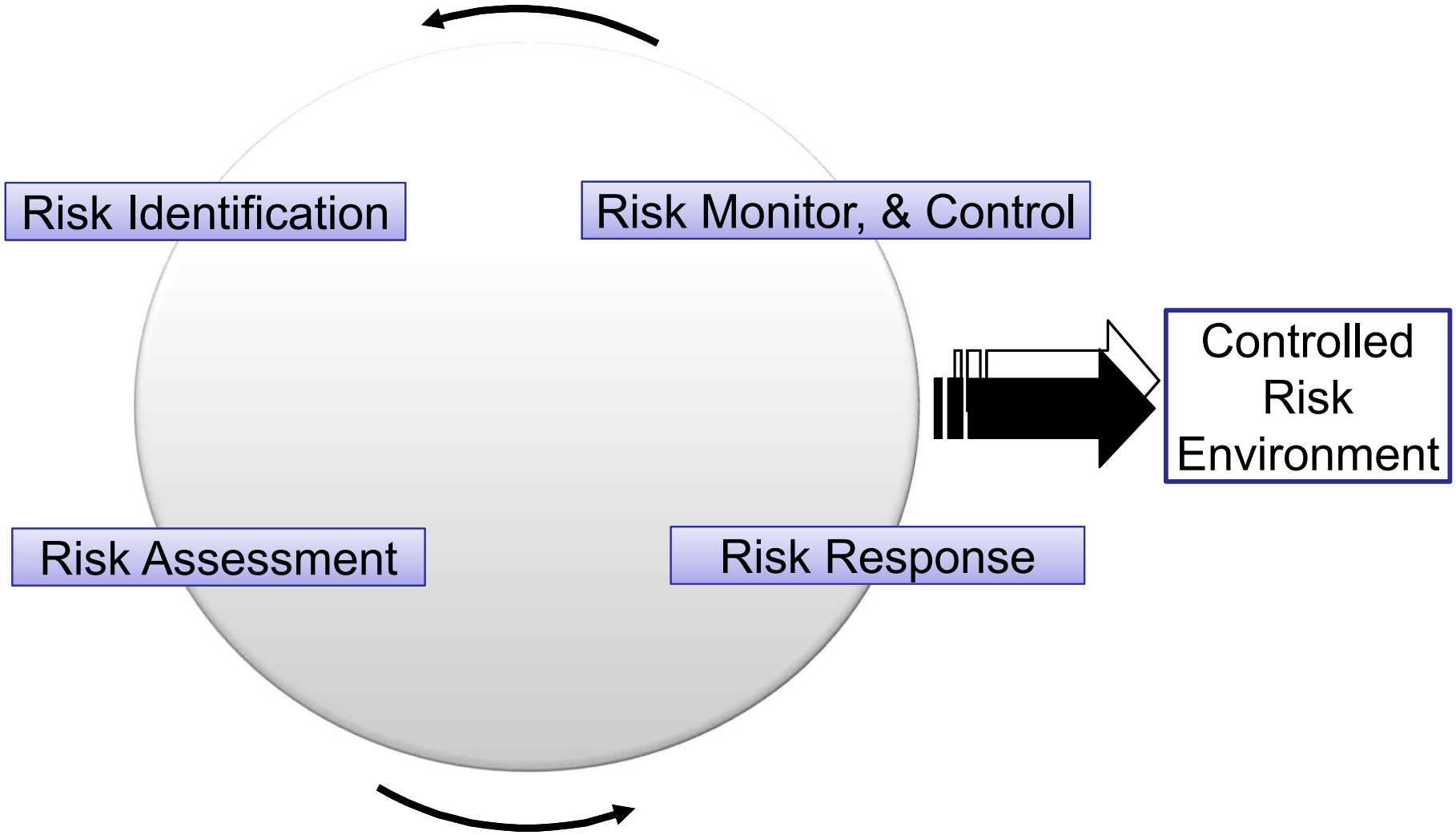
Measuring PPP (PDRI)

Project Assessment Session Action Items, June 22, 200x						
(Sorted in order of PDRI element)						
Item #	PDRI Element(s)	Level of Definition	PDRI Element Score	Item Description	Date Completed	Responsible
1	A2	2	3	Resolve recycle maintenance philosophy issues	July 1, 200x	John Ramos
2	B4	1	1	Issue affordability/feasibility report to the team	July 1, 200x	Jake Blinn
3	B5	1	2	Confirm distribution for finished product	July 1, 200x	Sue Howard
4	F2	2	4	Complete soil testing for duct work	July 15, 200x	Jose Garcia
5	F4	1	1	Monitor all open permits	Ongoing	Jake Blinn
6	G9	3	9	Waste gas, water treatment, HVAC, and misc. balance of plant mechanical equipment list	July 31, 200x	Tina Towne
				And so on.....		

Procurement Risk

- **Materials**
  - Long-lead items
    - Extrusion processing equipment, Gas compressor, Gas turbine, High pressure pump
  - How do the long-lead items impact the schedule?
    - They are on the critical path schedule. (Any delay on this leads to delay of the entire project.)
    - Associated facilities' construction schedule has to be matched to ensure minimum time expenditure in housing of the equipment after receipt.

Risk Management Process



Project Risk Identification (PMBoK®, 2008)

- **Contract type**
  - Lump Sum, Unit Price, Reimbursable
- **Unfair contract clauses**
  - Differing site condition, damage for delay, force majeure loss, quantity variation
- **Area factors**
  - Geography, altitude, government stability, local attitude, communications, infrastructure
- **Site factors**
  - Access, congestion, hazard for safety & health, availability of utilities, security
- **Weather**
  - Potential for extremes
- **Monetary**
  - Escalation, exchange rate, cost and award, payment float, retention, overhead cost, penalties

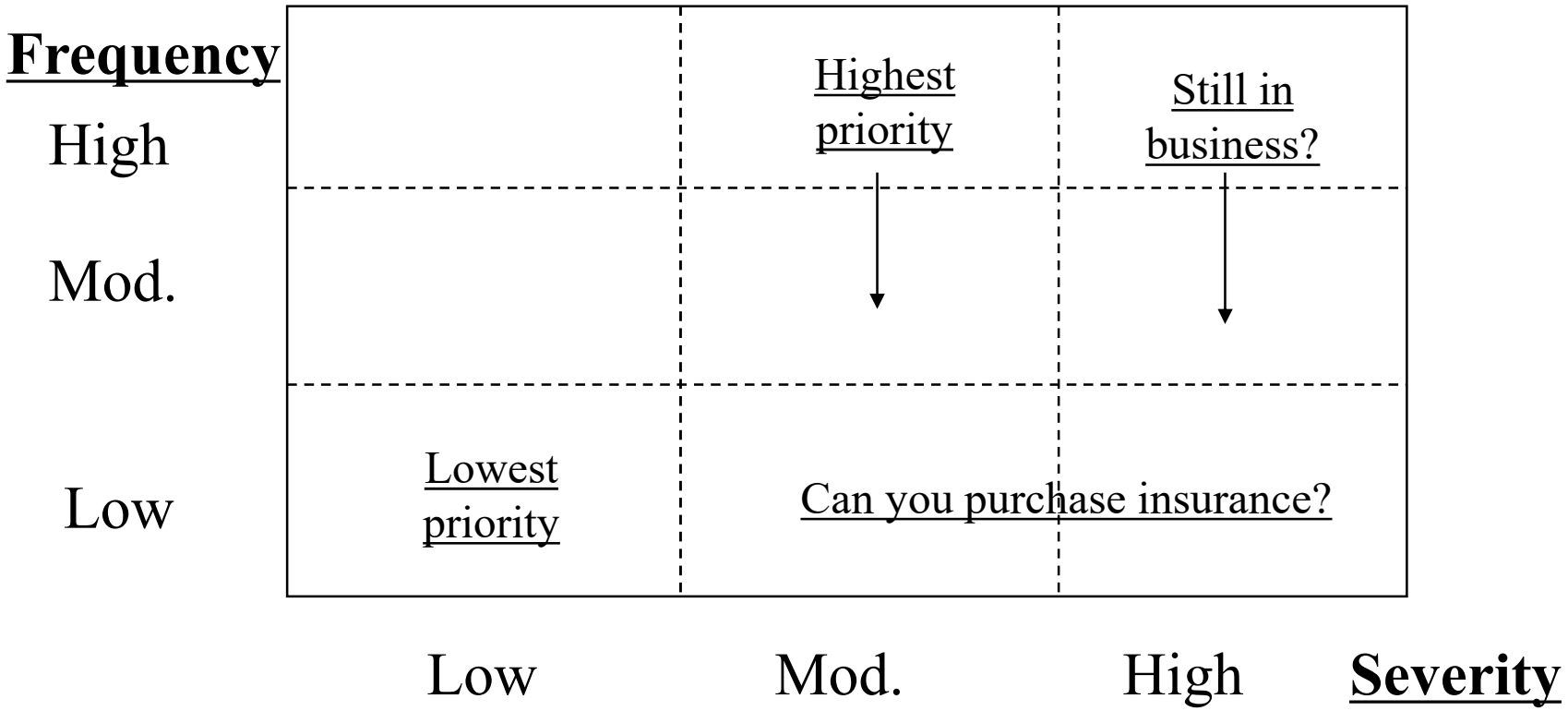
Project Risk Identification (PMBoK®, 2008)

- **Ability to perform**
  - Familiarity with work type, qualification of key personnel, quality of design, requirement of new technology, knowledge of area, need for work
- **Time factors**
  - Deadline and milestones, available work days, potential for stoppage
- **Regulatory factors**
  - Permits, environmental violation
- **Labor factors**
  - Availability, skill, productivity, wage scale, potential for adverse activity
- **Client factors**
  - Financial stability, interference, change management policy, quality expectations, interpretation of contract

Project Risk Identification (PMBoK®, 2008)

- **Material factors**
  - Quantity variation, quality, price, availability, delivery uncertainty, waste in use, potential for theft/damage
- **Equipment factors**
  - Availability, cost, loss or damage
- **Subcontractor/vendor factors**
  - Technical qualification, financial stability, reliability
- **Special exposures**
  - Insurance deductibles, client claim, third party litigation, warrantee & guarantee

Objective of Risk Response



Risk Response

- **Proactive Prevention**
  - Focus is on prevention, preferred, most cost-effective approach
  - Plan, then implement now

- **4Ts**
  - Transfer: **risk sharing** via contracts(negotiation), joint venture, incentives, insurance, bonds, liquidated damages, warranties, working day contract(disaster, severe weather), …
  - Treat: **risk reduction** via training, constructability, antitheft devices, sprinkler systems, ...
  - Take: **risk acceptance** with contingency, …
  - Terminate: **risk avoidance**: don't participate(problems of hazardous waste, political, financial, etc.), use only proven technologies, …

Risk Identification and Assessment

- **Objective Function**
  - What would be a more strategic, structured way for criteria and weights setting and assessing risks?
  - Become the basis for decision making
  - Explain what we are trying to achieve better

  - Formula-based support: Outcomes + Decision Criteria
  - Outcomes: What are the consequences of decisions and related events? (advantages and disadvantages)
  - Decision criteria: What are the measures of goodness or preference

Objective Function Practice (1)

- **Modularization/Preassembly (off-site manufacturing) → GO or NO GO**




Objective Functions – Example (1)

- **Modularization/Preassembly Go/No Go**
- **Possible Objective Function:**
  - Potential Total Value to Owner =

    (1) Potential Project Net Savings +

    (2) Potential Gross Revenue from Early Completion & Sales

    where, *Potential Project Net Savings* =

    Direct labor savings + Savings from reduced project duration + Scaffolding savings

    – Additional engineering cost – Additional material cost

    – Additional transport cost – Additional indirect cost

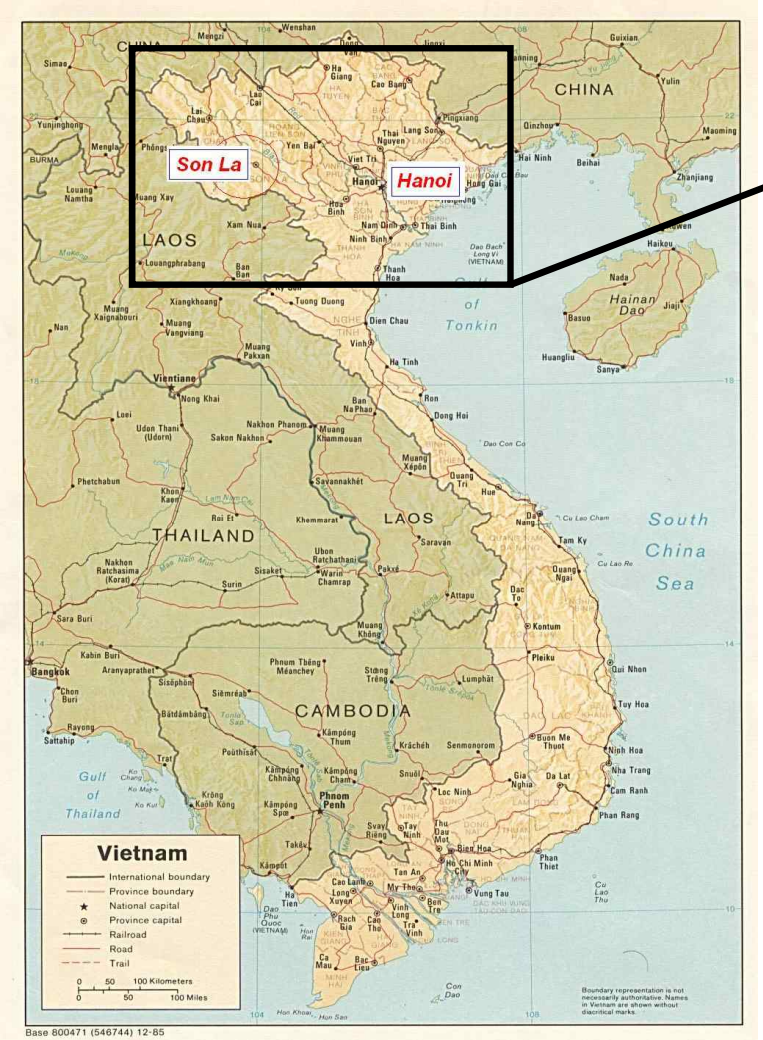
    – Additional rework cost

Objective Functions – Example (2)

- **Son-La dam construction in Vietnam: Go/No Go**
  - Vietnam is experiencing a more rapid rise in demand for electricity than economic growth.
  - Vietnam's energy demand heavily relies on coal fired generating plant
  - Vietnam government is deciding whether or not to do the great hydro expansion.
  - Son-La Dam will be the biggest project in this hydro expansion

Objective Functions – Example (2)

- **Son-La dam construction in Vietnam: Go/No Go**



Decisions need to be made?

The Son-La Dam project: Go/No Go

Decision Maker? A Vietnam government agency

Objective Functions – Example (2)

- **Son-La dam construction in Vietnam: Go/No Go**

Normal Water Level	265 m
Dam Height	177 m
Volume of Reservoir	25.4 billion m^3
Surface of Reservoir	440 km^2
Energy Production	14,124 GWh/year
Project Estimated Cost	$2.3 billion
Project Life Cycle	100 years