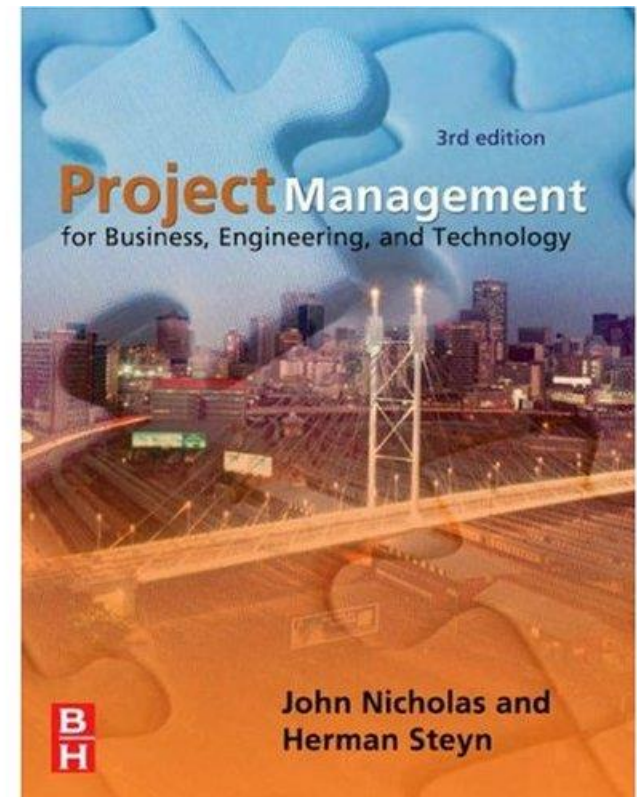# Chapter 3
Systems Development Cycle and Project Conception

Project Management for Business, Engineering, and Technology

Prepared by

John Nicholas, Ph.D.

Loyola University Chicago

3rd edition

Project Management
for Business, Engineering, and Technology

John Nicholas and Herman Steyn

Systems Development Cycle

- ## Systems Life Cycle
  - It's useful to think of a project end-item as a system that moves through phases of a "life cycle"

Life Cycle Stages: Natural Organisms

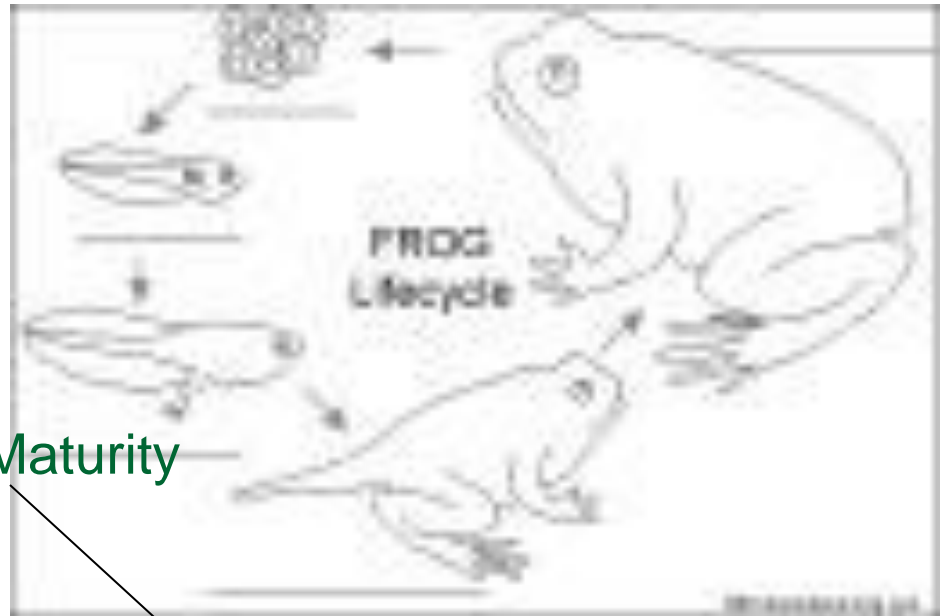- All living organisms follow life-cycle stages
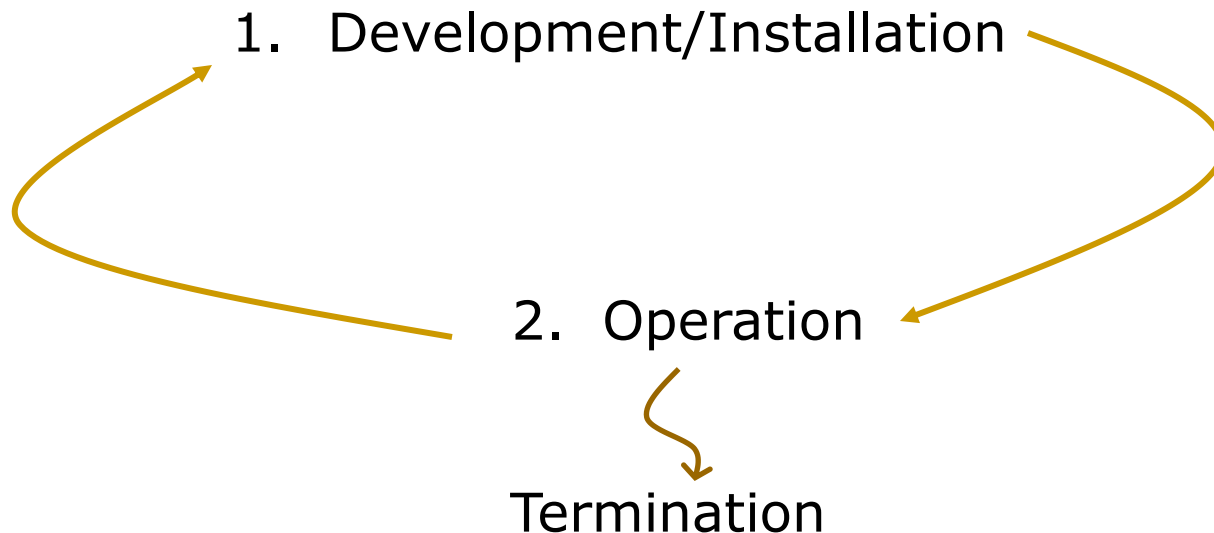
Conception

Birth

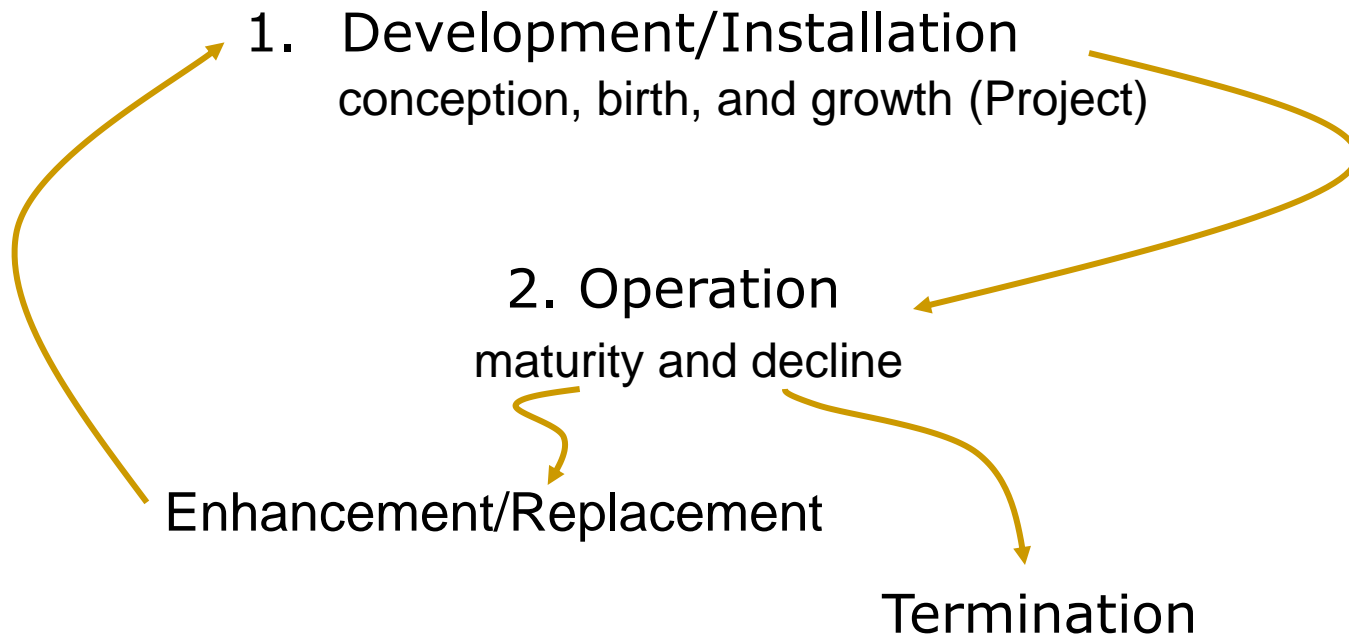Growth

Maturity

Decline

Death

FROG Lifecycle

Life Cycle Stages: Human-Made Systems

All human-made systems follow this cycle

1. Development/Installation

2. Operation

Termination

Life Cycle Stages: System Life Cycle

1. **Development/Installation**
   conception, birth, and growth (Project)

2. **Operation**
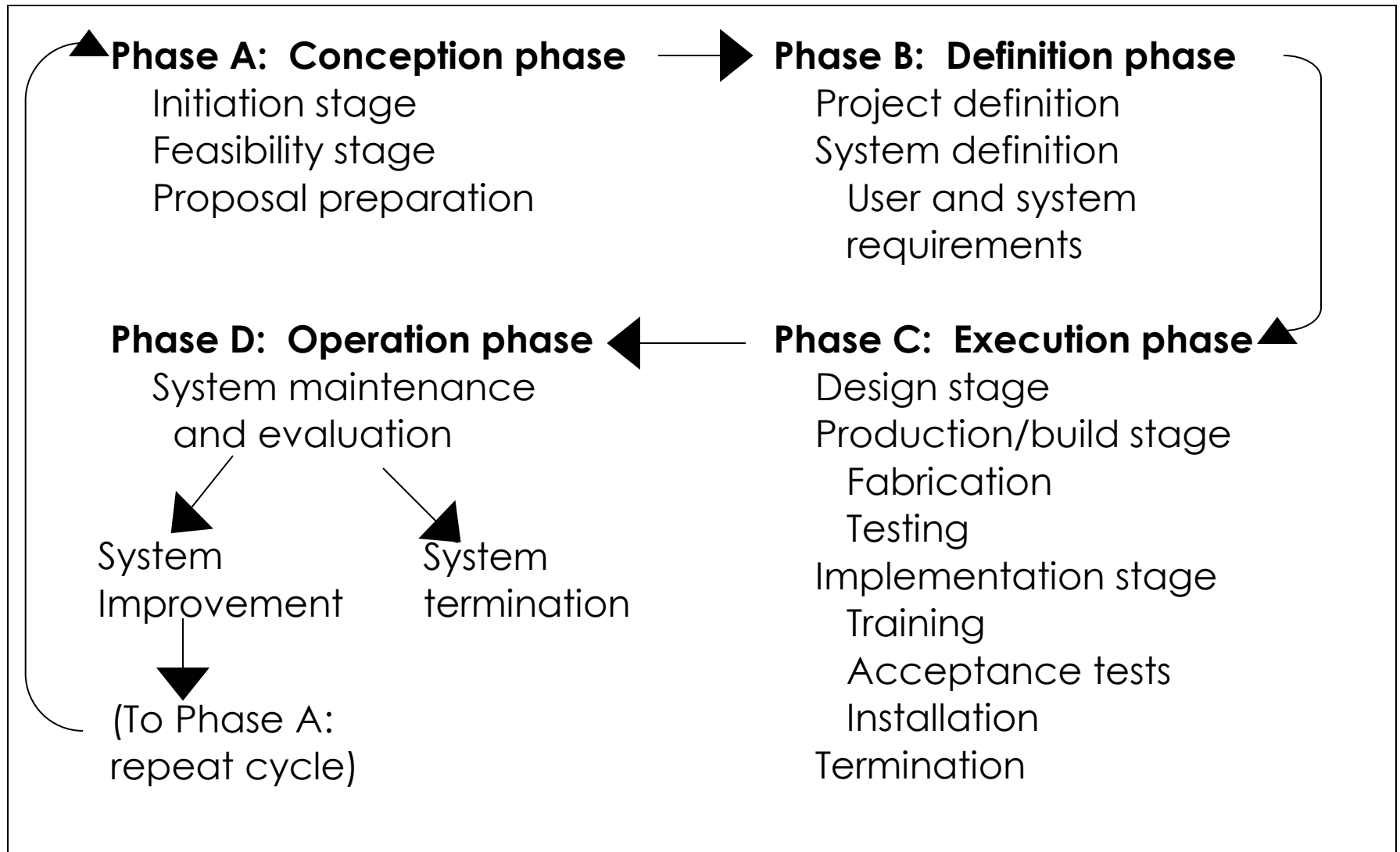   maturity and decline

Enhancement/Replacement

Termination

- For a human-made system termination is not inevitable.
- System is kept "alive" through enhancement/ replacement.
- This, *every* human-made system *begin* as a project and often ends with the start of a new project.

Systems Development Cycle

- Expanded version of the system life cycle:
  The Systems Development Cycle (SDC)

Systems Development Cycle

Phase A: Conception phase → **Phase B: Definition phase**

    Initiation stage   Project definition
    Feasibility stage   System definition
    Proposal preparation   User and system
                                        requirements

Phase D: Operation phase ← **Phase C: Execution phase**

    System maintenance   Design stage
    and evaluation   Production/build stage
                                   Fabrication
                                   Testing

System   System   Implementation stage
Improvement   termination   Training
                                   Acceptance tests
                                   Installation
(To Phase A: Termination
repeat cycle)

Key Actors (Stakeholders) in SDC

- Customer/Client
    - Party for whom project is being done
    - Pays for project
    - Has needs and requirements to be met
- User
    - Party that operates or is beneficiary of project end-item
    - Might be same as customer, might not
    - If different, important to differentiate user from customer
- System Development Organization (SDO)
    - Party that performs work for customer
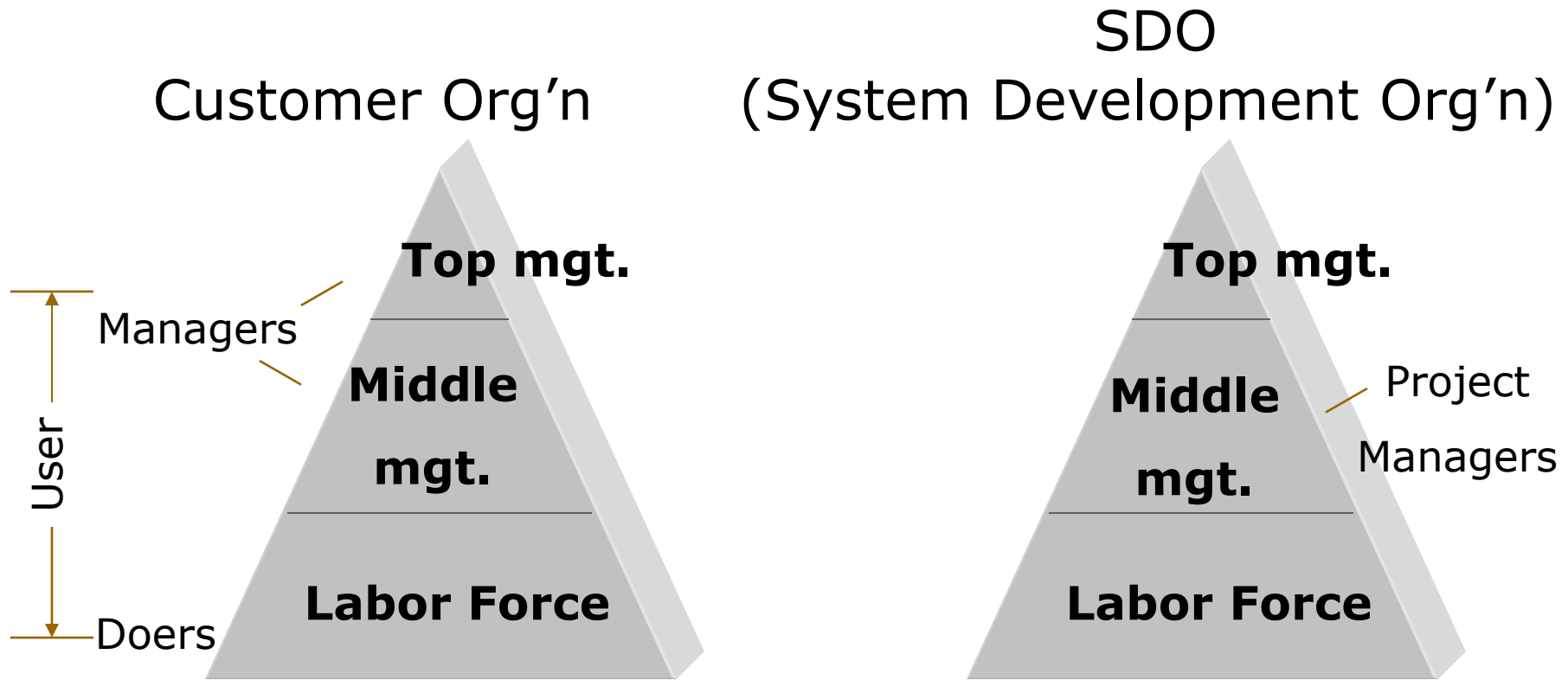   - aka developer, contractor, consultant

Key Actors in SDC (cont'd)

- For most projects, customer and developer are separate organizations or separate units within same organization.

- Sometimes they are same, but we will treat them as separate
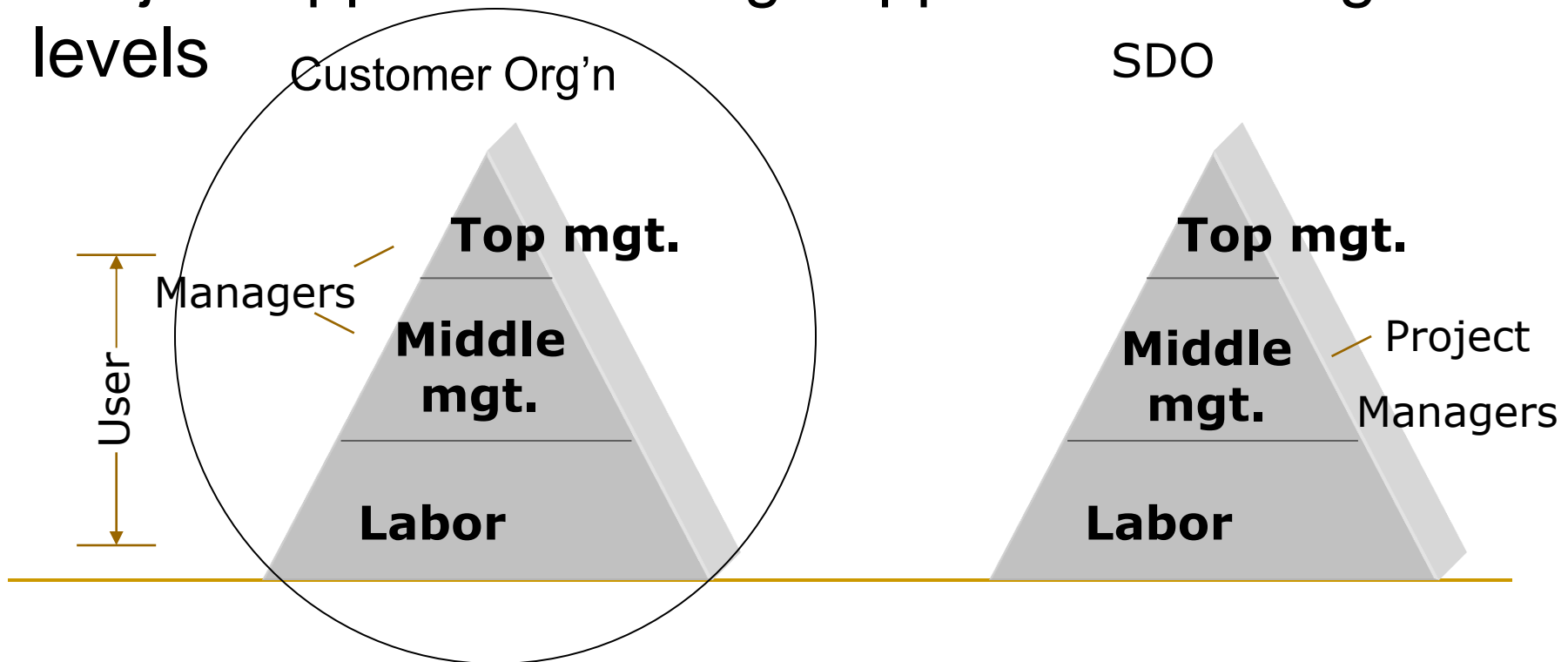
Key Actors in SDC (cont'd)

- Customer and contractor/developer each are organizations:

Customer Org'n

SDO
(System Development Org'n)

Managers
User
Doers

Top mgt.

Middle mgt.

Labor Force

Top mgt.

Middle mgt.

Labor Force

Project

Managers

Key Actors in SDC (cont'd)

In customer organization

- "User" (party with need or problem) can be at any level

- Project approval/funding happens at management levels

Customer Org'n

SDO

Managers

User

Top mgt.

Middle mgt.

Labor

Top mgt.

Middle mgt.

Project

Managers

Labor

Key Actors in SDC (cont'd)

In SDO organization

- Project approval happens at top
- Project work performed by "labor"
- Project managed by PM in middle level
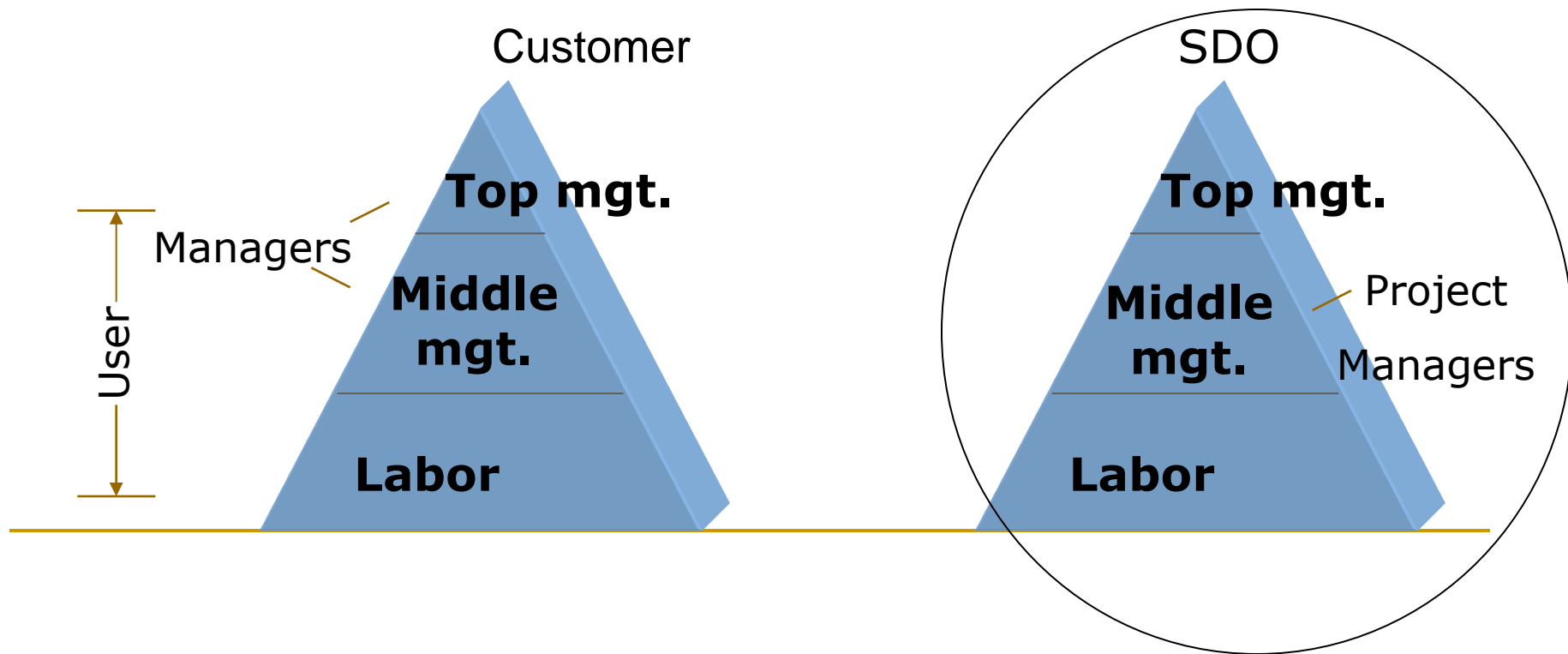
Systems Development Cycle: Phases

Phase A: Conception

- Perceived need or problem
- Initial screening or feasibility study
- Proposal
- Concept approval/rejection

SDC Phases (cont'd)

Phase B: Definition ("Birth")

- Specify requirements in detail:
  - User requirements
  - System requirements/
    system specifications
- Define project to produce end-item/deliver requirements:
  - Project master plan

SDC Phases (cont'd)

Phase C: Execution ("Growth")

- ❑ Design/development
- ❑ Procurement/fabrication
- ❑ Production/building
- ❑ Installation

SDC Phases (cont'd)

Phase D: Operation ("Maturity")

❑ Customer gains control

❑ System developer might remain involved with system/customer through:

- Maintenance
- Evaluation
- Enhancement
- Replacement

Phases A, B, C are "Project Life Cycle"

Phase A: Conception phase → **Phase B: Definition phase**

Phase A:
- Initiation stage
- Feasibility stage
- Proposal preparation

Phase B:
- Project definition
- System definition
  - User and system requirements

Phase C: Execution phase
- Design stage
- Production/build stage
  - Fabrication
  - Testing
- Implementation stage
  - Training
  - Acceptance tests
  - Installation
- Termination

Phase D: Operation phase
- System maintenance and evaluation
  - System Improvement
  - System termination

(To Phase A: repeat cycle)

Project Life Span, Variations

- **Phased Project/Program Planning**
  - In very large projects, phases A, B, and C are treated somewhat *independently*, almost like separate projects
  - Each phase requires justification and approval. Project can be cancelled in each phase. Different contractors can be involved in each phase. Examples: phase/gate methodology and DOD development/production contracting

Project Life Span, Variations (cont'd)

- ## Fast-tracking

  - Phases (and stages within phases) ***overlap*** so work in successive phases (stages) happens simultaneously.

  Phase A
  _____
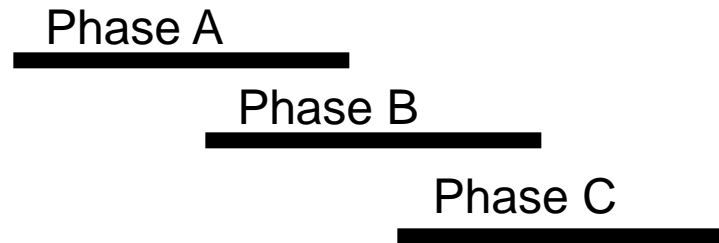
  Phase B
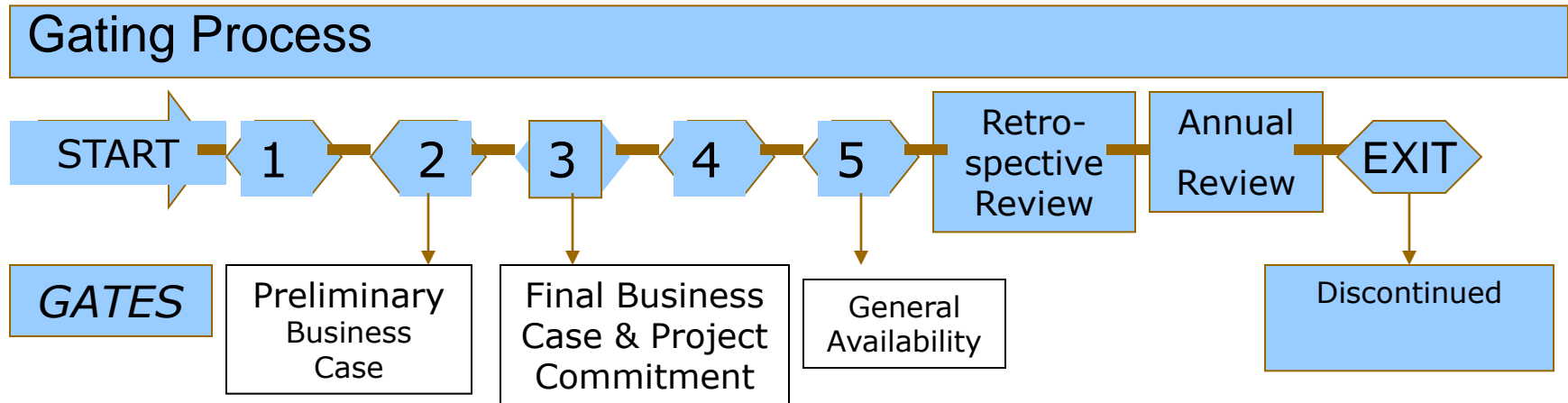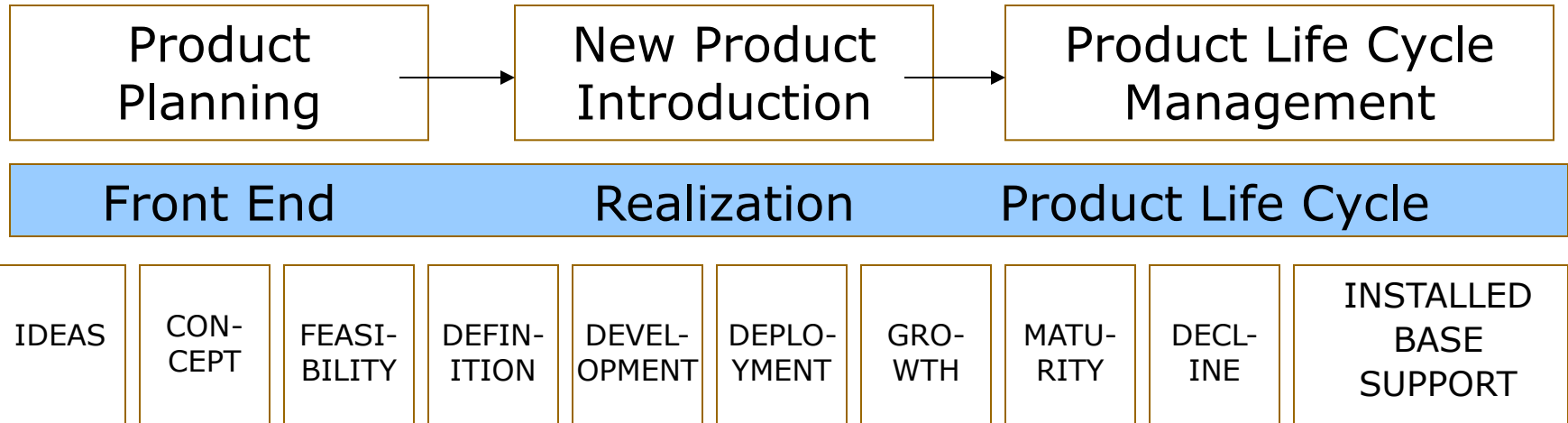 _____

  Phase C
  _____

  - Pro: shorten project life span
  - Con: Increase risk of mistakes/ rework

Project Methodology

- Companies follow own versions of project life span.
  - Create their own "project methodology".
- Example….

Project Methodology

Product Planning	→	New Product Introduction	→	Product Life Cycle Management

Front End	Realization	Product Life Cycle

IDEAS	CON-CEPT	FEASI-BILITY	DEFIN-ITION	DEVEL-OPMENT	DEPLO-YMENT	GRO-WTH	MATU-RITY	DECL-INE	INSTALLED BASE SUPPORT

Gating Process

START 1 2 3 4 5 Retro-spective Review Annual Review EXIT

GATES	Preliminary Business Case	Final Business Case & Project Commitment	General Availability		Discontinued

Phase A: Conception

- Project Conception involves:
  - Initiation
  - RFPs
  - Feasibility
  - Needs Analysis
  - Proposal preparation
  - Proposal evaluation/project selection
  - Contracting

Initiation

- Every project starts in somebody's mind as a need or problem, or as a solution to somebody else's need or problem.
- An "idea" develops based on perceived problem, opportunity, or need
- Idea can originate anywhere in customer or contractor organizations

Initiation (cont'd)

- To determine if idea has merit instigate an initial (usually brief) investigation
  - Data sources
    - Interviews
    - Background research
    - Documentation

Usually customer does this

Initiation (cont'd)

- Focus of initial investigation:
  - Symptoms, problems, needs
  - Objectives
  - Preliminary alternatives; estimated costs, benefits, strengths, weaknesses
 - People and groups effected

Initiation (cont'd)

- Customer's decision-to-proceed criteria:
  - The needs are real and funding is available
  - Project is consistent with goals and resources of organization
  - Project has priority with respect to other needs
  - Project has value in terms of new technology, organizational reputation, market share, profits, etc.

RFP (Request for Proposal)

- If customer decides to proceed with idea, next step is to contact an SDO (developer or contractor) to
  - investigate idea further, or
  - do the work and deliver the solution/end-item

RFP (Request for Proposal)

- Contact between customer and SDO initiated with the RFP
  - Also called RFB, RFQ, or RFT (*bid*, *quote*, or *tender*)

Customer

Top
mgt

SDO

RFP
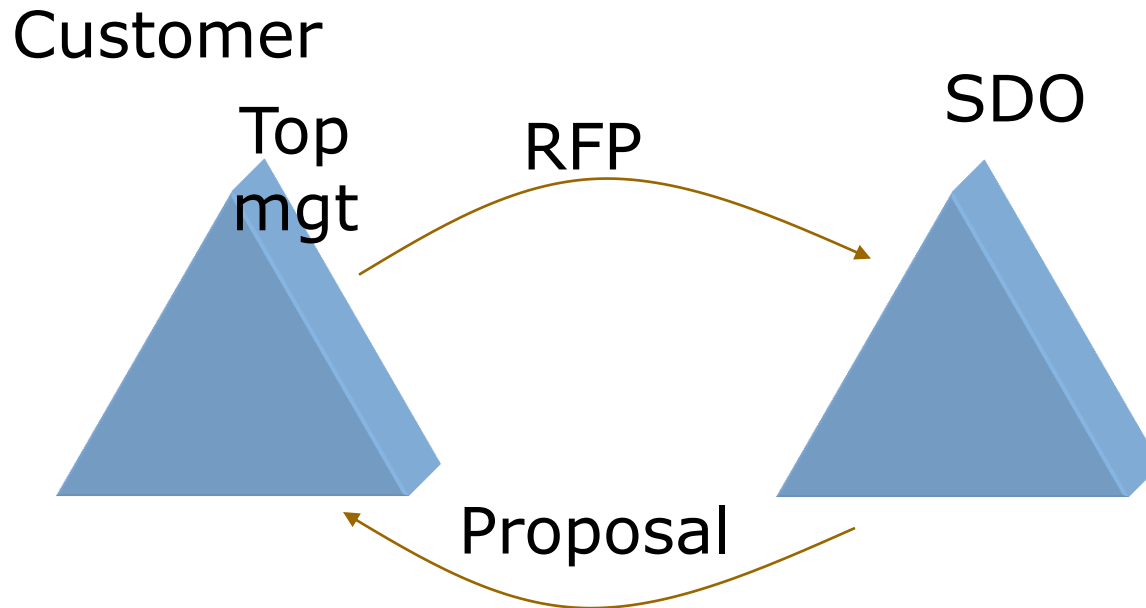
Proposal

RFP

- Purposes
  - Describe customer's needs, problems, or idea
  - Solicit suggestions/solutions from SDO
  - Inform SDO *how* to respond to RFP (where to send proposal, to whom, and what to include in proposal)

RFP

- Can be informal (e.g., email, phone call), or formal (written document)
- Formal is better

RFP

- Contents
    1. Statement of Work (SOW)
    2. Proposal requirements
    3. Contractual provisions
    4. Additional Information or Data

RFP Contents

1. Statement of Work (SOW)

- Description/background of problem, need, or general type solutions to be investigated
- *Scope* of work to be performed
  - work/deliverables to be *included*
  - work/deliverables to be *excluded*
  - work restrictions
  - criteria of acceptance for deliverables, results or end-items
- *Requirements* for results or end-item; e.g.,
  - specifications and standards
  - how results and work will be measured
  - expected relationship between user and contractor
  - expected completion date
  - constraints on cost of work to be performed

RFP Contents

2. Proposal Requirements

- Conditions placed on proposal
  - proposal contents and format
  - data requirements
  - sample forms to include
  - submission location and deadline
- All proposals should "look" same

RFP Contents

3. Contractual Provisions

- Type of contract to be awarded and contractual provisions
  - Fixed-price
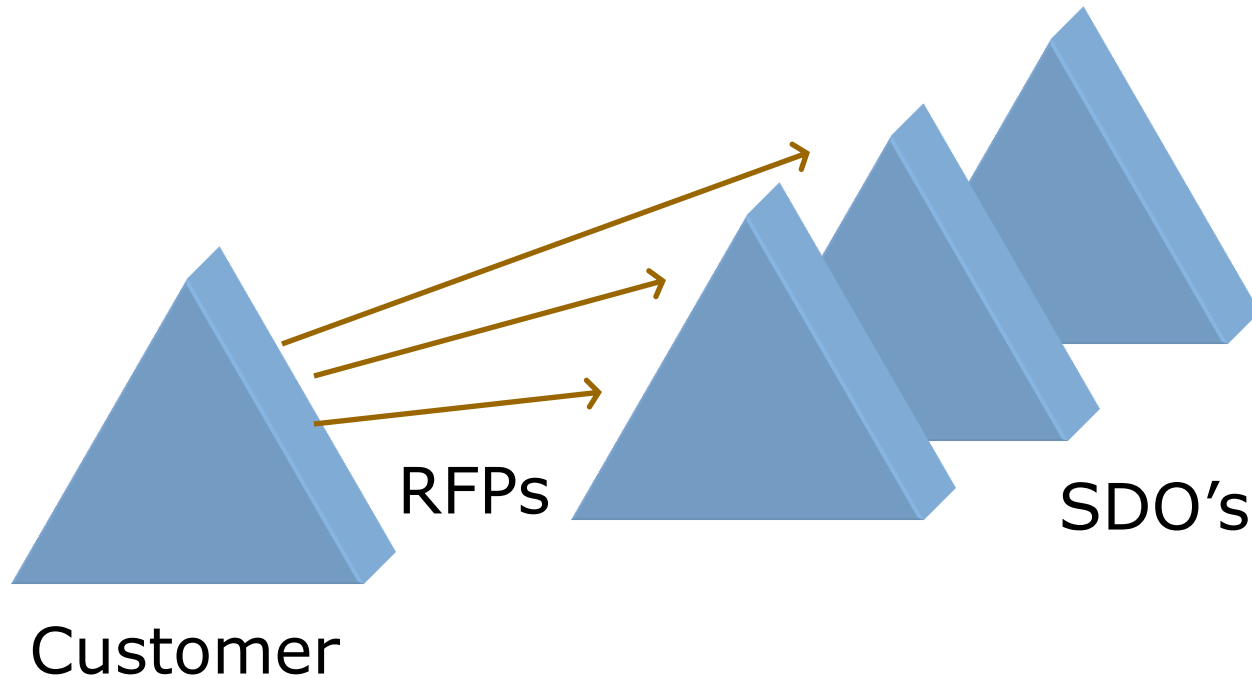 - Cost-plus
  - Incentives
  - Special considerations

RFP Contents

4. Additional Information or Data

- Name of contact person for requesting additional data—as necessary to enable SDO develop solution and prepare proposal or price quote
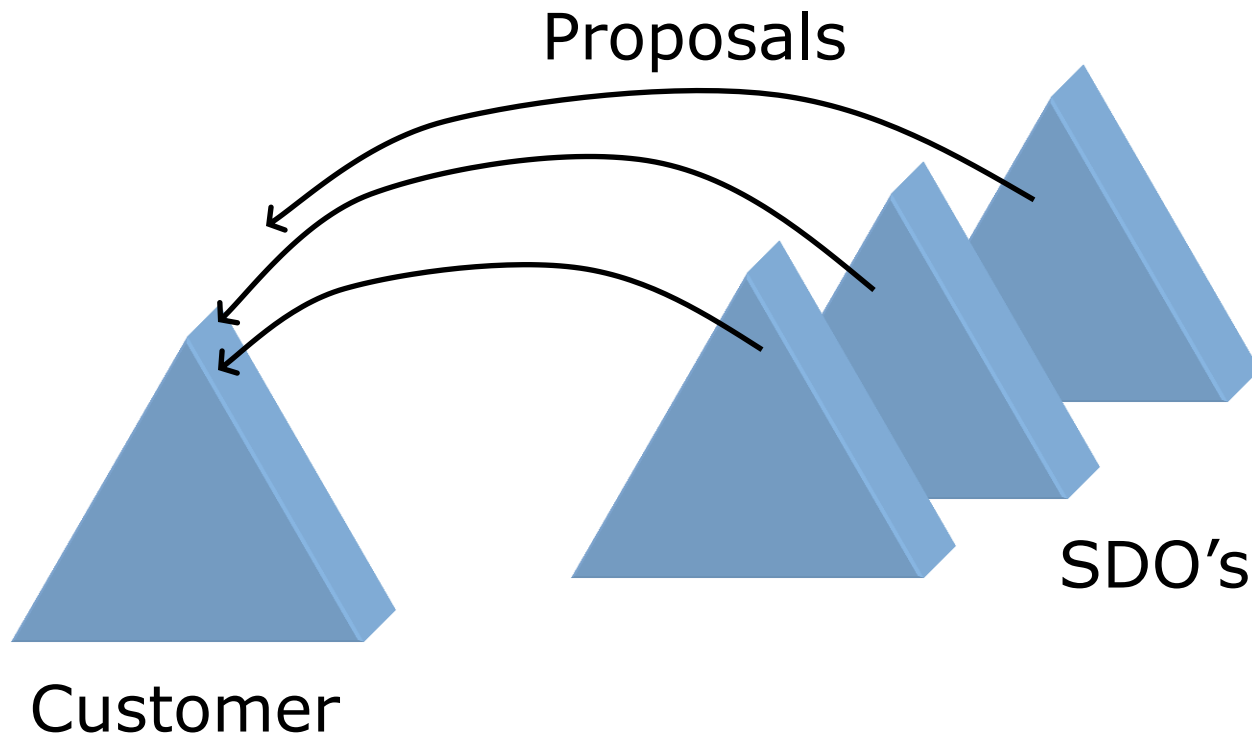- Technical information to support the SOW

RFP

- Send RFP's to multiple SDOs in hope of receiving multiple proposals

Customer

RFPs

SDO's

RFP

- Send RFP's to multiple SDOs in hope of receiving multiple proposals

Proposals

SDO's

Customer

Why is this process important?

- Clarification of user requirements
- Selection of best contractor
- Sets tone for project: systematic, organized, well-defined

Q: Where to send RFPs?

Where to send RFP?

- **Customer sends RFP's to**
  - SDO's on bidder's list
  - SDO's recommended by other customers
  - SDO's requesting an RFP (as advertised in Commerce Business Daily or trade newsletters)
  - Qualified SDO's based upon RFI's (requests for information)

Example RFP

Requirements for "Machine":

- Will be tested in front of Army officers
- Must be able to carry for one hour a passenger besides pilot, the two of them weighing not less than 350 lbs.
- Must show average speed of 40 miles per hour in ten-mile test
- Must carry enough fuel for 125 miles
- Must have "demountability" (built in such a way it can be taken apart and later reassembled without too much difficulty, so it can be transported on an army truck)
- Must submit with bid 10 percent of price of machine as sign of good faith!

Example RFP (cont'd)

- What is this a request for?
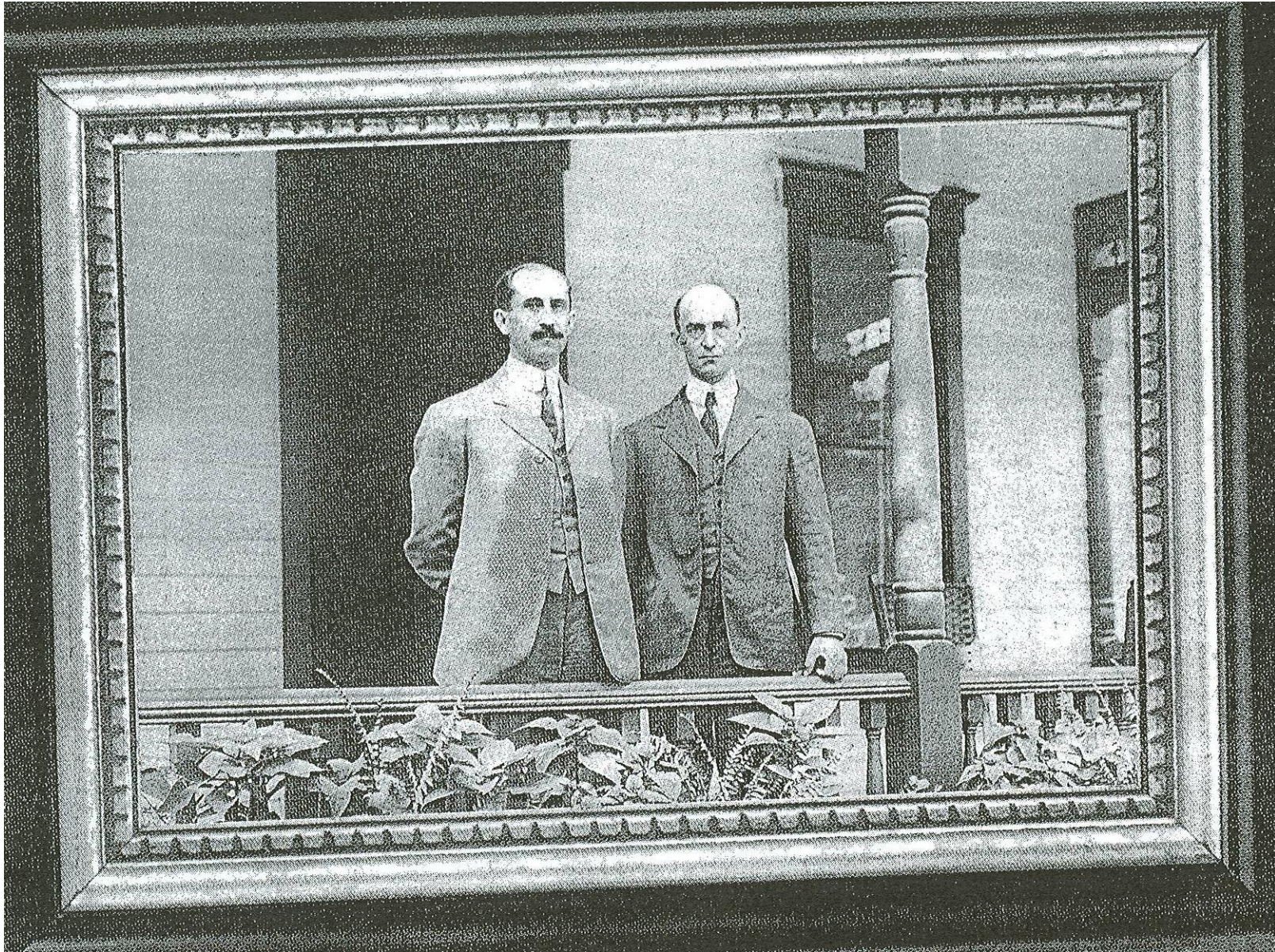- What is the "Machine"?
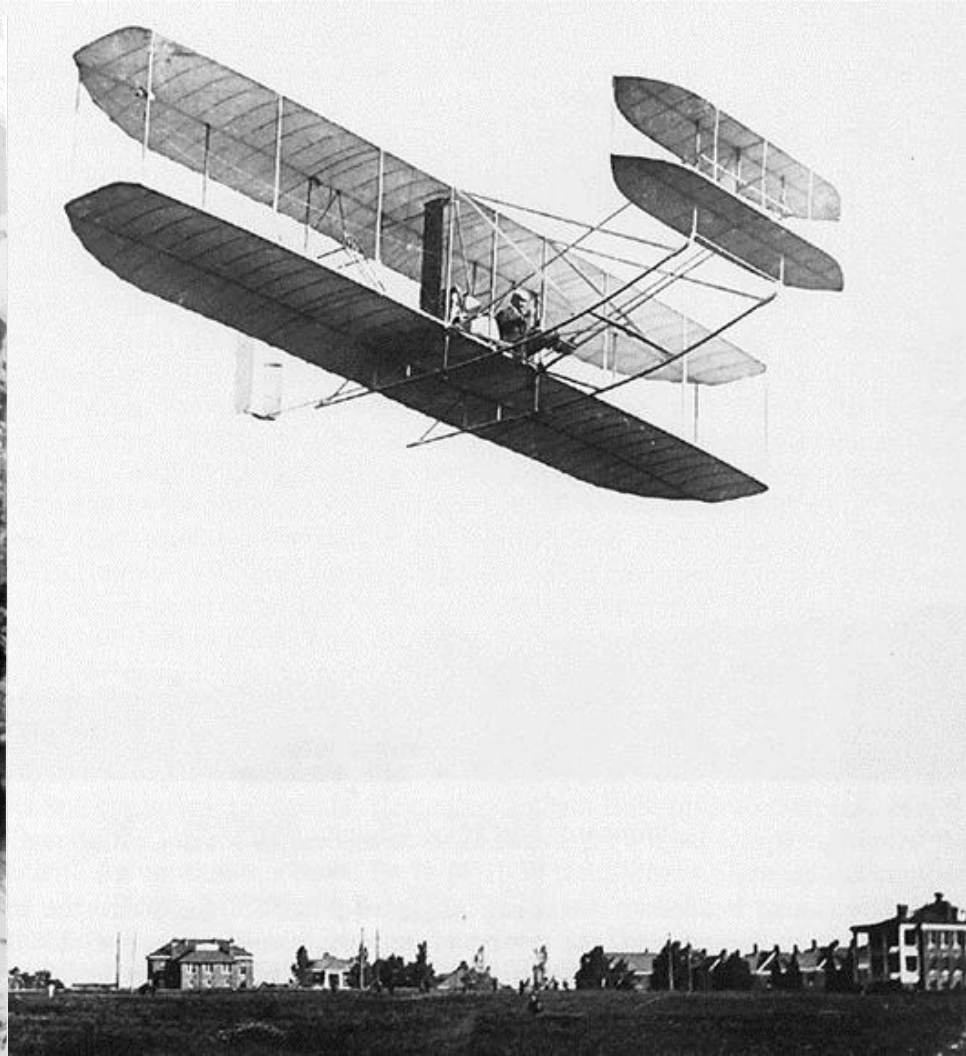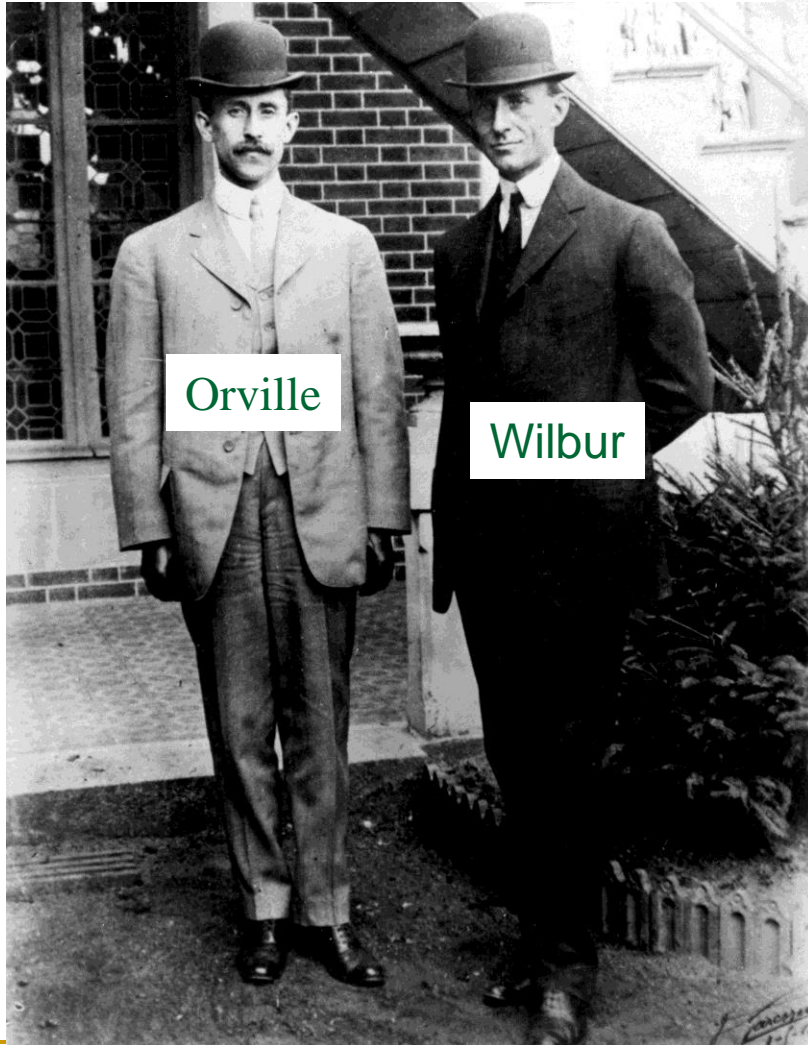
Example RFP (cont'd)

Answer:

- This is a Request for Bid from U.S. Army for "Flying Machine," Nov. 1907

- Responses received: Forty-one!
  - Only three included required 10 percent deposit; two of these drop out
  - **Only one bidder is actually capable of meeting the requirements…**

The Wright Brothers

The Wright Brothers

Orville

Wilbur

Feasibility Study

- Most projects are preceded by detailed study/analysis to compare costs with benefits/outcomes

- Study considers "feasibility" of idea or proposed work given proposed benefits constrained resources

- Feasibility study might be done by customer during initial investigation…

Feasibility Study (cont'd)

- Alternatively, might be done by SDO

- Regardless, somewhere in the Conception Phase a feasibility study is performed to justify the "idea" or proposed solution

Feasibility Study (cont'd)

- **Steps in Feasibility Study**
  1. Gain full understanding of user's problem, need, and current situation
     - Perform **needs analysis** to fullest extent possible

Feasibility Study

- Articulating User Needs
  - Ask user to define the need clearly
  - Ask user a complete set of questions about need
  - Do necessary research to understand the need better
  - Reformulate need as best you can
  - Ask user to respond to reformulation, and revise accordingly
  - Resulting "actual needs" are often different than original "stated needs"

Feasibility Study

- Example
  - Stated need:

    "We need a ledger system."

    BUT…A ledger system can be purchased at OfficeMax for $99! Will that system enable your organization (say, 18,000 employees with offices in 23 states and 9 countries) to close its books in three-days?

    Most likely not.

Feasibility Study

- Actual need:

    "We need a system that will enable our
       organization to close the books in three days."

Feasibility Study

- Pitfalls in Defining and Addressing Needs
  - Some needs are ever-changing
  - Some needs are only vaguely perceived
  - Solutions are identified prematurely
  - Needs identified are for wrong users
  - Multiple users exist, each with differing needs
  - User's needs are distorted by "expert"
    - Gold-plating of needs
    - Filtering of needs
    - Father-knows-best approach

Steps Feasibility Study

1. Gain full understanding of user's problem, need, and current situation
2. Document current system
   - Use schematic diagrams showing inputs, outputs, elements, attributes, flows, etc.
   - Summarize all information collected (or note where it can be found)
3. Devise alternative solutions
4. Analyze the alternatives
   - Use models to assess alternatives' ability to meet objectives as specified by user criteria
5. Include solution in proposal, technical section
6. In some cases, feasibility involves analysis of environmental impacts (next slide)

Environmental Impact

Typical contents of an EI Statement include

- Summary of proposed development and/or management plans.
- Alternative sites and technologies to the proposed project
- Description of project's existing site and surrounding area
- Potential project impacts, such as on
  - Quality of air, soil, watersheds, wetlands, flood plains
  - Fisheries; sensitive plants; sensitive, endangered, or threatened species
  - Scenic resources; societal and aesthetic experiences
  - Heritage resources (sites, structures, buildings, districts, objects)
  - Historical resources (logging, ranching, grazing, mining, recreation)
- Adverse impacts that cannot be avoided
- Long term impacts on resources.
- Ways to prevent, minimize or offset impacts; ways to monitor actual impacts

Project Charter

For *internal* projects, the charter describes the project to stakeholders.

- Sometimes it is used to generate interest in a proposed project.
- Often it is used to announce authorization of an approved project. in the organization and establish the project manager's authority to gather and make use resources.
- It provide a good overview of the project and may include
  - the project objectives and scope
  - stakeholders and their stakes,
  - estimated budget and schedule
  - risks
  - assumptions and constraints
  - resources
  - key roles and the people them.
- Sometimes it is used as the project plan; more commonly it is somewhat brief

SDO Decision to Respond to RFP

- **SDO considers whether**
  - Competition has head start
  - SDO has funds, facilities, etc., to devote to project
  - Value of project in terms of work reputation, profitability, etc., is worth it
  - Contract can be won
  - Project is doable for SDO

Proposal?

RFP

Customer

SDO
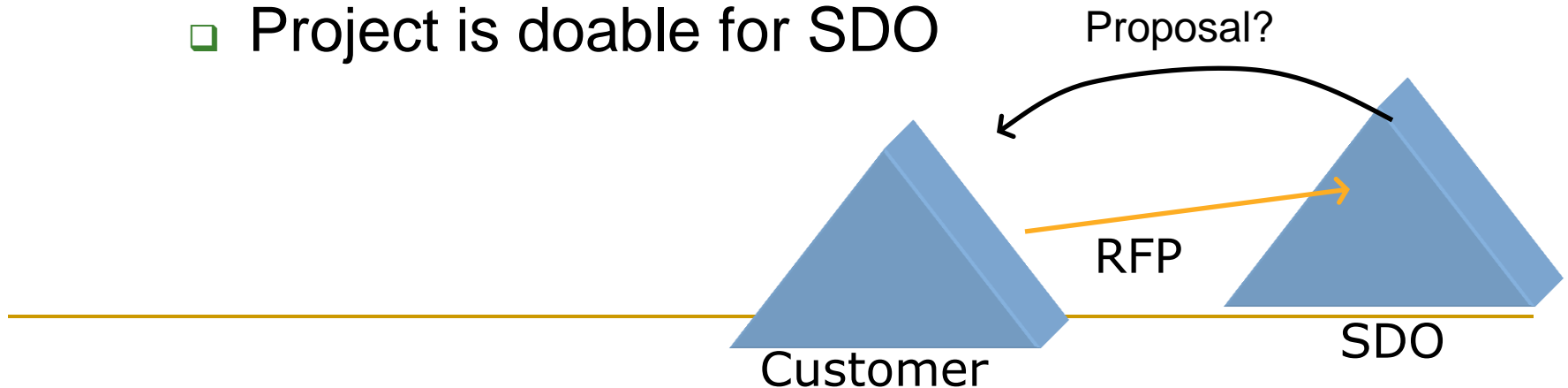
SDO Decision to Respond (cont'd)

- Issues
  - Contractor sends proposal with no hope of winning contract
  - Customer sends RFP with no intent of awarding contract
  - Unsolicited proposal (no RFP)

Proposals

- The proposal is one of most important documents in project life span.
- Purposes:
    1. Sales
        - SDO describes to customer what it will do
        - Proposal must "sell" customer
        - Getting contract depends on proposal
    2. Contract
        - Customer assumes SDO will be able to deliver on what is said in proposal
        - If both customer and SDO sign off on proposal, contract is created to deliver whatever SDO proposed

Preparation of Proposal

- Who Prepares Proposal?

Preparation of Proposal

- Could be…
  - Sales/marketing
  - Technical staff
  - Proposal specialists
  - Ideally: all of these
- Select Proposal Manager
  - Best person is would-be PM (usually not feasible)
  - Professional proposal manager

Preparation of Proposal (cont'd)

- Review RFP
  - Always start with RFP
  - Use RFP as checklist
  - Customer uses RFP criteria to weed-out proposals
- Outline SOW based on:
  - Proposed work in SOW in RFP
  - Results of feasibility study

Preparation of Proposal (cont'd)

- Prepare Preliminary Project Plan (Work, Time, Cost)
  - Use basic planning tools to determine necessary work, time, and cost for completion date and price in proposal

Preparation of Proposal (cont'd)

- **Involve Key People (Future Project Team)**
  - Determine who would be key people in project and include them in creating proposal especially SOW, technical section

Preparation of Proposal (cont'd)

- Issue: Who Pays for Proposal?
  - Usually SDO, sometimes customer pays cost for contract winner
  - Falls under "overhead"

Contents of Proposal

- **Standard Contents**
  - Executive Summary
  - Technical Section (Statement of Work)
  - Cost and Payment Section
  - Legal Section
  - Management/Qualifications Section

Contents of Proposal

- **Standard Contents**
  - ❑ Executive Summary
    - Should be more personal than proposal
    - Briefly state contractor's qualifications and experience
    - Draw attention to unique features of proposal, price, and contractor's ability to do project
    - Identify "contact" person with contractor
    - One of most important sections of the proposal

Contents of Proposal (cont'd)

- **Standard Contents**
  - Technical Section (Statement of Work)
    - Gives scope of work and planned approach
    - Based upon WBS and includes major project phases, key tasks, milestones, and reviews
    - Contains schedule when end-items will be delivered
    - Describes realistic benefits in detail to demonstrate that user needs will be fulfilled
    - Recognizes and discusses any problems or limitations to approach
    - Is *specific* to avoid misunderstandings and demonstrate method and appropriateness of approach, but not *too* specific

Contents of Proposal (cont'd)

- **Standard Contents**
  - Cost and Payment Section
    - Breakdown of projected hours for direct, indirect, and special activities, associated labor charges and materials expenses, and price of project
    - Addresses contractual arrangement and method of payment

Contents of Proposal (cont'd)

- **Standard Contents**
  - ❑ Legal Section
    - ■ Contains anticipated, possible, or likely problems and provisions for contingencies
      - ❑ Example – appropriate procedures for handling changes due to scope of project or cost inflation, and for terminating project

Contents of Proposal (cont'd)

- **Standard Contents**
  - Management/Qualifications Section
    - Background of contractor organization, related experience and achievements, and financial responsibility
    - Organization of management, and resumes of project manager and key project personnel
    - Very important section…

Contents of Proposal (cont'd)

- Management/Qualifications Section (cont'd)
  - Very important section.

    Customer might select SDO based upon this and not SOW!

Contents of Proposal (cont'd)

- **Proposal Must Reflect RFP**
  - Start with RFP, then include other "standard" content

- **Sales and Contract**
  - Must be worded and appear such that customer will want to "buy." But should not promise anything that cannot be delivered

Contents of Proposal (cont'd)

- Avoid "Giveaways"
  - Too detailed proposal tells everything
  - No need to hire SDO
  - Customer can do on its own, or hire another SDO to do it

Customer Review of Proposal

- Customer evaluates
  - Cost
  - Benefits
  - Success of Likelihood
  - Contractor Reputation
  - Narrow the List
- Often a handful of good proposals remain after many others have been discarded. These go to negotiation.

Negotiation

- Customer and SDO meet to
  - Clarify terms (ensure common understanding)
  - Reach Agreement on requirements, schedule, or price
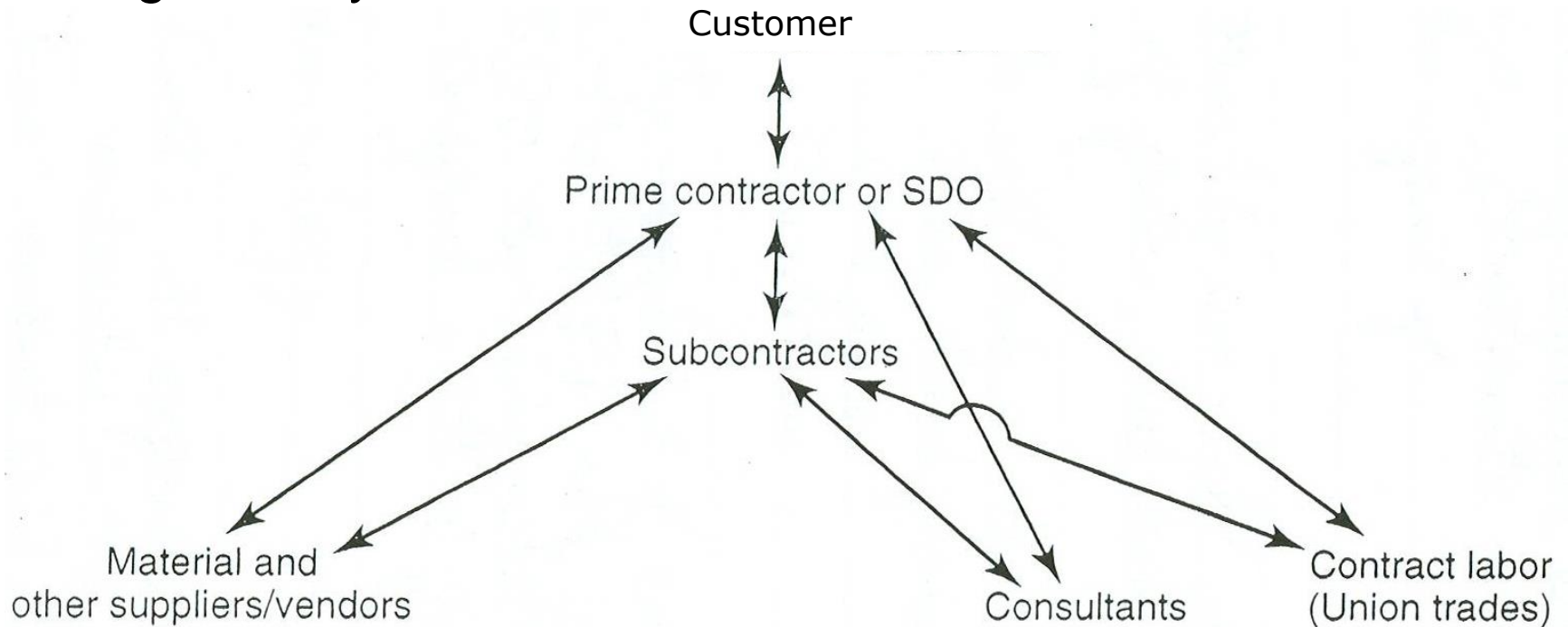
Negotiation (cont'd)

- Ideally, the would-be PM is involved. She must know:
  - Terms of contract and areas open to negotiation (What's Fixed, What's Flexible?)
  - Customer's situation (how much does customer need project?)
  - Competition (Who are competitors and what are they saying to customer?)

Contracting

- Every project involves contracting
  - an agreement for one party (SDO) to do something (project) for another (customer)
- Most people think of project contract only between customer and SDO
  - in many projects the SDO is also a customer that contracts its work to many other organizations

Contracting (cont'd)

- Sometimes SDO doesn't do any "work" but merely hires and manages work of others.
- Project team consists of numerous organizations held together by contracts

Customer

Prime contractor or SDO

Subcontractors

Material and other suppliers/vendors

Consultants

Contract labor (Union trades)

←——→ Contract agreement

Contracting (cont'd)

- PM of SDO hires other contractors (subcontractors), sometimes through RFP-proposal process, in which case SDO becomes "customer"
- PM must know how to *evaluate* proposals

  as well *write* them.
- After the contract agreement, the contractual agreement must be *managed,* i.e.,
  - ensuring that work performed is in conformance with the contract
  - that the contract is up-to-date regarding ongoing changes in the project, customer needs, and the contractor's capability.
- This process, called *contract administration*,

Basic Kinds of Contractual Agreements

Different contractual agreements offer different advantages to the customer and contractor, depending on the nature of the project. (These are discussed in the Appendix to this chapter)

The basic agreements are:

- ***Fixed Price Contract***—Price paid by the customer for the project is fixed regardless of the costs incurred by the contractor.
- ***Cost-Plus Contract***—Price paid by the customer is based on the costs incurred in the project plus the contractor's fee.
- ***Incentive Contract***—Price paid by the customer depends on the contractor's performance in comparison to the target price, schedule, or technical specification: the contractor either receives a *bonus* for exceeding the target, or must pay the customer a *penalty* for falling short of the target.