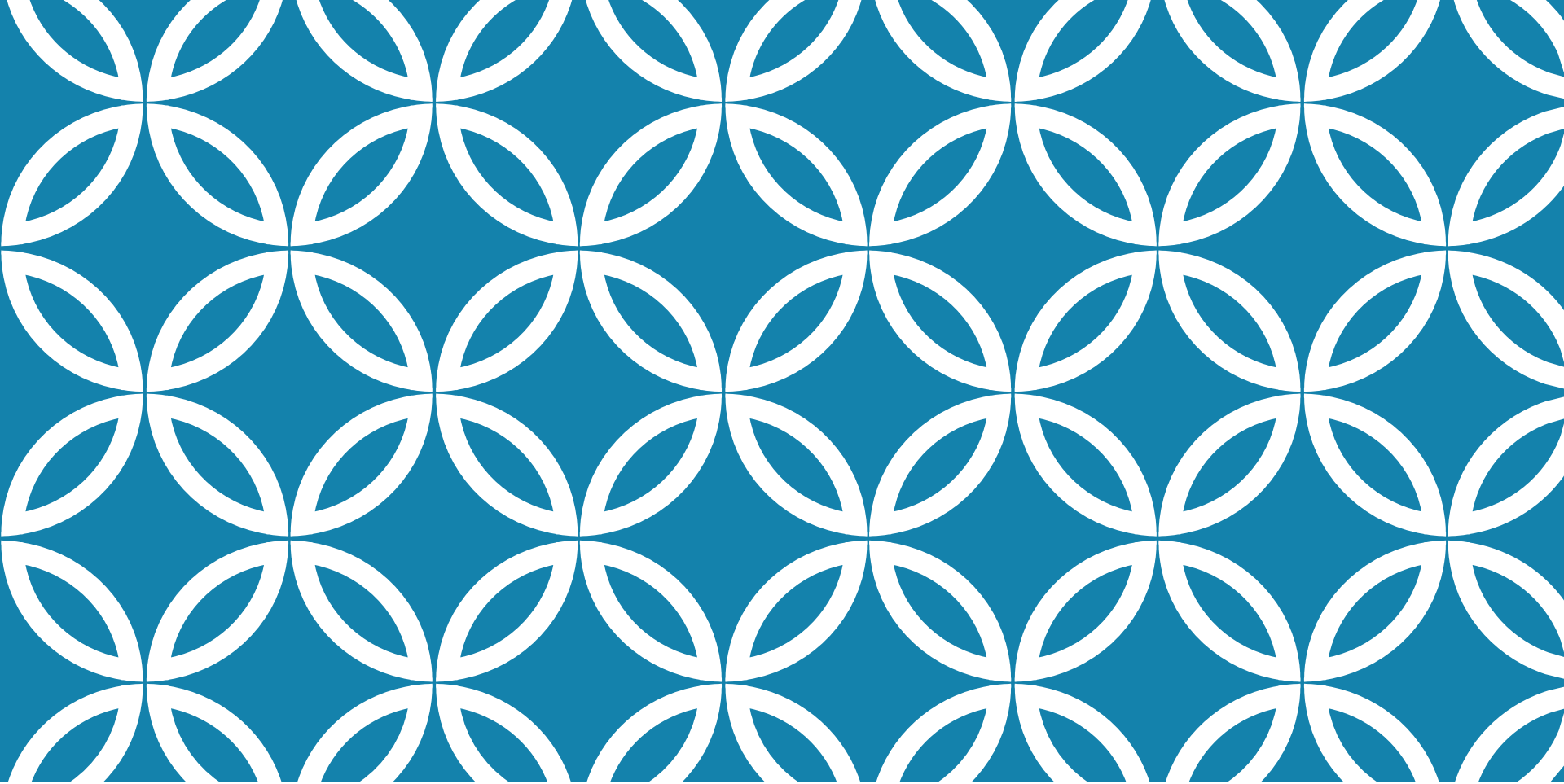


REQUIREMENT MODELING

System Analysis & Design Course

Sharif University of Technology

INTRODUCTION TO REQUIREMENTS DISCOVERY

Requirements discovery – the process and techniques used by systems analysts to identify or extract system problems and solution requirements from the user community.

System requirement – something that the information system must do or a property that it must have. Also called a *business requirement*.

FUNCTIONAL VS. NONFUNCTIONAL REQUIREMENTS

Functional requirement - something the information system must do

Nonfunctional requirement - a property or quality the system must have

- Performance
- Security
- Costs

RESULTS OF INCORRECT REQUIREMENTS

The system may cost more than projected.

The system may be delivered later than promised.

The system may not meet the users' expectations and they may not to use it.

Once in production, costs of maintaining and enhancing system may be excessively high.

The system may be unreliable and prone to errors and downtime.

Reputation of IT staff is tarnished as failure will be perceived as a mistake by the team.

RELATIVE COST TO FIX AN ERROR

Phase in Which Error Discovered	Cost Ratio
Requirements	1
Design	3–6
Coding	10
Development Testing	15–40
Acceptance Testing	30–70
Operation	40–1000

CRITERIA FOR SYSTEM REQUIREMENTS

Consistent – not conflicting or ambiguous.

Complete – describe all possible system inputs and responses.

Feasible – can be satisfied based on the available resources and constraints.

Required – truly needed and fulfill the purpose of the system.

Accurate – stated correctly.

Traceable – directly map to functions and features of system.

Verifiable – defined so can be demonstrated during testing.

REQUIREMENTS DISCOVERY

Given an understand of problems, the systems analyst can start to define requirements.

Fact-finding – the formal process of using research, meetings, interviews, questionnaires, sampling, and other techniques to collect information about system problems, requirements, and preferences. It is also called *information gathering* or *data collection*.

REQUIREMENTS DEFINITION DOCUMENT

Requirements Definition Document – A formal document that communicates the requirements of a proposed system to key stakeholders and serves as a contract for the systems project.

Synonyms

- Requirements definition report
- Requirements statement
- Requirements specification
- Functional specifications

SAMPLE REQUIREMENTS DEFINITION REPORT OUTLINE

REQUIREMENTS DEFINITION REPORT

1. Introduction
   - 1.1. Purpose
   - 1.2. Background
   - 1.3. Scope
   - 1.4. Definitions, Acronyms, and Abbreviations
   - 1.5. References
2. General Project Description
   - 2.1. Functional Requirements
3. Requirements and Constraints
   - 3.1. Functional Requirements
   - 3.2. Nonfunctional Requirements
4. Conclusion
   - 4.1. Outstanding Issues

Appendix (optional)

REQUIREMENTS MANAGEMENT

Requirements management - the process of managing change to the requirements.

- Over the lifetime of the project it is very common for new requirements to emerge and existing requirements to change.
- Studies have shown that over the life of a project as much as 50 percent or more of the requirements will change before the system is put into production.

SEVEN FACT-FINDING METHODS

Sampling of existing documentation, forms, and databases.

Research and site visits.

Observation of the work environment.

Questionnaires.

Interviews.

Prototyping.

Joint requirements planning (JRP).

SAMPLING EXISTING DOCUMENTATION, FORMS, & FILES

Sampling –process of collecting a representative sample of documents, forms, and records.

- Organization chart
- Memos and other documents that describe the problem
- Standard operating procedures for current system
- Completed forms
- Manual and computerized screens and reports
- Samples of databases
- Flowcharts and other system documentation
- And more

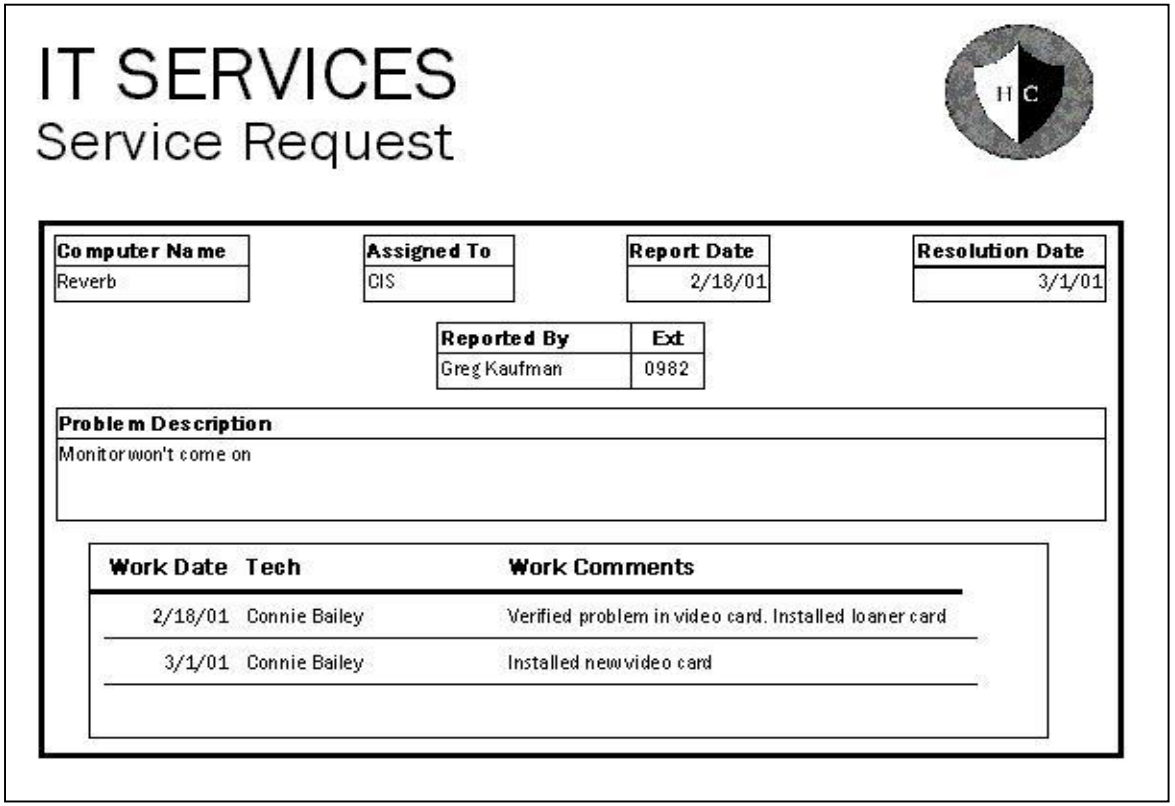
WHY TO SAMPLE COMPLETED RATHER THAN BLANK FORMS

Can determine type of data going into each blank

Can determine size of data going into each blank

Can determine which blanks are not used or not always used

Can see data relationships



IT SERVICES
Service Request

Computer Name	Assigned To	Report Date	Resolution Date
Reverb	CIS	2/18/01	3/1/01

Reported By	Ext
Greg Kaufman	0982

Problem Description
Monitor won't come on

Work Date	Tech	Work Comments
2/18/01	Connie Bailey	Verified problem in video card. Installed loaner card
3/1/01	Connie Bailey	Installed new video card

OBSERVATION

Observation – a fact-finding technique wherein the systems analyst either participates in or watches a person perform activities to learn about the system.

Advantages?

Disadvantages?

Work sampling - a fact-finding technique that involves a large number of observations taken at random intervals.

QUESTIONNAIRES

Questionnaire – a special-purpose document that allows the analyst to collect information and opinions from respondents.

Free-format questionnaire – a questionnaire designed to offer the respondent greater latitude in the answer. A question is asked, and the respondent records the answer in the space provided after the question.

Fixed-format questionnaire – a questionnaire containing questions that require selecting an answer from predefined available responses.

INTERVIEWS

Interview - a fact-finding technique whereby the systems analysts collect information from individuals through face-to-face interaction.

- Find facts
- Verify facts
- Clarify facts
- Generate enthusiasm
- Get the end-user involved
- Identify requirements
- Solicit ideas and opinions

The personal interview is generally recognized as the most important and most often used fact-finding technique.

DISCOVERY PROTOTYPING

Discovery prototyping – the act of building a small-scale, representative or working model of the users' requirements in order to discover or verify those requirements.

JOINT REQUIREMENTS PLANNING

Joint requirements planning (JRP) – a process whereby highly structured group meetings are conducted for the purpose of analyzing problems and defining requirements.

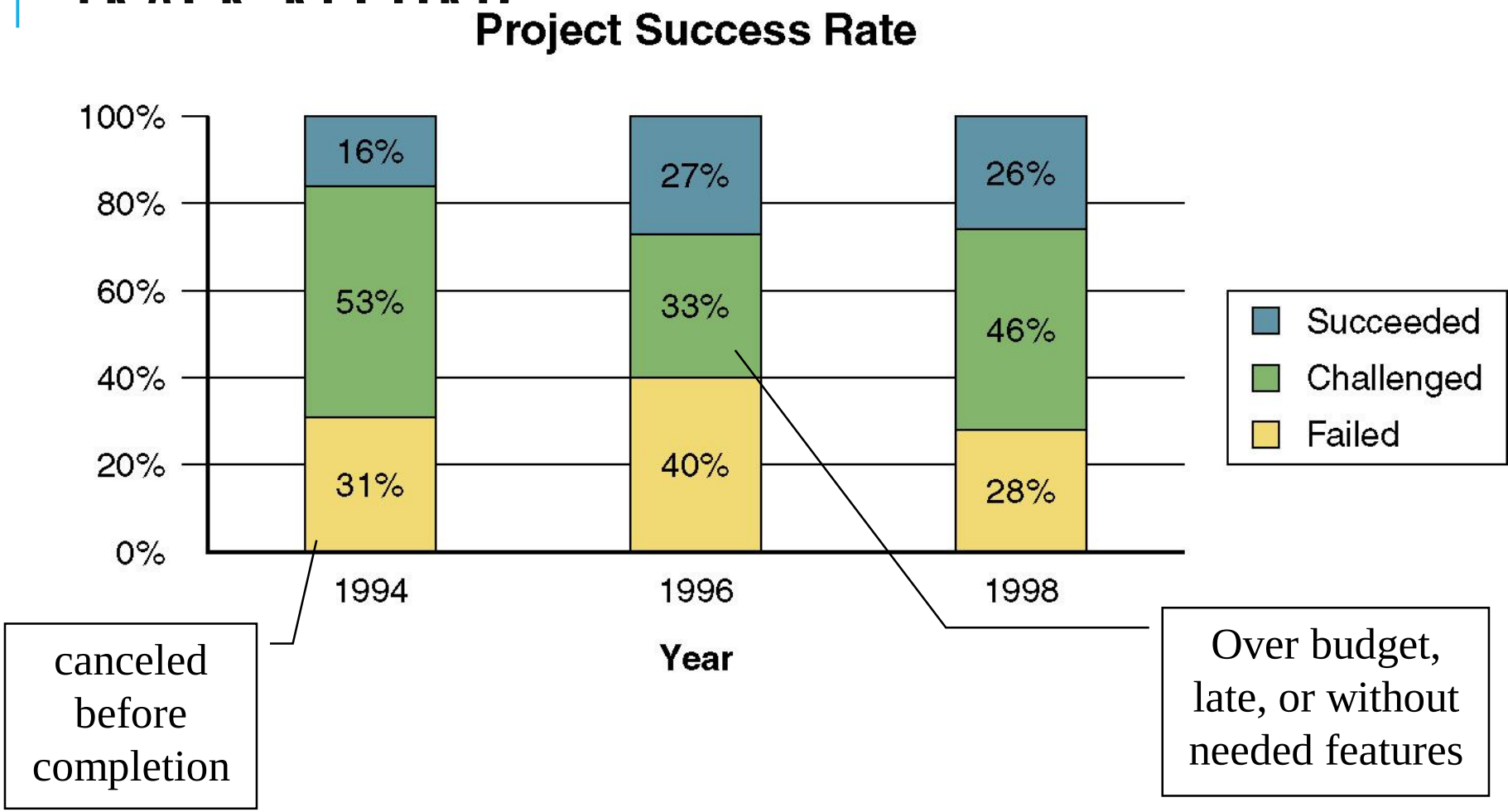
- JRP is a subset of a more comprehensive joint application development or JAD technique that encompasses the entire systems development process.

AN INTRODUCTION TO USE-CASE MODELING

One of the primary challenges is the ability to elicit the correct and necessary system requirements from the stakeholders and specify them in a manner understandable to them so those requirements can be verified and validated.

The hardest single part of building a software system is deciding precisely what to build. No other part of the conceptual work is a difficult as establishing the detailed technical requirements, including all the interfaces to people, to machines, and to other software systems. No other work so cripples the resulting system if done wrong. No other part is more difficult to rectify later. Fred Brooks

IS DEVELOPMENT PROJECT TRACK RECORD



Source: The Standish Group International, Inc., “Chaos: A Recipe for Success”

USER-CENTERED DEVELOPMENT AND USE-CASE MODELING

User-centered development – a process of systems development based on understanding the needs of the stakeholders and the reasons why the system should be developed.

Use-case modeling – the process of modeling a system's functions in terms of business events, who initiated the events, and how the system responds to those events.

- Use-case modeling has roots in object-oriented modeling.
- Gaining popularity in non-object development environments because of its usefulness in communicating with users.
- Compliments traditional modeling tools.

BENEFITS OF USE-CASE MODELING

Provides tool for capturing functional requirements.

Assists in decomposing system into manageable pieces.

Provides means of communicating with users/stakeholders concerning system functionality in language they understand.

Provides means of identifying, assigning, tracking, controlling, and management system development activities.

Provides aid in estimating project scope, effort, and schedule.

BENEFITS OF USE-CASE MODELING (CONTINUED)

Aids in defining test plans and test cases.

Provides baseline for user documentation.

Provides tool for requirements traceability.

Provides starting point for identification of data objects or entities.

Provides specifications for designing user and system interfaces.

Provides means of defining database access requirements.

Provides framework for driving the system development project.

SYSTEM CONCEPTS FOR USE-CASE MODELING

Use case – a behaviorally related sequence of steps (scenario), both automated and manual, for the purpose of completing a single business task.

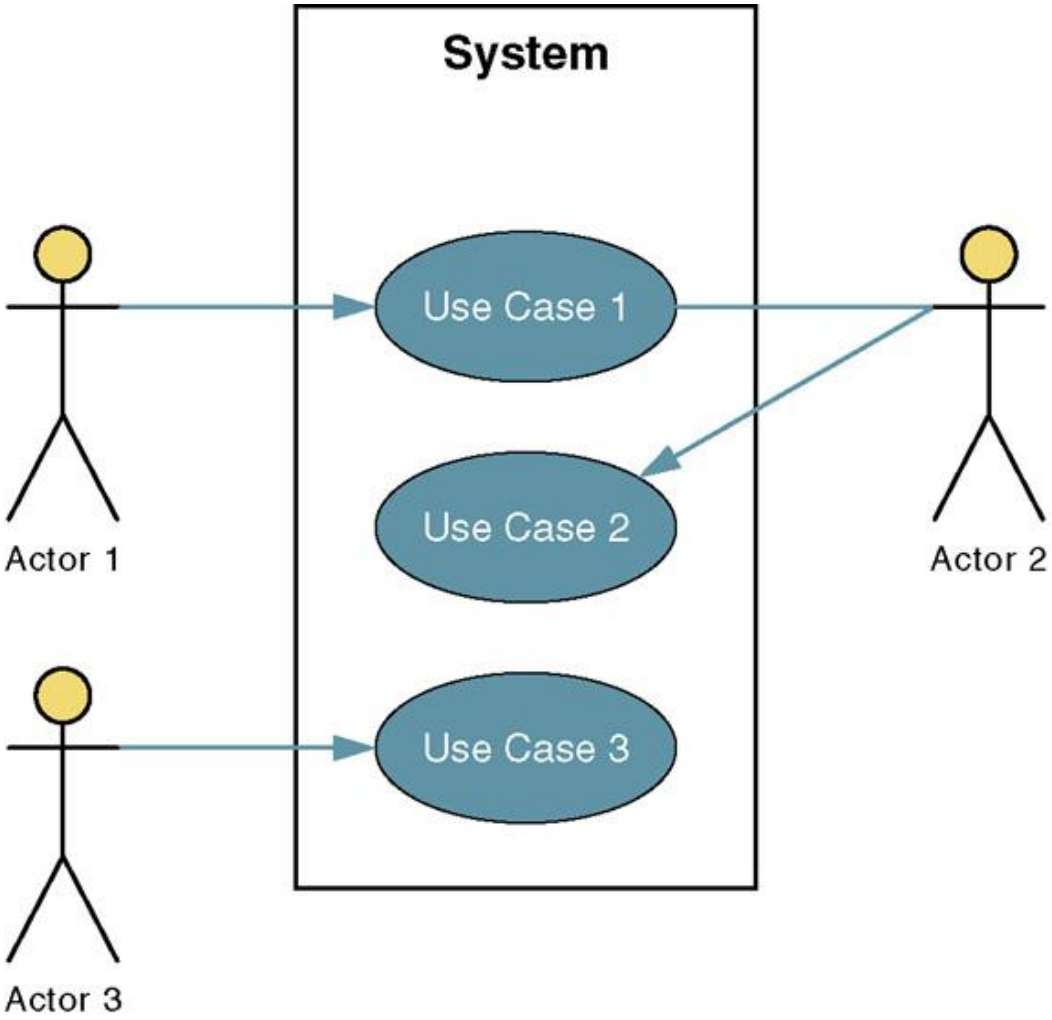
- Description of system functions from the perspective of external users in terminology they understand.

Use-case diagram – a diagram that depicts the interactions between the system and external systems and users.

- graphically describes who will use the system and in what ways the user expects to interact with the system.

Use-case narrative – a textual description of the business event and how the user will interact with the system to accomplish the task.

SAMPLE USE-CASE MODEL DIAGRAM



BASIC USE-CASE SYMBOLS

Use case – subset of the overall system functionality

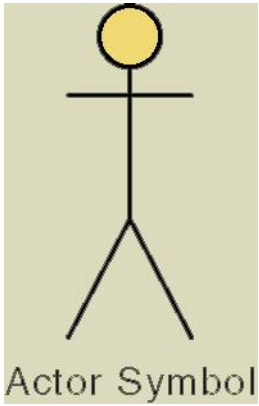
- Represented by a horizontal ellipse with name of use case above, below, or inside the ellipse.

Actor – anyone or anything that needs to interact with the system to exchange information.

- human, organization, another information system, external device, even time.

Temporal event – a system event triggered by time.

- The actor is time.



FOUR TYPES OF ACTORS

Primary business actor

- The stakeholder that primarily benefits from the execution of the use case.
- e.g. the employee receiving the paycheck

Primary system actor

- The stakeholder that directly interfaces with the system to initiate or trigger the business or system event.
- e.g. the bank teller entering deposit information

External server actor

- The stakeholder that responds to a request from the use case.
- e.g. the credit bureau authorizing a credit card charge

External receiver actor

- The stakeholder that is not the primary actor but receives something of value from the use case.
- e.g. the warehouse receiving a packing slip

USE CASE ASSOCIATION RELATIONSHIP

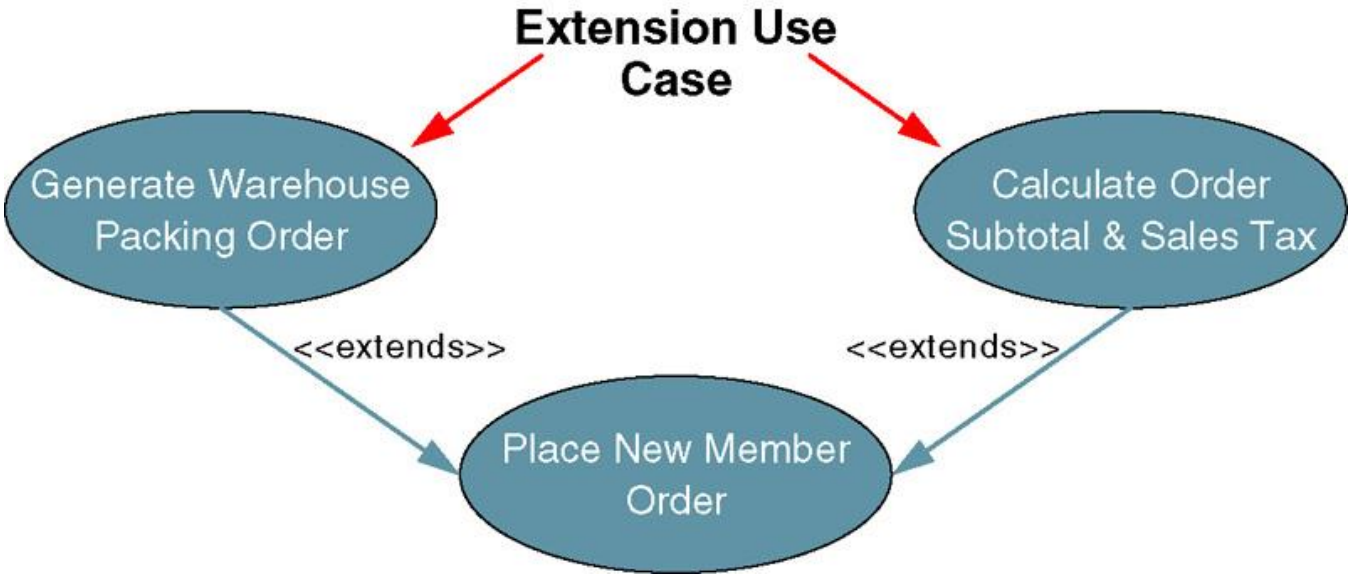
Association – a relationship between an actor and a use case in which an interaction occurs between them.

- Association modeled as a solid line connecting the actor and the use case.
- Association with an arrowhead touching the use case indicates that the use case was initiated by the actor. (1)
- Association lacking arrowhead indicates a receiver actor. (2)
- Associations may be bidirectional or unidirectional.

USE CASE EXTENDS RELATIONSHIP

Extension use case –use case consisting of steps extracted from another use case to simplify the original.

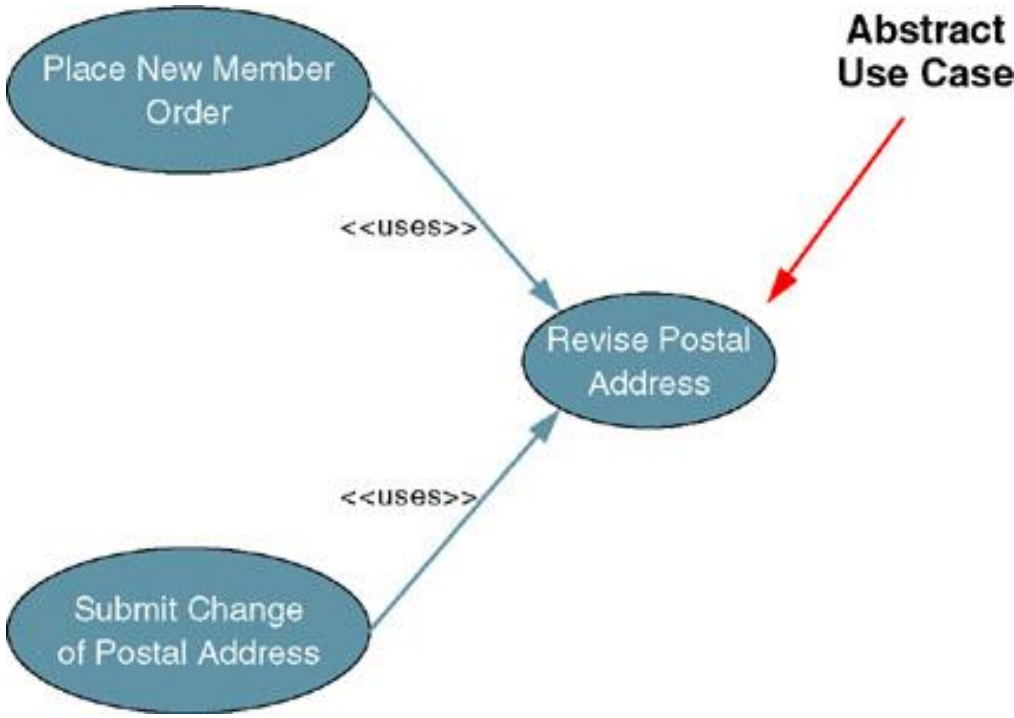
- Extends the functionality of the original use case.
- Generally not identified in the requirements phase
- Extends relationship represented as arrow beginning at the extension use case and pointing to use case it is extending.
- Labeled <<extends>>.



USE CASE USES RELATIONSHIP

Abstract use case – use case that reduces redundancy in two or more other use cases by combining common steps found in both.

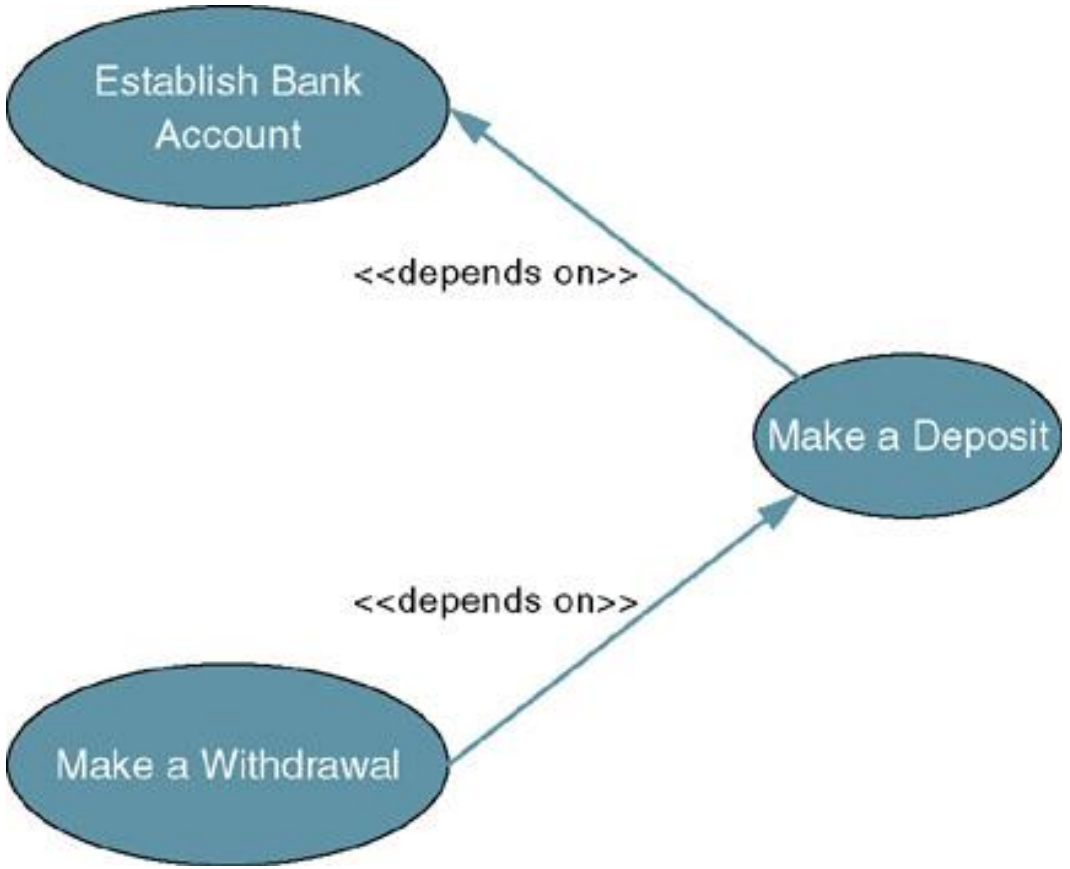
- Available by any other use case that requires its functionality.
- Generally not identified in requirements phase
- Relationship between abstract use case and use case that uses it is called a *uses* (or *includes*) relationship.
- Depicted as arrow beginning at original use case and pointing to use case it is using.
- Labeled <<uses>>.



USE CASE DEPENDS ON RELATIONSHIP

Depends On – use case relationship that specifies which other use cases must be performed before the current use case.

- Can help determine sequence in which use cases need to be developed.
- Depicted as arrow beginning at one use case and pointing to use case it depends on.
- Labeled <<depends on>>.

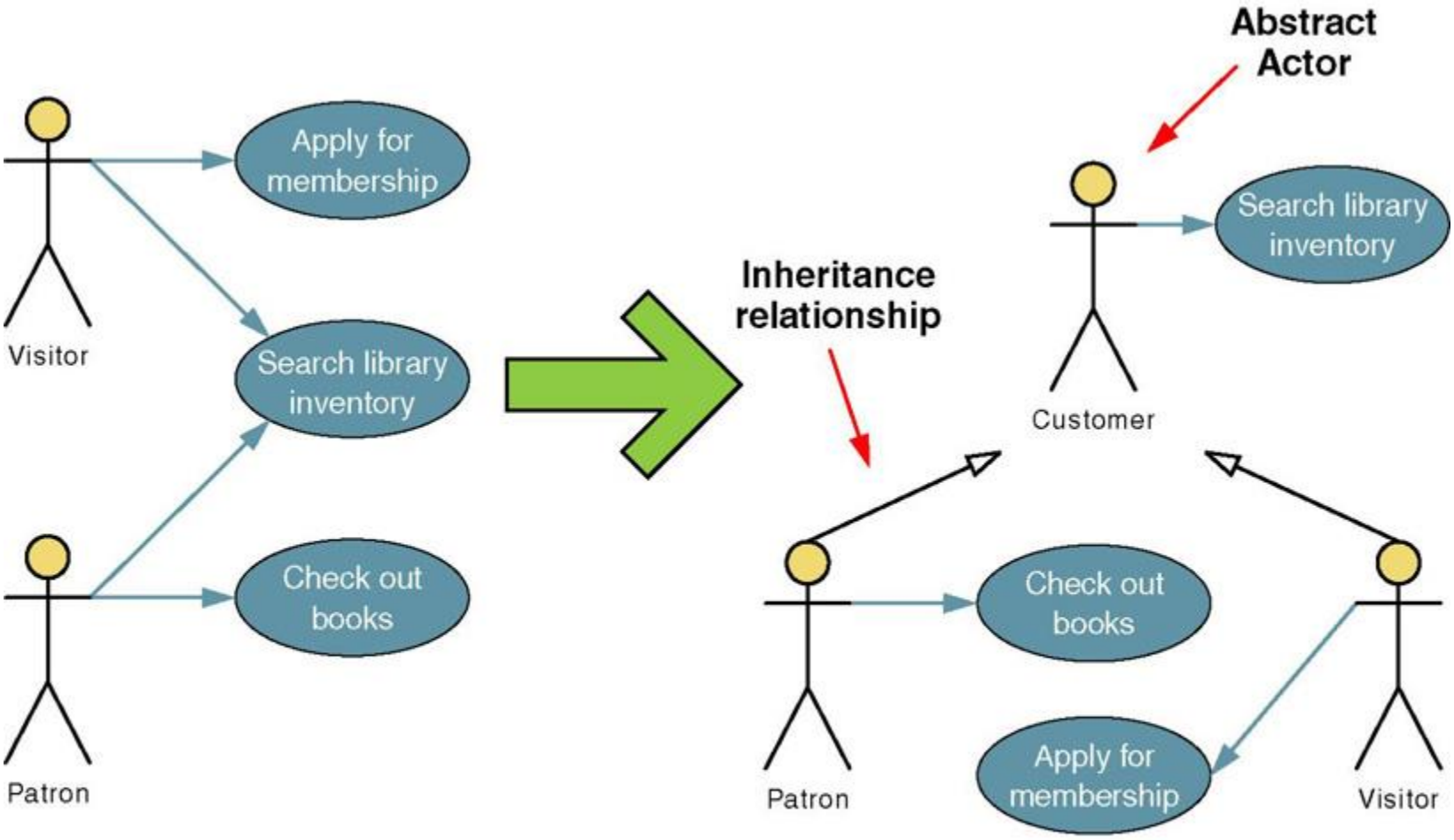


USE CASE INHERITANCE RELATIONSHIP

Inheritance – a use case relationship in which the common behavior of two actors initiating the same use case is extrapolated and assigned to a new *abstract* actor to reduce redundancy.

- Other actors can inherit the interactions of the abstract actor.
- Depicted as an arrow beginning at one actor and pointing to the abstract actor whose interactions the first actor inherits.

USE CASE INHERITANCE RELATIONSHIP



THE PROCESS OF REQUIREMENTS USE-CASE MODELING

Objective is to elicit and analyze enough requirements information to prepare a model that:

- Communicates what is required from a user perspective.
- Is free of specific details about how system will be implemented.

To effectively estimate and schedule project, may need to include preliminary implementation assumptions.

Steps

1. Identify business actors.
2. Identify business use cases.
3. Construct use-case model diagram.
4. Documents business requirements use-case narratives.

STEP 1: IDENTIFY BUSINESS ACTORS

When looking for actors, ask the following questions:

- Who or what provides inputs to the system?
- Who or what receives outputs from the system?
- Are interfaces required to other systems?
- Are there events that are automatically triggered at a predetermined time?
- Who will maintain information in the system?

Actors should be named with a noun or noun phrase

SAMPLE LIST OF ACTORS

	Term	Synonym	Description
1.	Potential member		An individual or corporation that submits a subscription order in order to join the club.
2.	Club member	Member	An individual or corporation that has joined the club via an agreement.
3.	Past member	Inactive member	A type of member that has fulfilled the agreement obligation but has not placed an order within the last six months but is still in good standing.
4.	Marketing		Organization responsible for creating promotion and subscription programs and generating sales for the company.
5.	Member services		Organization responsible for providing point of contact for SoundStage Entertainment customers in terms of agreements and orders.
6.	Distribution center	Warehouse	Entity that houses and maintains SoundStage Entertainment product inventory and processes customer shipments and returns.
7.	Accounts receivable		Organization responsible for processing customer payments and billing as well as maintaining customer account information.
8.	Time		Actor concept responsible for triggering temporal events.

STEP 2: IDENTIFY BUSINESS REQUIREMENTS USE CASES

Business Requirements Use Case - a use case created during requirements analysis to capture the interactions between a user and the system free of technology and implementation details.

- During requirements analysis, strive to identify and document only the most critical, complex, and important use cases, often called *essential* use cases.

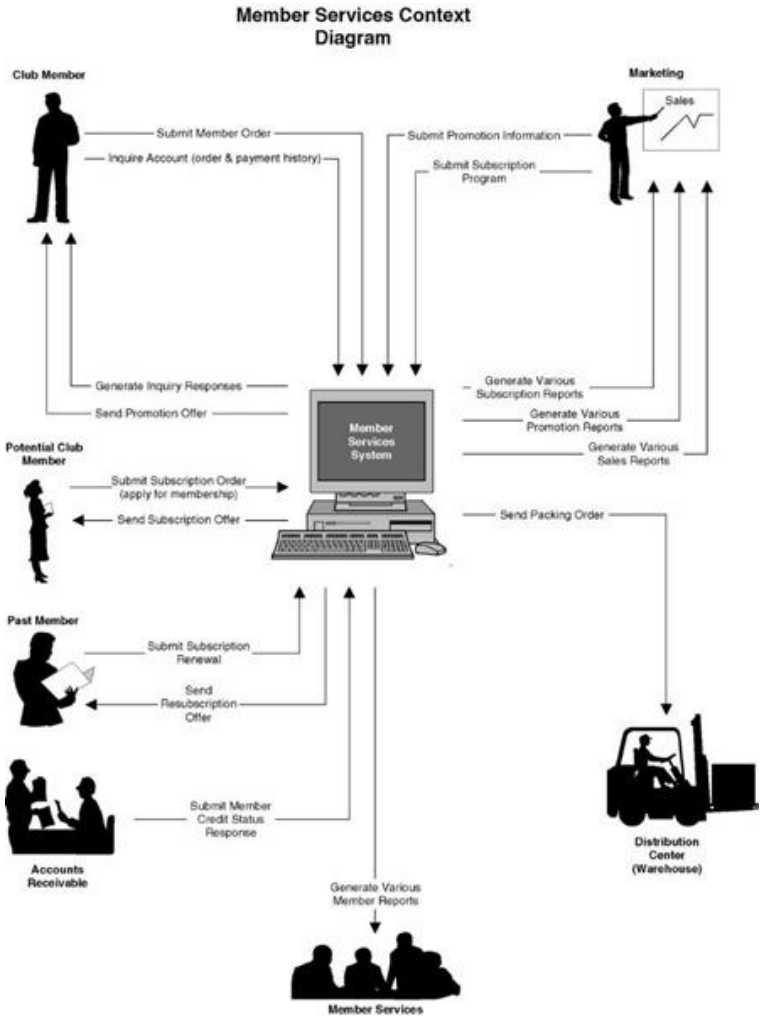
STEP 2: IDENTIFY BUSINESS REQUIREMENTS USE CASES (CONT.)

When looking for use cases, ask the following questions:

- What are the main tasks of the actor?
- What information does the actor need form the system?
- What information does the actor provide to the system?
- Does the system need to inform the actor of any changes or events that have occurred?
- Does the actor need to inform the system of any changes or events that have occurred?

Use cases should be named with a verb phrase specifying the goal of the actor (i.e. Submit Subscription Order)

SAMPLE CONTEXT DIAGRAM



SAMPLE USE-CASE GLOSSARY

Use-Case Name	Use-Case Description	Participating Actors and Roles
Submit Subscription Order	This use case describes the event of a potential member requesting to join the club by subscribing. ("Take any 12 CDs for one penny and agree to buy 4 more at regular prices within two years.")	• Potential member (primary business) • Distribution Center (external receiver)
Submit Subscription Renewal Order	This use case describes the event of a past member requesting to rejoin the club by subscribing. ("Take any 12 CDs for one penny and agree to buy 4 more at regular prices within two years.")	• Past member (primary business) • Distribution Center (external receiver)
Submit Member Profile Changes	This use case describes the event of a club member submitting changes to his or her profile for such things as postal address, e-mail address, privacy codes, and order preferences.	• Club member (primary business)
Place New Order	This use case describes the event of a club member submitting an order for SoundStage products.	• Club member (primary business) • Distribution Center (external receiver) • Accounts Payable/Receivable (external server)

continued

SAMPLE USE-CASE GLOSSARY (CONT.)

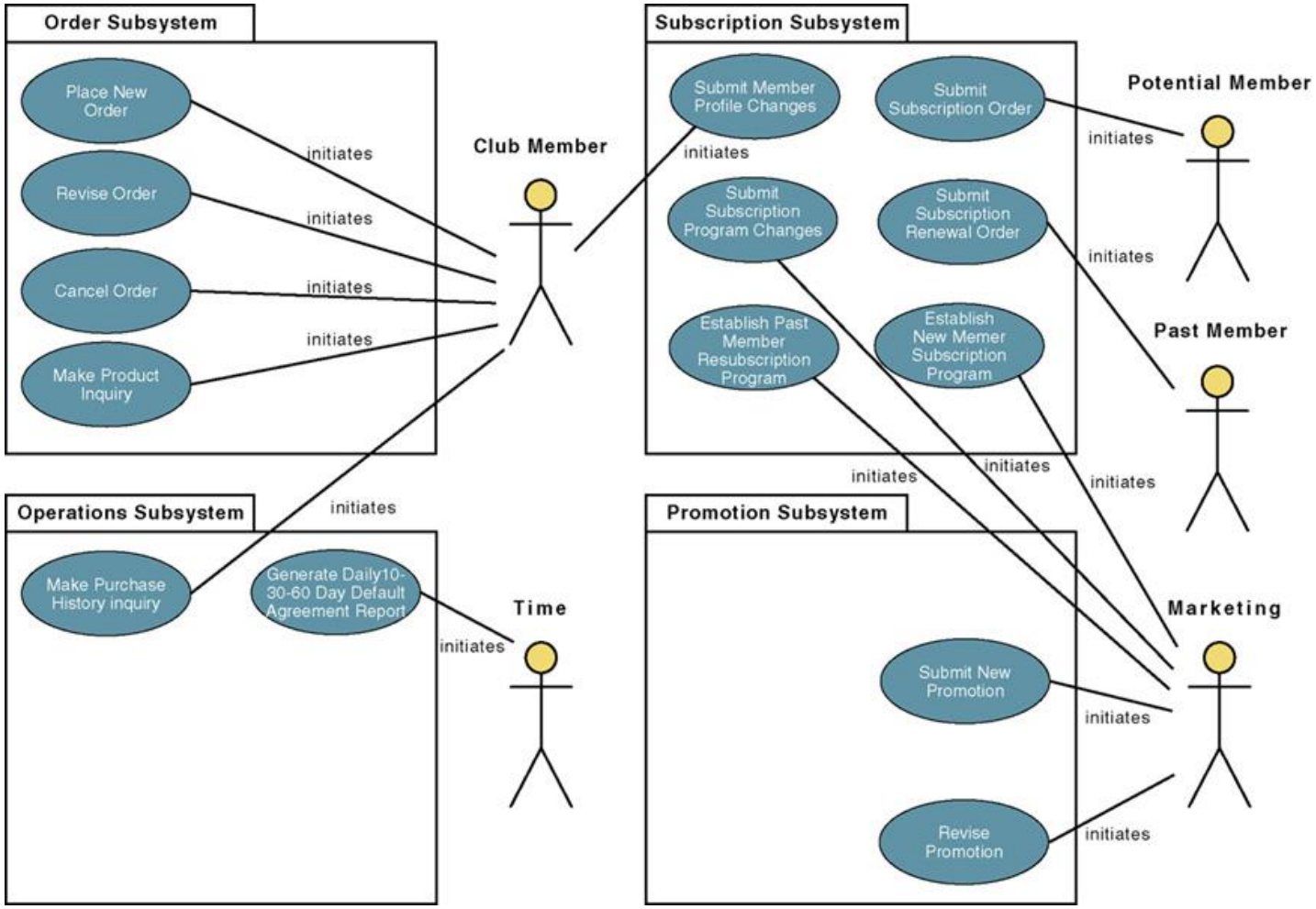
Revise Order	This use case describes the event of a club member revising an order previously placed. (Order must not have shipped.)	• Club member (primary business) • Distribution Center (external receiver) • Accounts Payable/Receivable (external server)
Cancel Order	This use case describes the event of a club member canceling an order previously placed. (Order must not have shipped.)	• Club member (primary business) • Distribution Center (external receiver) • Accounts Payable/Receivable (external server)
Make Product Inquiry	This use case describes the event of a club member viewing products for possible purchase. (Driven by web access requirement.)	• Club member (primary business)
Make Purchase History Inquiry	This use case describes the event of a club member viewing her or his purchasing history. (Three-year time limit.)	• Club member (primary business)

continued

SAMPLE USE-CASE GLOSSARY (CONT.)

Establish New Member Subscription Program	This use case describes the event of the marketing department establishing a new membership subscription plan to entice new members	• Marketing (primary business)
Submit Subscription Program Changes	This use case describes the event of the marketing department changing a subscription plan for club members (e.g., extending the fulfillment period).	• Marketing (primary business)
Establish Past Member Resubscription Program	This use case describes the event of the marketing department establishing a resubscription plan to lure back former members.	• Marketing (primary business)
Submit Member Profile Changes	This use case describes the event of the marketing department establishing a new promotion plan to entice active and inactive members to order the product. (Note: A promotion features specific titles, usually new, that the company is trying to sell at a special price. These promotions are integrated into a catalog sent (or communicated) to all members.)	• Marketing (primary business)
Revise Promotion	This use case describes the event of the marketing department revising a promotion.	• Marketing (primary business)
Generate Daily 10-30-60-Day Default Agreement Report	This use case describes the event of a report that is generated on a daily basis to list the members who have not fulfilled their agreement by purchasing the required number of products outlined when they subscribed. This report is sorted by members who are 10 days past due, 30 days past due, and 60 days past due.	• Time (initiating actor) • Member Services (primary* — external receiver)

STEP 3: CONSTRUCT USE-CASE MODEL DIAGRAM



STEP 4: DOCUMENT BUSINESS REQUIREMENTS USE-CASE NARRATIVES

Document first at high level to quickly obtain an understanding of the events and magnitude of the system.

Then expand to a fully-documented business requirement narrative.

- Include the use case's typical course of events and its alternate courses.

SAMPLE HIGH-LEVEL VERSION OF A USE-CASE NARRATIVE

Member Services System

Author (s): (1) _____ **Date:** (2) _____

Version: (3)

Use-Case Name:	Place New Order (4)	**Use-Case Type** **Business Requirements:** ☑ (5)
Use-Case ID:	MSS-BUC002.00 (6)	
Priority:	High (7)	
Source:	Requirement — MSS-R1.00 (8)	
Primary Business Actor:	Club member (9)	
Other Participating Actors:	• Warehouse (external receiver) • Accounts Receivable (external server) (10)	
Other Interested Stakeholders: (11)	• Marketing — Interested in sales activity in order to plan new promotions. • Procurement — Interested in sales activity in order to replenish inventory. • Management — Interested in order activity in order to evaluate company performance and customer (member) satisfaction.	
Description: (12)	This use case describes the event of a club member submitting a new order for SoundStage products. The member's demographic information as well as his or her account standing is validated. Once the products are verified as being in stock, a packing order is sent to the warehouse for it to prepare the shipment. For any product not in stock, a back order is created. On completion, the member will be sent an order confirmation.	

SAMPLE EXPANDED VERSION OF A USE-CASE NARRATIVE

Member Services System

Author (s): _____ **Date:** _____

Version:

Use-Case Name:	Place New Order	**Use-Case Type** **Business Requirements:** ☑
Use-Case ID:	MSS-BUC002.00	
Priority:	High	
Source:	Requirement — MSS-R1.00	
Primary Business Actor:	Club member	
Other Participating Actors:	• Warehouse (external receiver) • Accounts Receivable (external server)	
Other Interested Stakeholders:	• Marketing — Interested in sales activity in order to plan new promotions. • Procurement — Interested in sales activity in order to replenish inventory. • Management — Interested in order activity in order to evaluate company performance and customer (member) satisfaction.	
Description:	This use case describes the event of a club member submitting a new order for SoundStage products. The member's demographic information as well as his or her account standing is validated. Once the products are verified as being in stock, a packing order is sent to the warehouse for it to prepare the shipment. For any product not in stock, a back order is created. On completion, the member will be sent an order confirmation.	
Precondition: 1	The party (individual or company) submitting the order must be a member.	
Trigger: 2	This use case is initiated when a new order is submitted.	

SAMPLE EXPANDED VERSION OF A USE-CASE NARRATIVE (CONT)

Typical Course of Events: 3	Actor Action	System Response
	Step 1: The club member provides his or her demographic information as well as order and payment information.	**Step 2:** The system responds by verifying that all required information has been provided. **Step 3:** The system verifies the club member's demographic information against what has been previously recorded. **Step 4:** For each product ordered, the system validates the product identity. **Step 5:** For each product ordered, the system verifies the product availability. **Step 6:** For each available product, the system determines the price to be charged to the club member. **Step 7:** Once all ordered products are processed, the system determines the total cost of the order. **Step 8:** The system checks the status of the club member's account. **Step 9:** The system validates the club member's payment if provided. **Step 10:** The system records the order information and then releases the order to the appropriate distribution center (warehouse) to be filled. **Step 10:** Once the order is processed, the system generates an order confirmation and sends it to the club member.

SAMPLE EXPANDED VERSION OF A USE-CASE NARRATIVE (CONT)

Alternate Courses: 4	**Alt-Step 2:** The club member has not provided all the information necessary to process the order. The club member is notified of the discrepancy and prompted to resubmit. **Alt-Step 3:** If the club member information provided is different from what was previously recorded, verify what was recorded is current, then update the club member information accordingly. **Alt-Step 4:** If the product information the club member provided does not match any of SoundStage's products, notify the club member of the discrepancy and request clarification. **Alt-Step 5:** If the quantity ordered of the product is not available, a back order is created. **Alt-Step 8:** If the status of the club member's account is not in good standing, record the order information and place it in hold status. Notify the club member of the account status and the reason the order is being held. Terminate use case. **Alt-Step 9:** If the payment the club member provided (credit card) cannot be validated, notify the club member and request an alternative means of payment. If the club member cannot provide an alternate means, cancel the order and terminate the use case.
Conclusion: 5	This use case concludes when the club member receives a confirmation of the order.
Postcondition: 6	The order has been recorded and if the ordered products were available, they were released. For any product not available a back order has been created.
Business Rules: 7	• The club member responding to a promotion or a member using credits may affect the price of each ordered item. • Cash or checks will not be accepted with the orders. If provided, they will be returned to the club member. • The club member is billed for products only when they are shipped.
Implementation Constraints and Specifications: 8	• GUI to be provided for Member Services associate, and web screen to be provided for club member.
Assumptions: 9	Procurement will be notified of back orders by a daily report (separate use case).
Open Issues: 10	1. Need to determine how distribution centers are assigned.

USE CASES AND PROJECT MANAGEMENT

Use-case model can drive entire development effort.

Project manager or systems analyst uses business requirements use cases to estimate and schedule the build cycles of the project.

- Build cycles are scoped on the basis of the importance of the use case and the time it takes to implement the use case.

To determine importance of use cases, will create:

- Use-case ranking and evaluation matrix
- Use-case dependency diagram

USE-CASE RANKING AND PRIORITY MATRIX

In most projects, the most important use cases are developed first.

Use-case ranking and priority matrix – a tool used to evaluate use cases and determine their priority.

- Evaluates use cases on 1-5 scale against six criteria.
  1. Significant impact on the architectural design.
  2. Easy to implement but contains significant functionality.
  3. Includes risky, time-critical, or complex functions.
  4. Involves significant research or new or risky technology.
  5. Includes primary business functions.
  6. Will increase revenue or decrease costs.

SAMPLE USE-CASE RANKING AND PRIORITY MATRIX

Use-Case Name	Ranking Criteria, 1 to 5						Total Score	Priority	Build Cycle
	1	2	3	4	5	6			
Submit Subscription Order	5	5	5	4	5	5	29	High	1
Place New Order	4	4	5	4	5	5	27	High	2
Make Product Inquiry	1	1	1	1	1	1	6	Low	3
Establish New Member Subscription Program	4	5	5	3	5	5	27	High	1
Generate Daily 10-30-60-Day Default Agreement Report	1	1	1	1	1	1	6	Low	3
Revise Order	2	2	3	3	4	4	18	Medium	2

USE-CASE DEPENDENCY DIAGRAM

Use-case dependency diagram – graphical depiction of the dependencies among use cases.

- Provides the following benefits:
  - Graphical depiction of the system's events and their states enhances understanding of system functionality.
  - Helps identify missing use cases.
  - Helps facilitate project management by depicting which use cases are more critical.

SAMPLE USE-CASE DEPENDENCY DIAGRAM