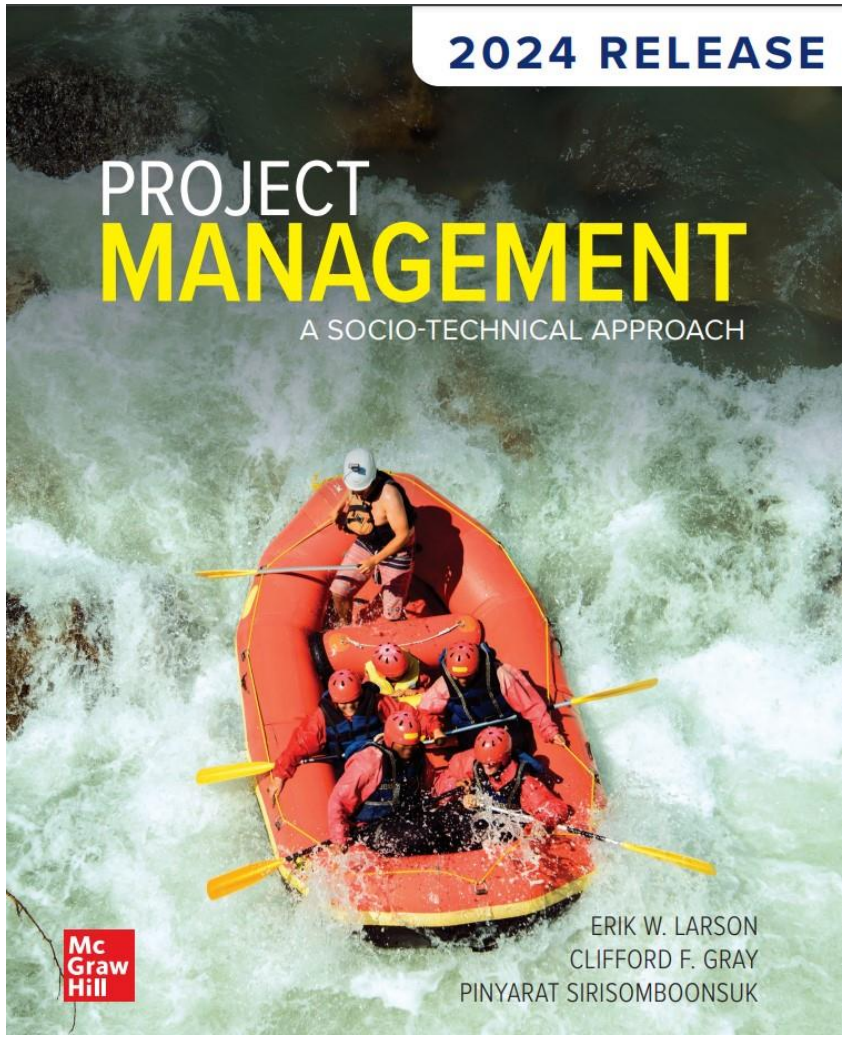
OntarioTech
Engineering
& Applied Science

Project Management for Engineers - ENGR 5410G
Fall 2024

Unit 1:
Introduction & Strategy

Chapter 1

Modern Project Management



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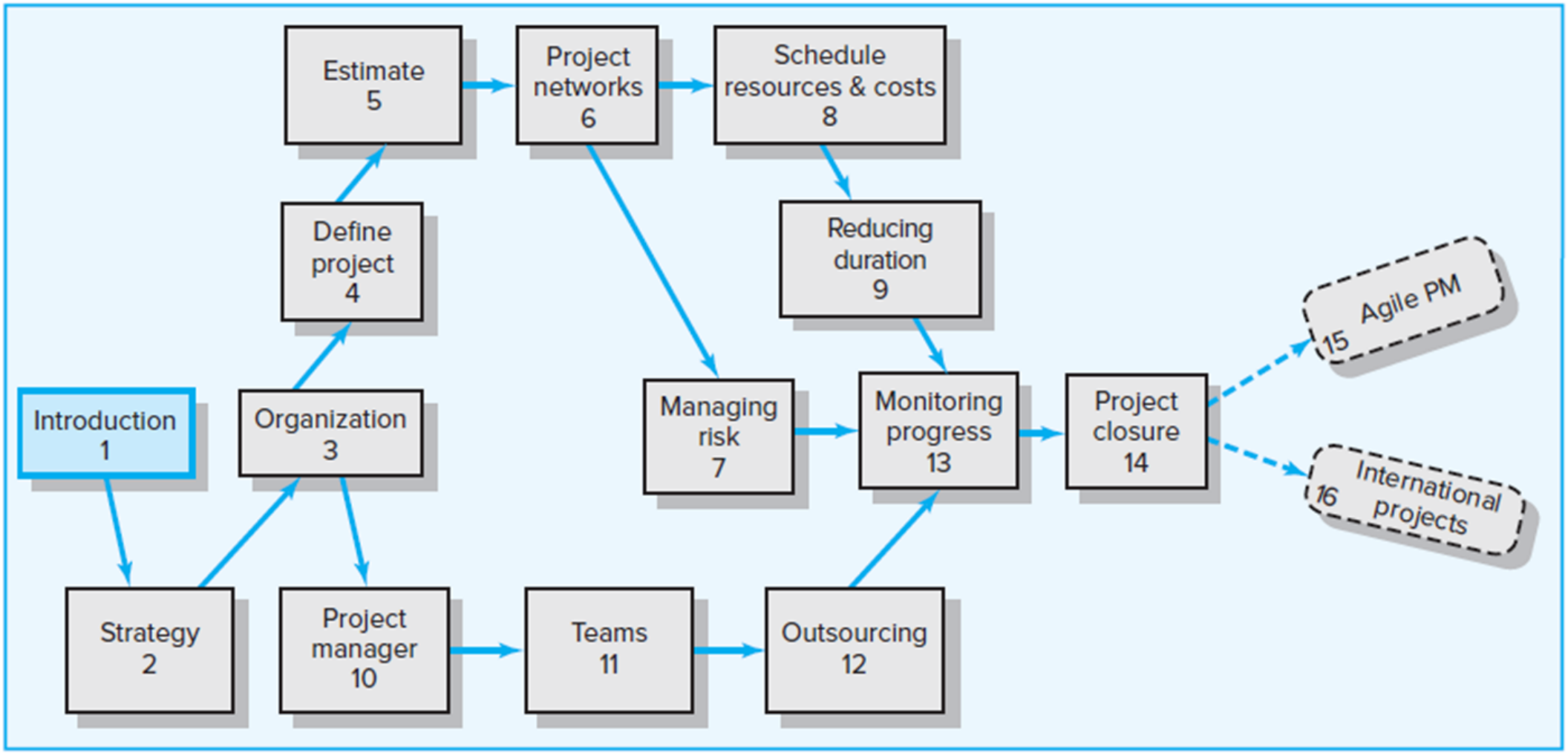
An Overview of Project Management



Text Overview 1

Chapter 2 focuses on how organizations go about evaluating and selecting projects based on organization strategy.

Chapter 3 discusses functional organizations, matrix management, and other organization forms but also discusses the significant role that culture of an organization plays in the implementation of projects.

Chapter 4 deals with defining the scope of the project and developing a work breakdown structure (WBS).

Chapter 5 explores methods for formulating cost and time estimates or projects and their tasks.

Chapter 6 focuses on utilizing the information from the WBS to create a project plan in the form of a timed and sequenced network of activities.

Text Overview 2

Chapter 7 examines how organizations and managers identify and manage risks associated with project work.

Chapter 8 explores resource allocation and how resource limitations impact the project schedule and how time-phased budgets are determined.

Chapter 9 examines strategies for reducing project duration either prior to the initiation of the project or in response to problems or new demands placed on the project.

Chapter 10 focuses on the role of the project manager as a leader and stresses the importance of managing project stakeholders within the organization.

Chapter 11 focuses on the core project team and combines the latest information on team dynamics with leadership skills/techniques of developing a high-performance project team.

Text Overview 3

Chapter 12 discusses how to outsource project work and how to negotiate with contractors, customers, and suppliers.

Chapter 13 focuses on the kinds of information managers use to monitor project progress and discusses the key concept of earned value.

Chapter 14 covers closing out a project and the important assessment of performance and lessons learned.

Chapter 15 discusses Agile Project Management, a much more flexible approach to managing projects with high degree of uncertainty.

Chapter 16 focuses on working on projects across cultures.

Learning Objectives

1-1: Understand why project management (PM) is crucial in today's world.

1-2: Distinguish a project from routine operations.

1-3: Identify the different stages of a project life cycle.

1-4: Describe how Agile PM is different from traditional PM.

1-5: Understand that managing projects involves balancing the technical and sociocultural dimensions of the project.

Chapter 1 Outline

1.1 What Is a Project?

1.2 Agile Project Management.

1.3 Current Drivers of Project Management.

1.4 Project Management Today: A Socio-Technical Approach.

Examples of Projects Given to Recent College Graduates

Business information: install new data security system.

Physical education: develop a new fitness program for senior citizens.

Marketing: execute a sales program for a new home air purifier.

Industrial engineering: create a value chain report for every aspect of a key product from design to customer delivery.

Chemistry: develop a quality control program for an organization's drug production facilities.

Management: implement a new store layout design.

Pre-med neurology student: join a project team linking mind mapping to an embedded prosthetic that will allow blind people to function normally.

Sports communication: create a promotion plan for a women's basketball project.

Systems engineer: develop data mining software for medical papers and studies related to drug efficacy.

Accounting: work on an audit of a major client.

Public health: design a medical marijuana educational program.

English: create a web-based user manual for a new electronics product.

What Is a Project?

Project Defined (according to PMI):

- A temporary endeavor undertaken to create a unique product, service, or result.

Major Characteristics of a Project:

- Has an established objective.
- Has a defined lifespan with a beginning and an end.
- Involves several departments and professionals.
- Involves doing something never done before.
- Has specific time, cost, and performance requirements.

Program versus Project

Program Defined:

- A group of related projects designed to accomplish a common goal over an extended period of time.

Program Management Defined:

- A process of managing a group of ongoing, interdependent, related projects in a coordinated way to achieve strategic objectives.

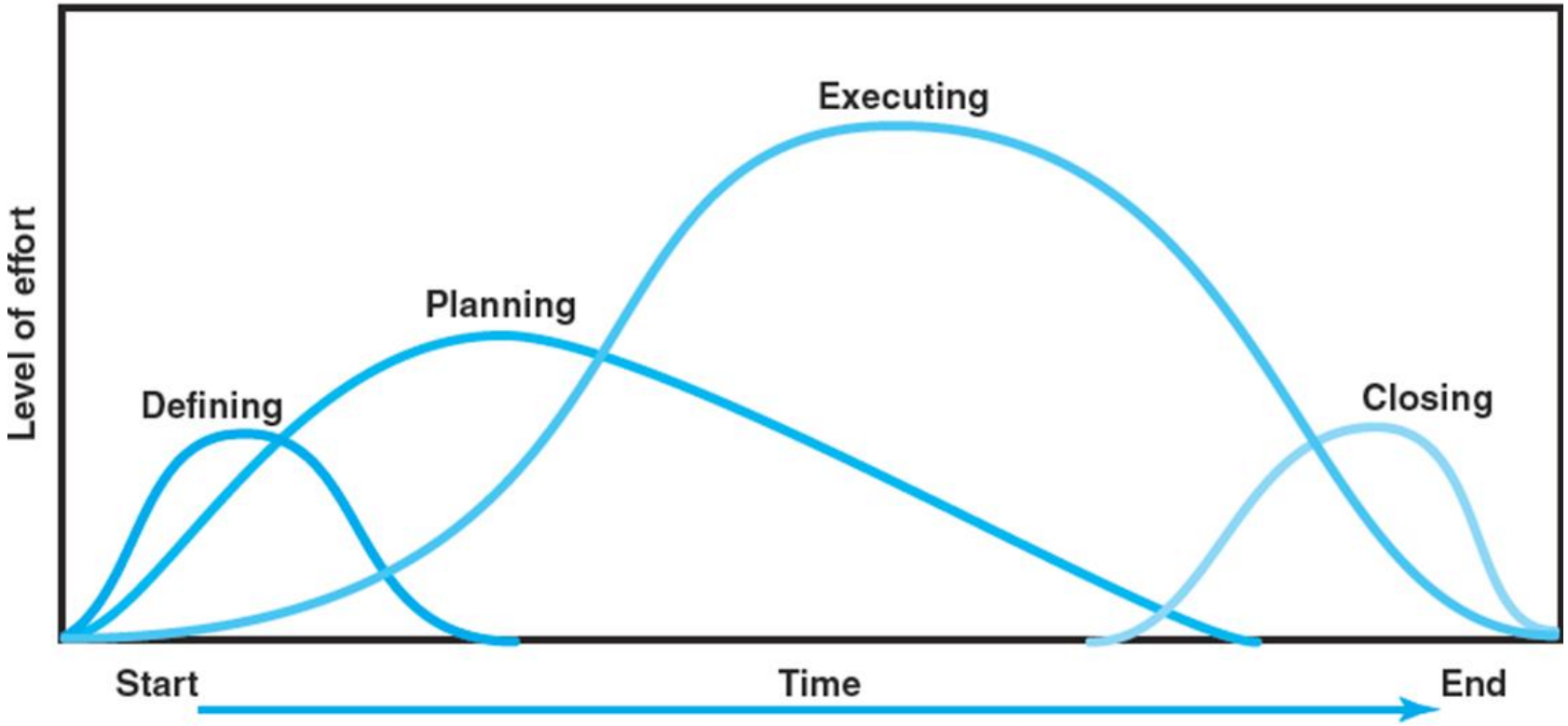
Examples:

- Project: completion of a required course in project management.
- Program: completion of all courses required for a business major.

Comparison of Routine Work with Projects

Routine, Repetitive Work	Projects
Taking class notes	Writing a term paper
Daily entering sales receipts into the accounting ledger	Setting up a sales kiosk for a professional accounting meeting
Responding to a supply-chain request	Developing a supply-chain information system
Practicing scales on the piano	Writing a new piano piece
Routine manufacture of an Apple iPod	Designing an iPod that is approximately 2 × 4 inches, interfaces with PC, and stores 10,000 songs
Attaching tags on a manufactured product	Wire-tag projects for GE and Walmart

Project Life Cycle



Defining	Planning	Executing	Closing
1. Goals	1. Schedules	1. Status reports	1. Train customer
2. Specifications	2. Budgets	2. Changes	2. Transfer documents
3. Tasks	3. Resources	3. Quality	3. Release resources
4. Responsibilities	4. Risks	4. Forecasts	4. Evaluation
	5. Staffing		5. Lessons learned

The Challenge of Project Management

The Project Manager:

- Manages temporary, nonrepetitive activities and frequently acts independently of the formal organization.
- Marshals resources for the project.
- Is the direct link to the customer.
- Works with a diverse troupe of characters.
- Provides direction, coordination, and integration to the project team.
- Is responsible for performance and success of the project.
- Must induce the right people at the right time to address the right issues and make the right decisions.

Agile Project Management

- Is a methodology emerged out of frustration with using traditional project management processes to develop software.
- Is now being used across industries to manage projects with high levels of uncertainty.
- Employs an incremental, iterative process sometimes referred to as a “rolling wave” approach to complete projects.
- Focuses on active collaboration between the project and customer representatives, breaking projects into small functional pieces, and adapting to changing requirements.
- Is often used up front in the defining phase to establish specifications and requirements, and then traditional methods are used to plan, execute, and close the project.
- Works best in small teams of four to eight members.

Rolling Wave Development

- Iterations typically last from one to four weeks.
- The goal of each iteration is to make tangible progress such as define a key requirement, solve a technical problem, or create desired features to demonstrate to the customer.
- At the end of each iteration, progress is reviewed, adjustments are made, and a different iterative cycle begins.
- Each new iteration subsumes the work of the previous iterations until the project is completed and the customer is satisfied.

Current Drivers of Project Management

Factors leading to the increased use of project management:

- Compression of the product life cycle.
- Knowledge explosion.
- Triple bottom line (planet, people, profit).
- Increased customer focus.
- Small projects represent big problems.

Project Management Today: A Socio-Technical Approach

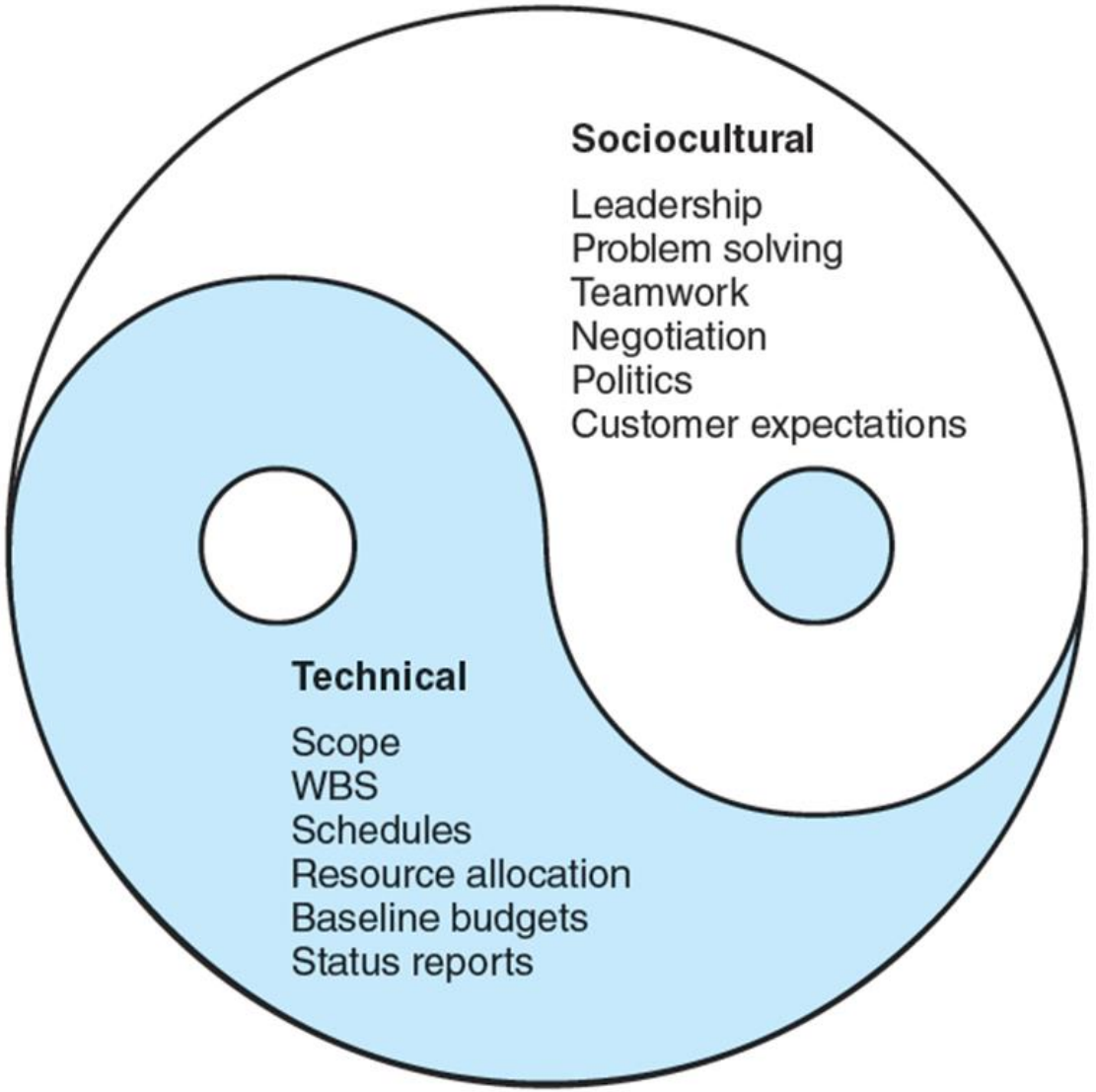
The Technical Dimension (The “Science”):

- Consists of the formal, disciplined, purely logical parts of the process.
- Includes planning, scheduling, and controlling projects.

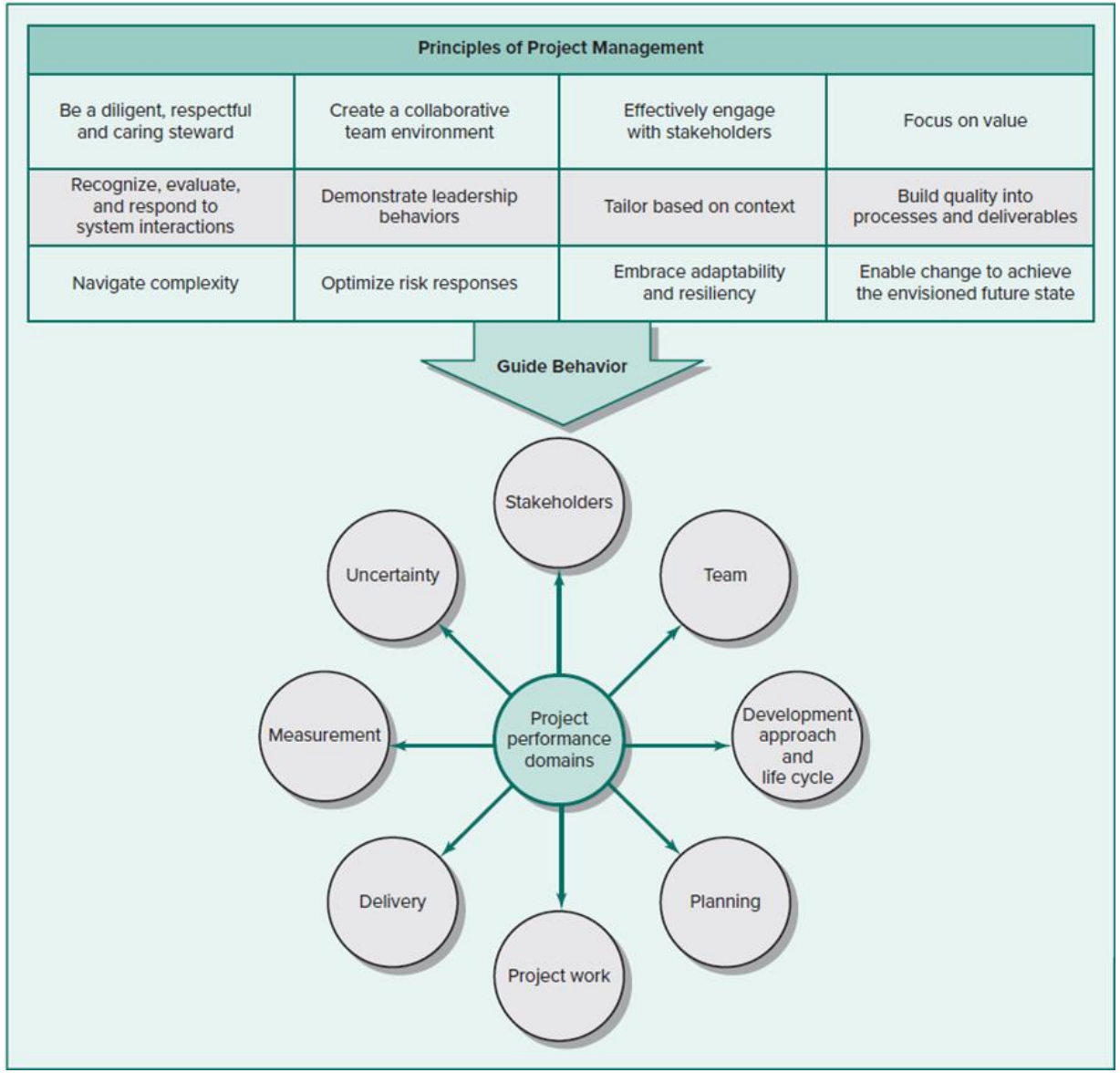
The Sociocultural Dimension (The “Art”):

- Involves the contradictory and paradoxical world of implementation.
- Centers on creating a temporary social system within a larger organizational environment that combines the talents of a divergent set of professionals working to complete the project.

A Socio-Technical Approach to Project Management

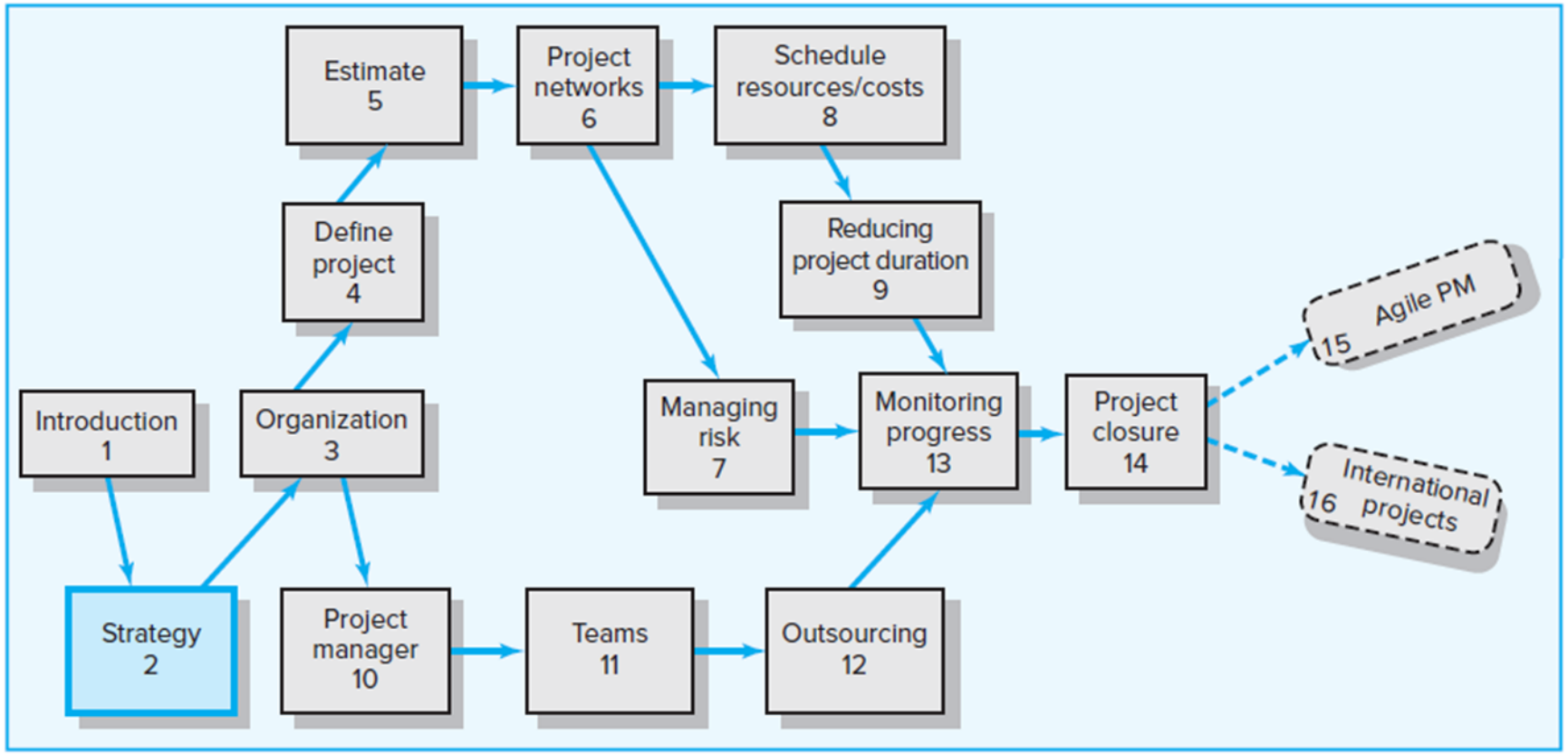


Relationship between 12 Project Management Principles and Project Performance Domains



Source: **Project Management Institute, *A Guide to Project Management Body of Knowledge PMBOK Guide, Seventh edition* (Pennsylvania: Project Management Institute, 2021), p. PGS1:5.**

Where We Are Now



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Chapter 2: Learning Objectives

2-1: Explain why it is important for project managers to understand their organization's strategy.

2-2: Identify the significant role projects contribute to the strategic direction of the organization.

2-3: Understand the need for a project priority system.

2-4: Distinguish among three kinds of projects.

2-5: Describe how the phase gate model applies to project management.

2-6: Apply financial and nonfinancial criteria to assess the value of projects.

2-7: Understand how multi-criteria models can be used to select projects.

2-8: Apply an objective priority system to project selection.

2-9: Understand the need to manage the project portfolio.

Chapter Outline

2.1 Why Project Managers Need to Understand Strategy.

2.2 The Strategic Management Process: An Overview.

2.3 The Need for a Project Priority System.

2.4 Project Classification.

2.5 Phase Gate Model.

2.6 Selection Criteria.

2.7 Applying a Selection Model.

2.8 Managing the Portfolio System.

Why Project Managers Need to Understand Strategy

Two main reasons project managers need to understand their organization's mission and strategy:

1. So they can make appropriate decisions and adjustments.
    - How a project manager would respond to a suggestion to modify the design of a product or to delays may vary depending upon strategic concerns
2. So they can be effective project advocates. They have to be able to:
    - Demonstrate to senior management how their project contributes to the firm's mission in order to garner the continued support of management.
    - Explain to stakeholders why certain project objectives and priorities are critical in order to secure buy-in.
    - Explain why the project is important to motivate and empower the project team (Brown, Hyer, & Ettenson, 2013).

The Strategic Management Process: An Overview

Strategic Management Defined:

- Is the process of assessing “what we are” and deciding and implementing “what we intend to be and how we are going to get there.”
- Is a continuous, iterative process aimed at developing an integrated and coordinated long-term plan of action.
- Requires strong links among mission, goals, objectives, strategy, and implementation.

Two Major Dimensions of Strategic Management:

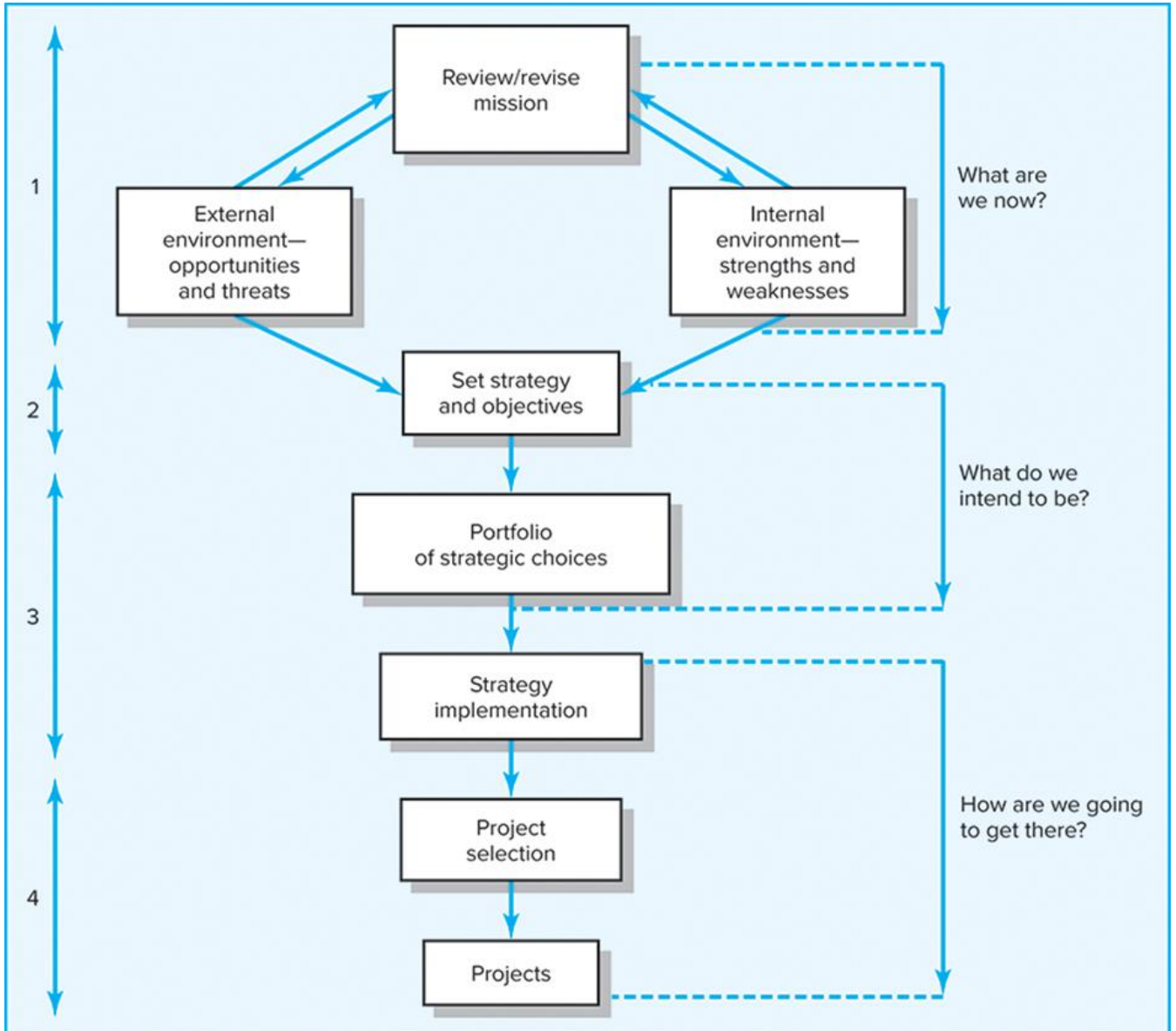
1. Responds to changes in the external environment and allocates the firm’s scarce resources to improve its competitive position.
2. Internal responses to new action programs aimed at enhancing the competitive position of the firm.

Four Activities of the Strategic Management Process

The sequence of activities of the strategic management process is:

1. **Review and define the organizational mission.**
   - The mission identifies “what we want to become.” Mission statements identify the scope of the organization in terms of its product and service.
2. **Analyze and formulate strategies.**
   - Formulating strategy answers the question of what needs to be done to reach objectives. Strategy formulation includes determining and evaluating alternatives that support the organization’s objectives and selecting the best alternative.
3. **Set objectives to achieve strategies.**
   - Objectives translate the organization strategy into specific, concrete, measurable terms. Objectives answer in detail where a firm is headed and when it is going to get there.
4. **Implement strategies through projects.**
   - Implementation addresses the question of how strategies will be realized, given available resources.

Strategic Management Process



Characteristics of Objectives

S M A R T

S	**Specific**	Be specific in targeting an objective
M	**Measurable**	Establish a measurable indicator(s) of progress
A	**Assignable**	Make the objective assignable to one person for completion
R	**Realistic**	State what can realistically be done with available resources
T	**Time related**	State when the objective can be achieved, that is, duration

The Need for a Project Priority System

Implementation of projects without a strong priority system linked to strategy create problems.

Problem 1: Behavioral Biases.

- Two predispositions are optimism bias (overly positive about the outcomes of planned activities) and uniqueness bias (individuals see themselves as more singular than they actually are).

Problem 2: The Implementation Gap.

- The implementation gap is the lack of understanding and consensus of organization strategy among top and middle-level managers.

Problem 3: Organization Politics.

- Project selection may be based not so much on facts and sound reasoning as on the persuasiveness and power of people advocating projects.
- The term *sacred cow* is often used to denote a project that a powerful, high-ranking official is advocating.

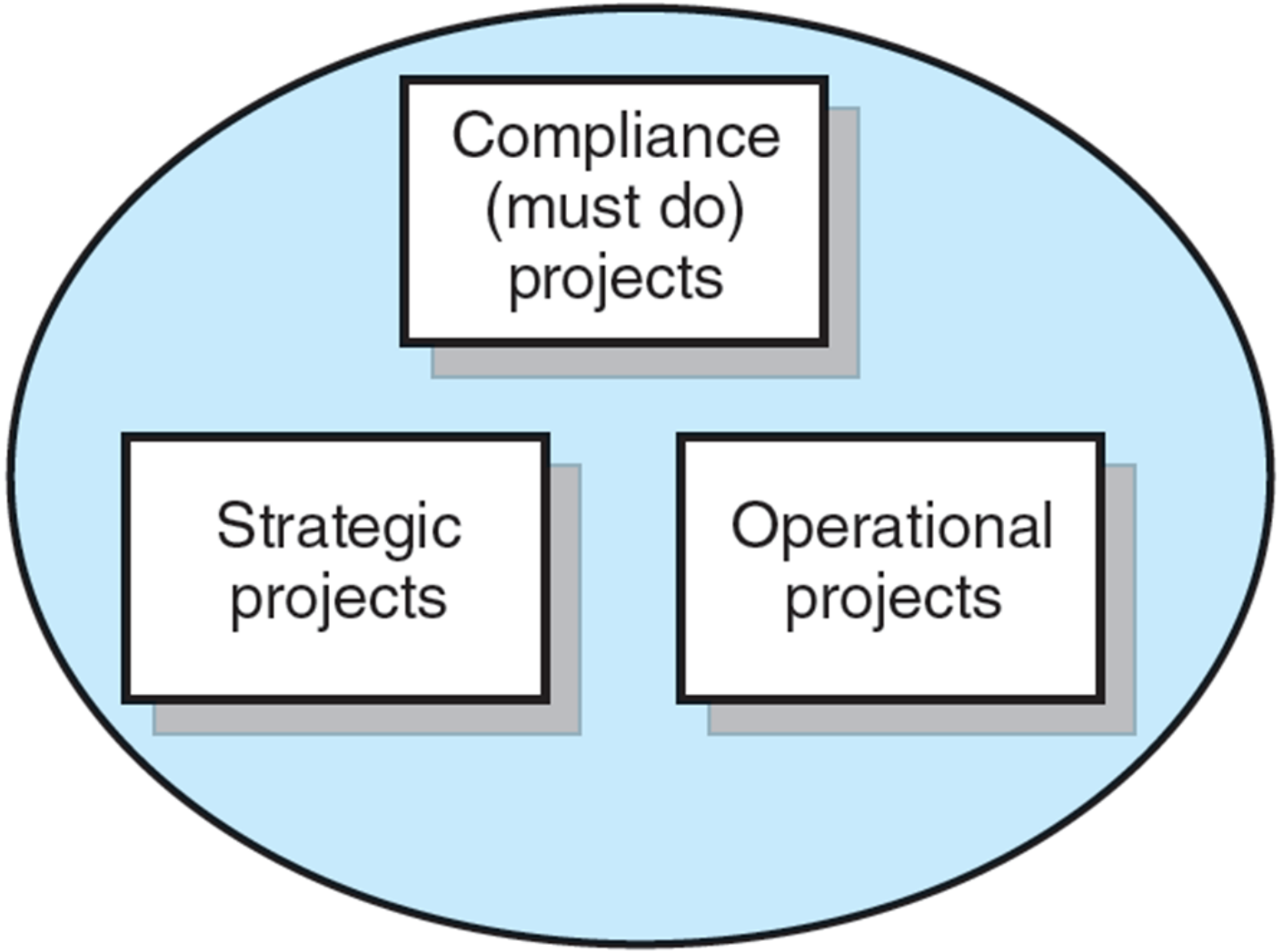
Problem 4: Resource Conflicts and Multitasking.

- A multiproject environment creates the problems of project interdependency and the need to share resources. Resource sharing leads to multitasking—involves starting and stopping work on one task to go and work on another project, then returning to the work on the original task.

Benefits of Project Portfolio Management

- Builds discipline into project selection process.
- Links project selection to strategic metrics.
- Prioritizes project proposals across a common set of criteria, rather than on politics or emotion.
- Allocates resources to projects that align with strategic direction.
- Balances risk across all projects.
- Justifies killing projects that do not support organization strategy.
- Improves communication and supports agreement on project goals.

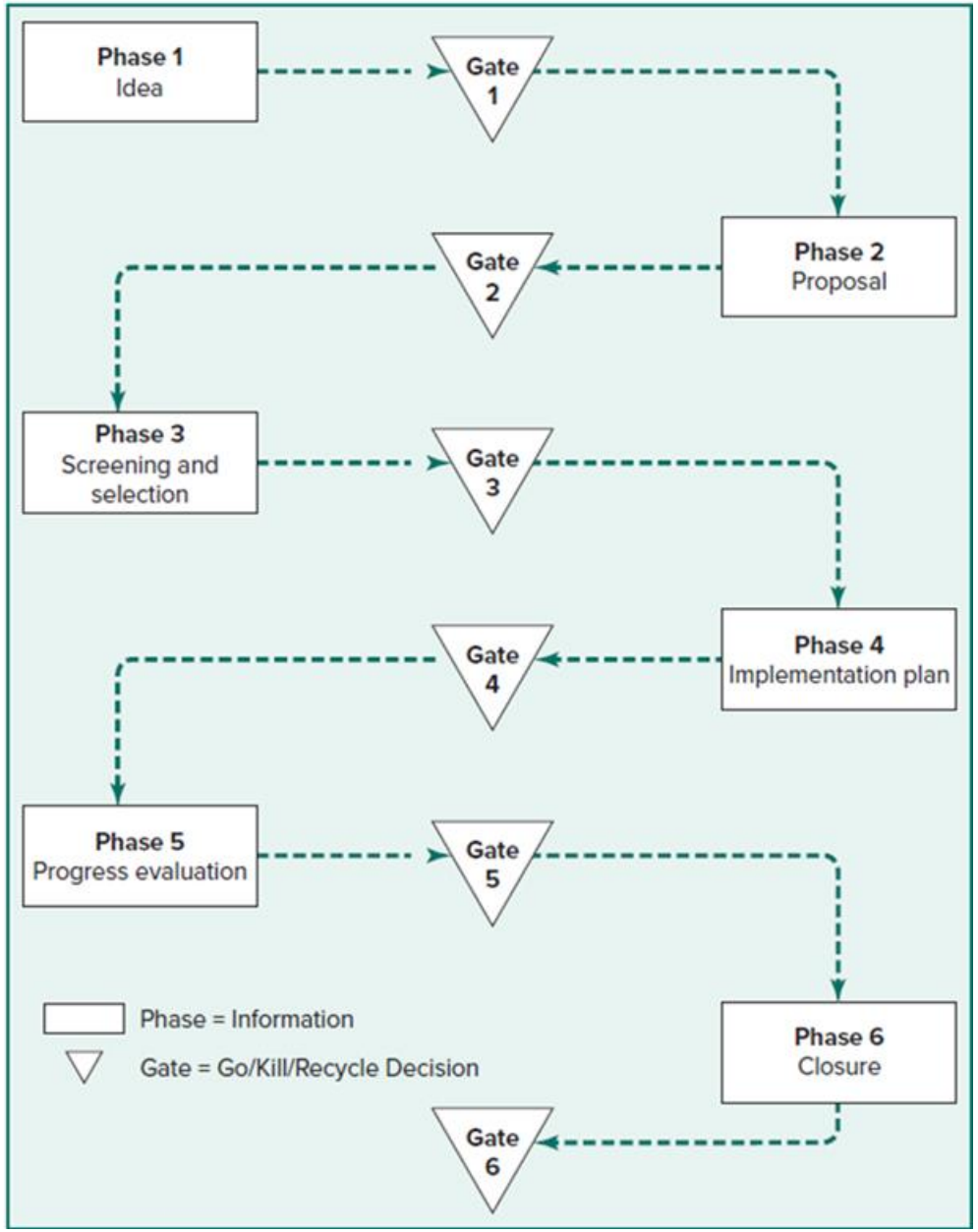
Project Classification



Phase Gate Model

Phase Gate Model:

- Is a series of gates that a project must pass through in order to be completed.
- Its purpose is to ensure that the organization is investing time and resources on worthwhile projects that contribute to its mission and strategy.
- Each gate is associated with a project phase and represents a decision point.
- A gate can lead to three possible outcomes: go (proceed), kill (cancel), or recycle (revise and resubmit).



Selection Criteria

Financial Criteria:

- Payback.
- Net present value (NPV).

Nonfinancial Criteria:

- Projects of strategic importance to the firm.

Two Multi-Criteria Selection Models:

- Checklist Models.
- Multi-Weighted Scoring Models.

Financial Criteria: The Payback Model

The Payback Model:

- Measures the time the project will take to recover the project investment.
- Desires shorter paybacks.
- Is the simplest and most widely used model.
- Emphasizes cash flows, a key factor in business.

Limitations of the Payback Method:

- Ignores the time value of money.
- Assumes cash inflows for the investment period (and not beyond).
- Does not consider profitability.

The Payback Formula Is:

$$\text{Payback period (yrs)} = \frac{\text{Estimated project cost}}{\text{Annual savings}}$$

Example Comparing Two Projects Using Payback Method

	A	B	C	D	E	F	G	H	I	J	K	L	M
1					Exhibit 2.3A								
2													
3				Example Comparing Two Projects Using the Payback Method									
4													
5				Project A		Project B				Formulas			
6													
7													
8		Investment		$700,000		$400,000				Project A: Payback = (D8/D9)			
9		Annual savings		$225,000		$110,000				Project B: Payback = (F8/F9)			
10													
11		Payback period*		3.1 years		3.6 years							
12													
13		Rate of return **		32.1%		27.5%				Project A: Rate of return = (D9/D8)			
14										Project B: Rate of return = (F9/F8)			
15	Project A: Accept. Less than 5 years and exceeds 15% desired rate.												
16													
17	Project B: Accept. Less than 5 years and exceeds 15% desired rate.												
18													
19	* Note: Payback does not use the time value of money.												
20	** Note: Rate of return is reciprocal of Payback.												
21													

Financial Criteria: Net Present Value (NPV)

Net Present Value (NPV):

- Uses management's minimum desired rate of return (discount rate) to compute the present value of all net cash inflows.
- Prefers positive NPV to negative NPV.
- Desires higher positive NPVs.
- Is more realistic because it considers the time value of money, cash flows, and profitability.

The NPV Formula Using Microsoft Excel is,

$$Project\ NPV = I_0 + \sum_{t=1}^{n} \frac{F_t}{(1+k)^t}$$

where

$I_0 =$ Initial investment (since it is an outflow, the number will be negative).

$F_t =$ Net cash inflow for period *t*.

k = Required rate of return.

n = Number of years.

Example Comparing Two Projects Using Net Present Value Method

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2						Exhibit 2.3B							
3													
4						Example Comparing Two Projects Using NPV							
5	Project A		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total		Formulas		
6	Required	15%											
7	Outflows		-$700,000						-$700,000				
8	Inflows			$225,000	$225,000	$225,000	$225,000	$225,000	$1,125,000				
9	Net inflows			$225,000	$225,000	$225,000	$225,000	$225,000	$425,000	Project A:	=C7+NPV(B6,D9:H9)		
10	NPV	$54,235											
11													
12													
13	Project B												
14	Required	15%											
15	Outflows		-$400,000						-$400,000				
16	Inflows			$110,000	$110,000	$110,000	$110,000	$110,000	$550,000				
17	Net inflows			$110,000	$110,000	$110,000	$110,000	$110,000	$150,000	Project B:	=C15+NPV(B14,D17:H17)		
18	NPV	-$31,263											
19													
20													
21													
22	NPV comparison: Accept Project A---NPV is positive.												
23	Reject Project B---NPV is negative.												

Nonfinancial Criteria

Examples of strategic objectives are:

- To capture larger market share.
- To make it difficult for competitors to enter the market.
- To develop an enabler product, which by its introduction will increase sales in more profitable products.
- To develop core technology that will be used in next-generation products.
- To reduce dependency on unreliable suppliers.
- To prevent government intervention and regulation.

Two Multi-Criteria Selection Models

Checklist Models:

- Use a list of questions to review potential projects and to determine their acceptance or rejection.
- Allow greater flexibility in selecting among many different types of projects and are easily used across different divisions and locations.
- Fail to answer the relative importance or value of a potential project to the organization and does not allow for comparison with other potential projects.

Multi-Weighted Scoring Models:

- Use several weighted selection criteria to evaluate project proposals.
- Include qualitative and/or quantitative criteria.
- Allow for comparison with other potential projects.

Checklist Models: Sample Selection Questions Used in Practice

Topic	Question
Strategy/alignment	What specific organization strategy does this project align with?
Driver	What business problem does the project solve?
Sponsorship	Who is the project sponsor?
Risk	What is the impact of not doing this project?
Risk	How risky is the project?
Benefits, value, ROI	What is the value of the project to this organization?
Benefits, value, ROI	When will the project show results?
Objectives	What are the project objectives?
Organization culture	Is our organizational culture right for this type of project?
Resources	Will internal resources be available for this project?
Schedule	How long will this project take?
Finance/portfolio	What is the estimated cost of the project?
Portfolio	How does this project interact with current projects?

Multi-Weighted Scoring Models: Project Screening Matrix

Criteria / Weight	Stay within core competencies	Strategic fit	Urgency	25% of sales from new products	Reduce defects to less than 1%	Improve customer loyalty	ROI of 18% plus	Weighted total
	2.0	3.0	2.0	2.5	1.0	1.0	3.0	
Project 1	1	8	2	6	0	6	5	66
Project 2	3	3	2	0	0	5	1	27
Project 3	9	5	2	0	2	2	5	56
Project 4	3	0	10	0	0	6	0	32
Project 5	1	10	5	10	0	8	9	102
Project 6	6	5	0	2	0	2	7	55
⋮								
Project *n*	5	5	7	0	10	10	8	83

Applying a Selection Model 1

Project Classification:

Deciding whether the project fits with the organization strategy.

Selecting a Model.

- Weighted scoring criteria seem the best alternative because:
  - They reduce the number of wasteful projects using resources.
  - They help to identify project goals that can be communicated using the selection criteria as corroboration.
  - They help project managers understand how their project was selected, how their project contributes to organization goals, and how it compares with other projects.

Applying a Selection Model 2

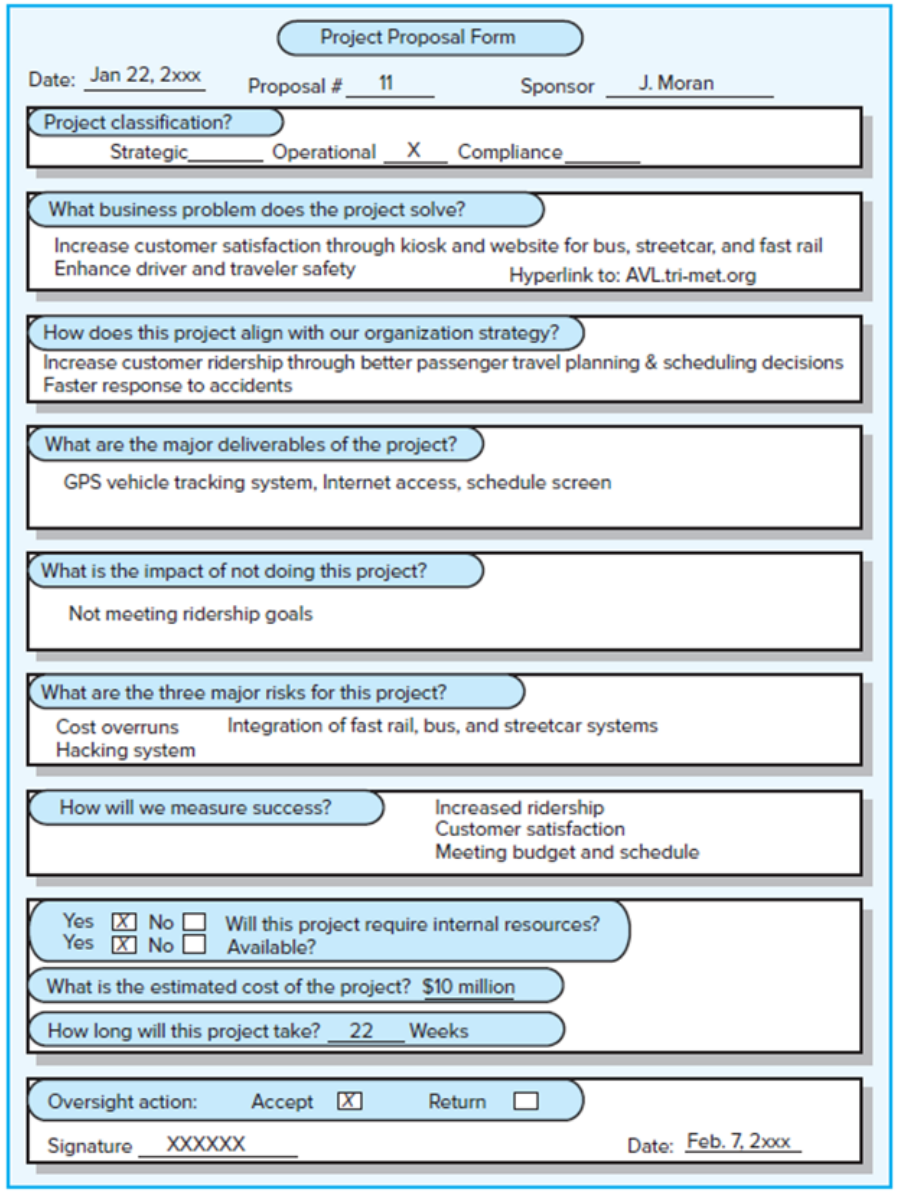
Sources and Solicitation of Project Proposals:

- Within the organization.
- Request for Proposal (RFP) from external sources (contractors/vendors).

Ranking Proposal and Selection of Projects:

- Evaluating each proposal in terms of feasibility, potential contribution to strategic objectives, and fit within a portfolio of current projects.
- Rejecting or accepting the projects based on given selection criteria and current portfolio.
- Prioritizing projects by senior management.

A Proposal Form for an Automatic Vehicular Tracking (AVL) Public Transportation Project



Project Proposal Form

Date: Jan 22, 2xxx Proposal # 11 Sponsor J. Moran

Project classification?

Strategic_____ Operational X Compliance_____

What business problem does the project solve?

Increase customer satisfaction through kiosk and website for bus, streetcar, and fast rail
Enhance driver and traveler safety
Hyperlink to: AVL.tri-met.org

How does this project align with our organization strategy?

Increase customer ridership through better passenger travel planning & scheduling decisions
Faster response to accidents

What are the major deliverables of the project?

GPS vehicle tracking system, Internet access, schedule screen

What is the impact of not doing this project?

Not meeting ridership goals

What are the three major risks for this project?

Cost overruns
Hacking system
Integration of fast rail, bus, and streetcar systems

How will we measure success?

Increased ridership
Customer satisfaction
Meeting budget and schedule

Yes [X] No [ ] Will this project require internal resources?
Yes [X] No [ ] Available?

What is the estimated cost of the project? $10 million

How long will this project take? 22 Weeks

Oversight action: Accept [X] Return [ ]

Signature XXXXXX Date: Feb. 7, 2xxx

Risk Analysis for a 500-Acre Wind Farm

Brief Risk Assessment

Purpose: To draw attention to apparent project risks that will need management attention.

What are the four major risks of this project?
1. *Government incentives curtailed*
2. *Land use injunction*
3. *Energy price decrease*
4. *New import tax*

Rank risks above by "probability" and "impact" on the chart below by High, Medium or Low.

Risk Intensity Rating

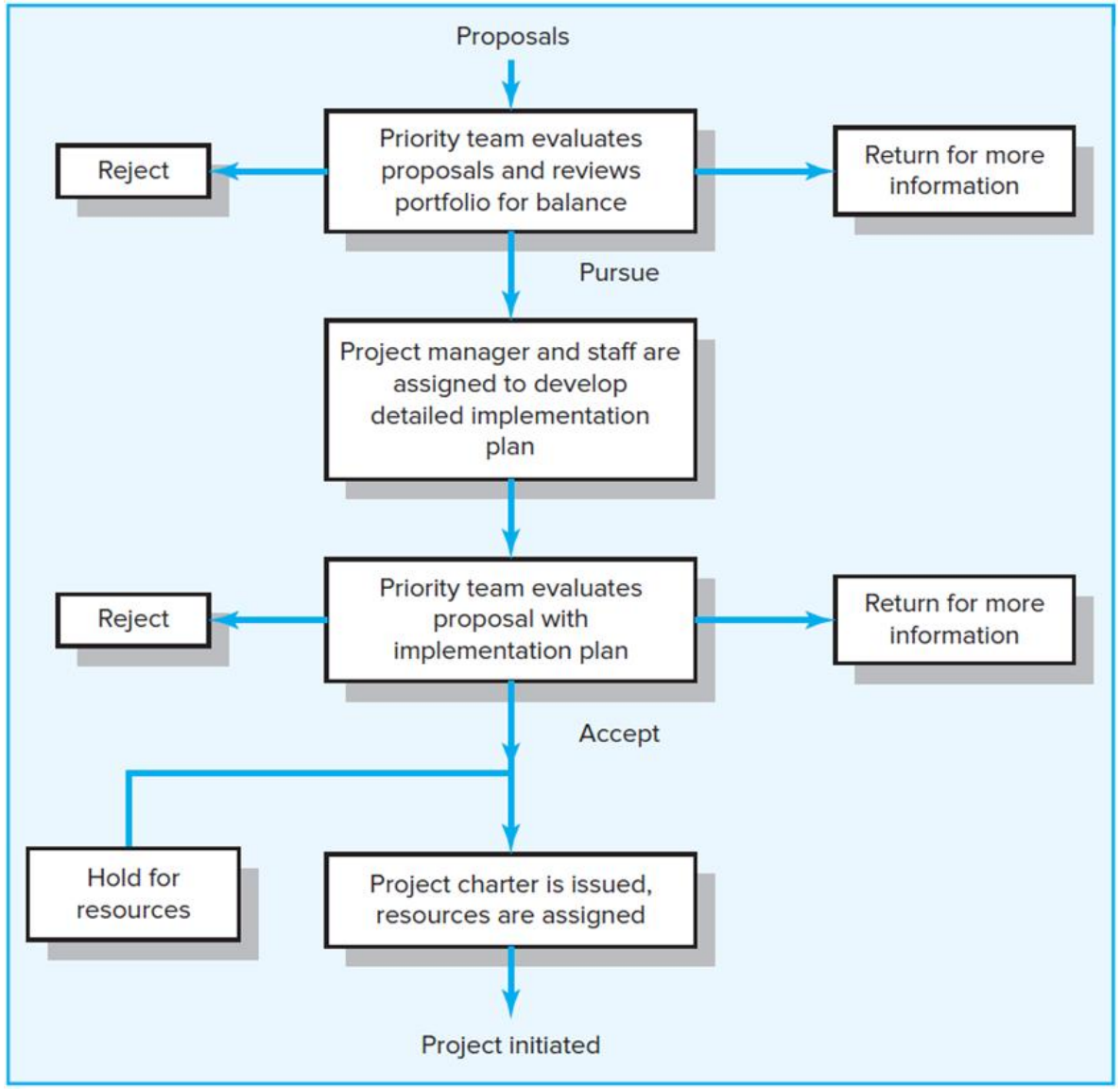
Risk	Probability	Impact
1. *Government incentives curtailed*	*High*	*High*
2. *Land use injunction*	*Medium*	*High*
3. *Energy price decrease*	*Medium*	*Medium*
4. *New import tax*	*Low*	*High*

Check other project risk factors:

Complexity	Low ☐		Average ☒		High ☐
Resource skills	Good ☒		Okay ☐		Lacking ☐
Technology	Low ☐		Average ☒		High ☐

Reviewed by *Rachel* **Date** *April 1, 2xxx*

Project Screening Process



Priority Screening Analysis

			Project number			
Must objectives		**Must meet if impacts**	**...26**	**27**	**28**	**29**
All activities meet current legal, safety, and environmental standards		Yes-Meets objective No-Does not meet obj N/A-No impact	**N/A**			
All new products will have a complete market analysis		Yes-Meets objective No-Does not meet obj N/A-No impact	**Yes**			
Want objectives	**Relative Importance 1-100**	**Single project impact definitions**	**Weighted score**	**Weighted score**	**Weighted score**	**Weighted score**
Provides immediate response to field problems	**99**	0 = Does not address 1 = Opportunity to fix 2 = Urgent problem	**99**			
Create $5 million in new sales by 20xx	**88**	0 < $100,000 1 = $100,000–500,000 2 > $500,000	**0**			
Improve external customer service	**83**	0 = Minor impact 1 = Significant impact 2 = Major impact	**166**			
Total weighted score						
Priority						

Managing the Portfolio System

Senior Management Input:

- Provides guidance in establishing selection criteria that strongly align with the current organization strategies.
- Annually decides how to balance the available organizational resources (people and capital) among the different types of projects.

Governance Team Responsibilities:

- Publish the priority of every project.
- Ensure the selection process is open and free of power politics.
- Evaluate the progress of current projects.
- Constantly scan the external environment to determine if organization focus and/or selection criteria need to be changed.

Balancing the Portfolio for Risks and Types of Projects

David and Jim Matheson studied R&D organizations and developed a classification scheme that could be used for assessing a project portfolio. They separated projects in terms of degrees of difficulty and commercial value. The four basic types of projects are:

- **Bread-and-butter** projects involve evolutionary improvements to current products and services.
- **Pearls** represent revolutionary commercial advances using proven technology.
- **Oysters** involve technological breakthroughs with tremendous commercial potential.
- **White elephants** showed promise at one time but are no longer viable.

Any Questions!