Software Engineering and Information System Design

Capturing Requirements Through Use-Cases

Chapter 7 – Modeling System Requirements with Use Cases

- Describe the benefits of use-case modeling.
- Define actors and use cases and be able to identify them from context diagrams and other sources.
- Describe the relationships that can appear on a use-case model diagram.
- Describe the steps for preparing a use-case model.
- Describe how to construct a use-case model diagram.
- Describe the various sections of a use-case narrative and be able to prepare one.
- Define the purpose of the use-case ranking and priority matrix and the use-case dependency diagram.

Benefits of Use-Case Modeling

- Provides a tool for capturing functional requirements.
- Assists in decomposing system scope into more manageable pieces.
- Provides a means of communicating with users and other stakeholders concerning system functionality in a language that is easily understood.
- Provides a means of identifying, assigning, tracking, controlling, and management system development activities, especially incremental and iterative development.
- Provides an aid in estimating project scope, effort, and schedule.

Benefits of Use-Case Modeling

- Provides a baseline for testing in terms of defining test plans and test cases.
- Provides a baseline for user help systems and manuals as well as system development documentation.
- Provides a tool for requirements traceability.
- Provides a starting point for the identification of data objects or entities.
- Provides functional specifications for designing user and system interfaces.
- Provides a means of defining database access requirements.
- Provides a framework for driving the system development project.

System Concepts for Use-Case Modeling

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

Use case – a behaviorally related sequence of steps (a 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.
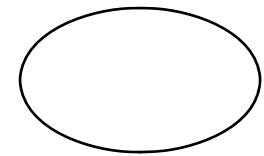
Sample Use-Case Model Diagram
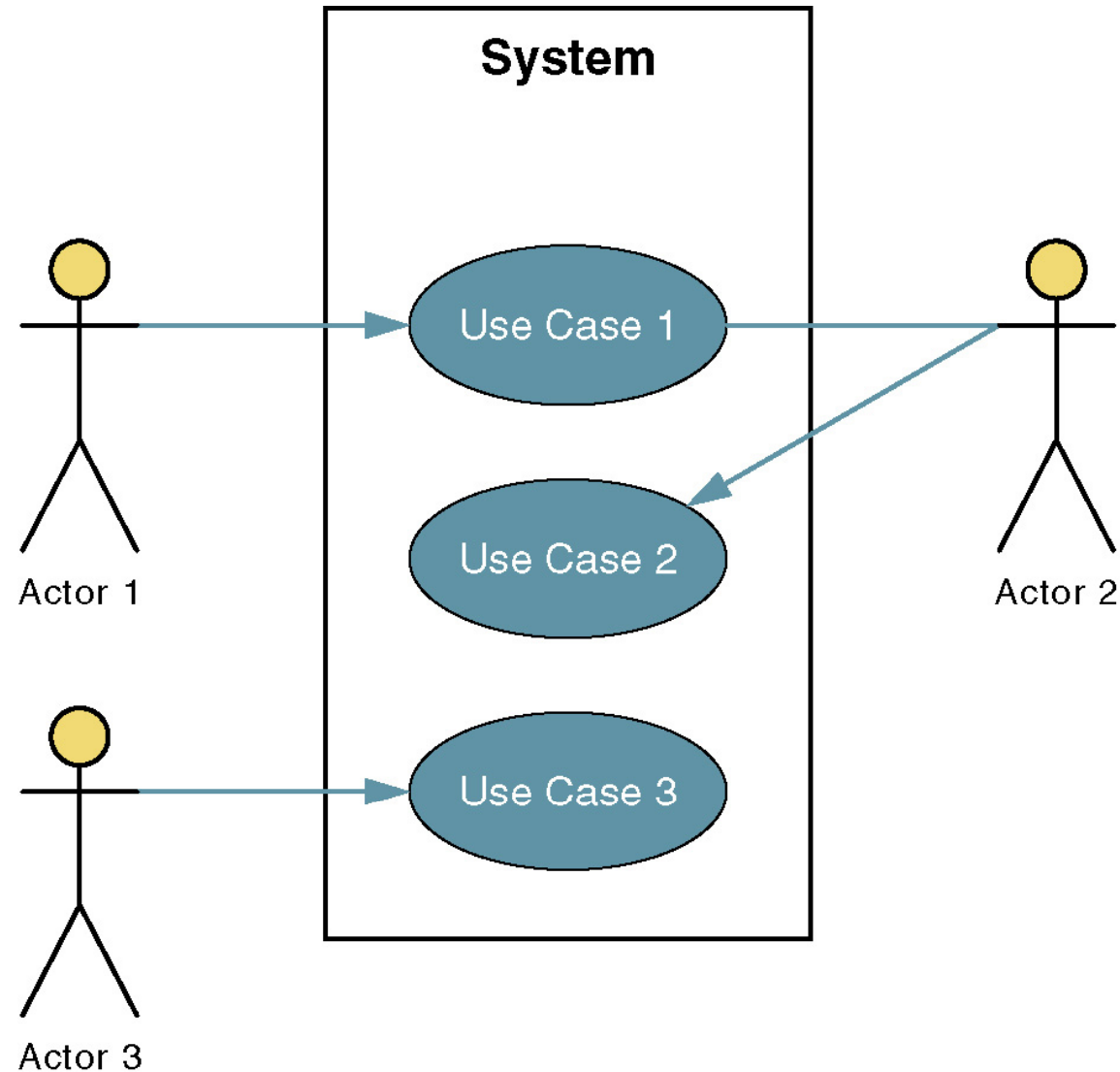
Basic Use-Case Symbols

Use case – subset of the overall system functionality
– Represented graphically by a horizontal
ellipse with the name of the use case
appearing above, below, or inside the ellipse.

Actor – anything that needs to interact with the system
to exchange information.
– Could be a human, an organization, another information
system, an external device,
or even time.
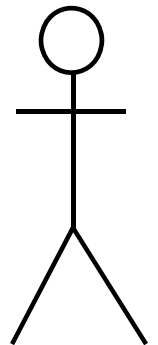
Temporal event – a system event triggered by time.
– The actor is time.

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

Four Types of Actors

- **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

'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.
- Association lacking arrowhead indicates a receiver actor.
- Associations may be bidirectional or unidirectional.

Club Member   **1**   Place New Member Order   **2**   Distribution Center
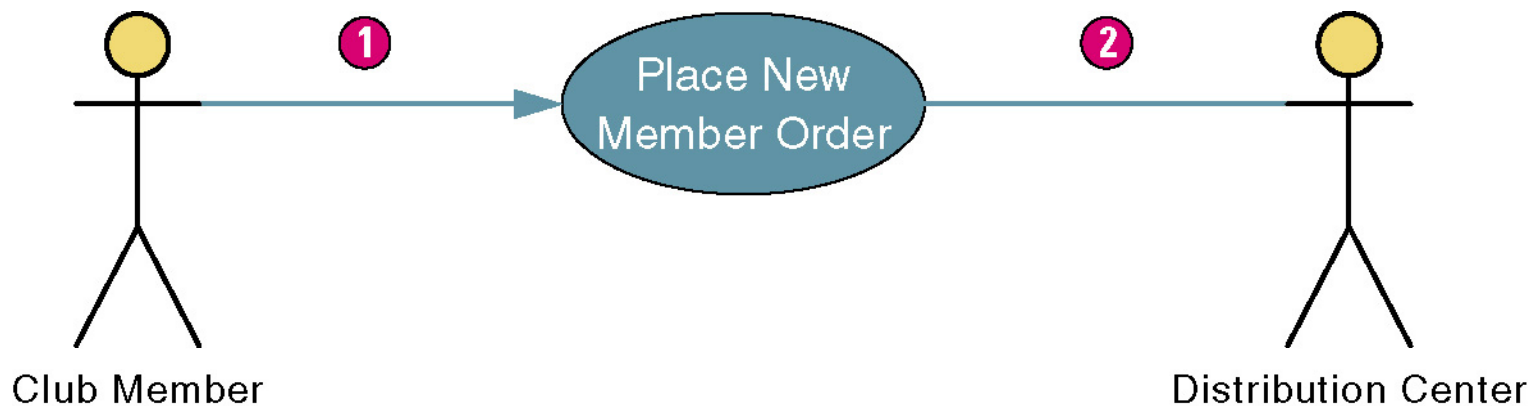
'Extends' Relationship

Extension use case – a use case consisting of steps extracted from a more complex use case in order to simplify the original case and thus extend its functionality.

- Relationship between the extension use case and the use case it is extending is called an *extends* relationship.

- Represented as an arrow headed line beginning at the extension use case and pointing to the use case it is extending.

- Each extends relationship line is labeled "<<extends>>."

'Extends' Relationship

Extension Use Case

Generate Warehouse Packing Order

Calculate Order Subtotal & Sales Tax

<<extends>>   <<extends>>

Place New Member Order
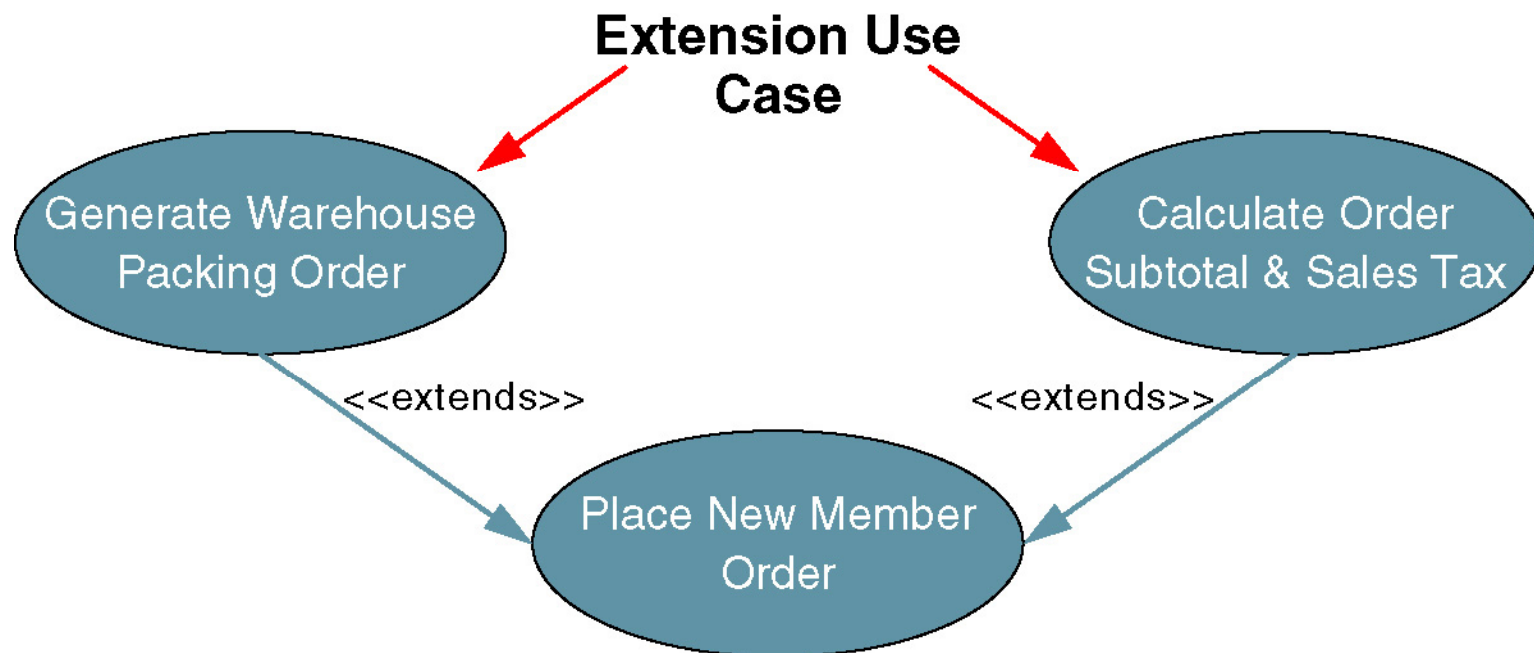
'Extends' Relationship
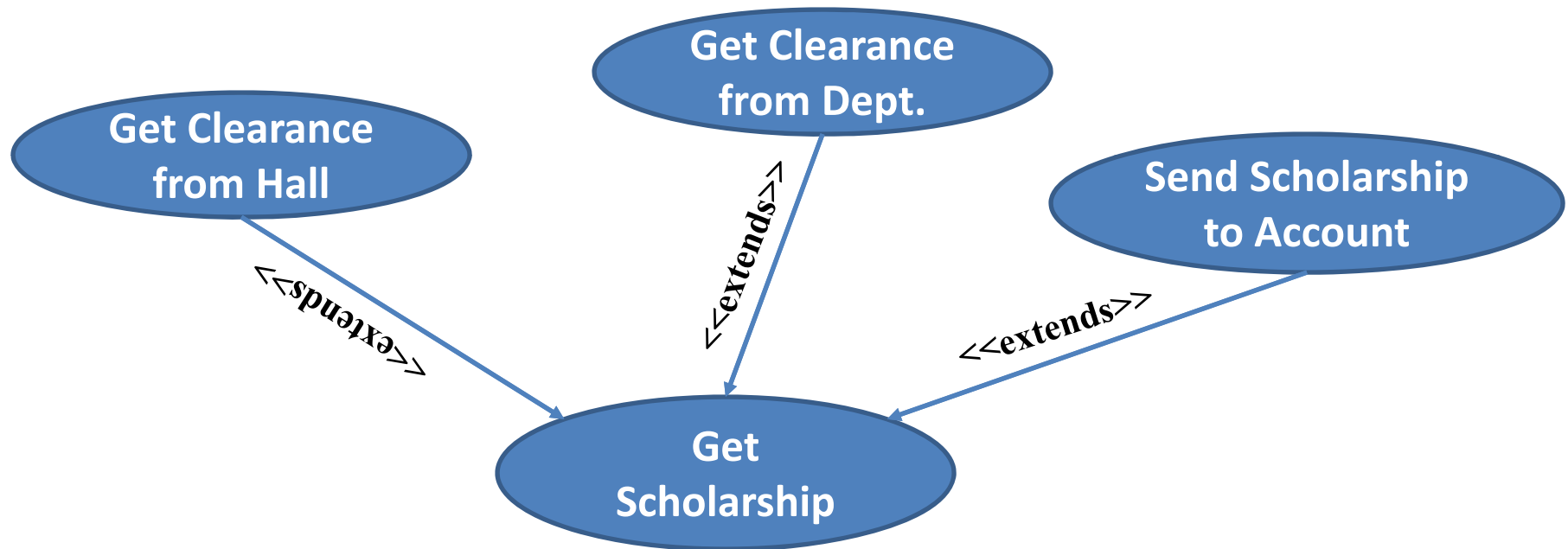
'Uses' Relationship

Abstract use case – a use case that reduces redundancy among two or more other use cases by combining the common steps found in those cases.

- An abstract case is available for use by any other use case that requires its functionality.

- Relationship between the abstract use case and the use case that uses it is called a *uses* (or *includes*) relationship.

- Depicted as an arrow headed line beginning at the original use case and pointing to the use case it is using.

- Each uses relationship line is labeled "<<uses>>."

'Uses' Relationship
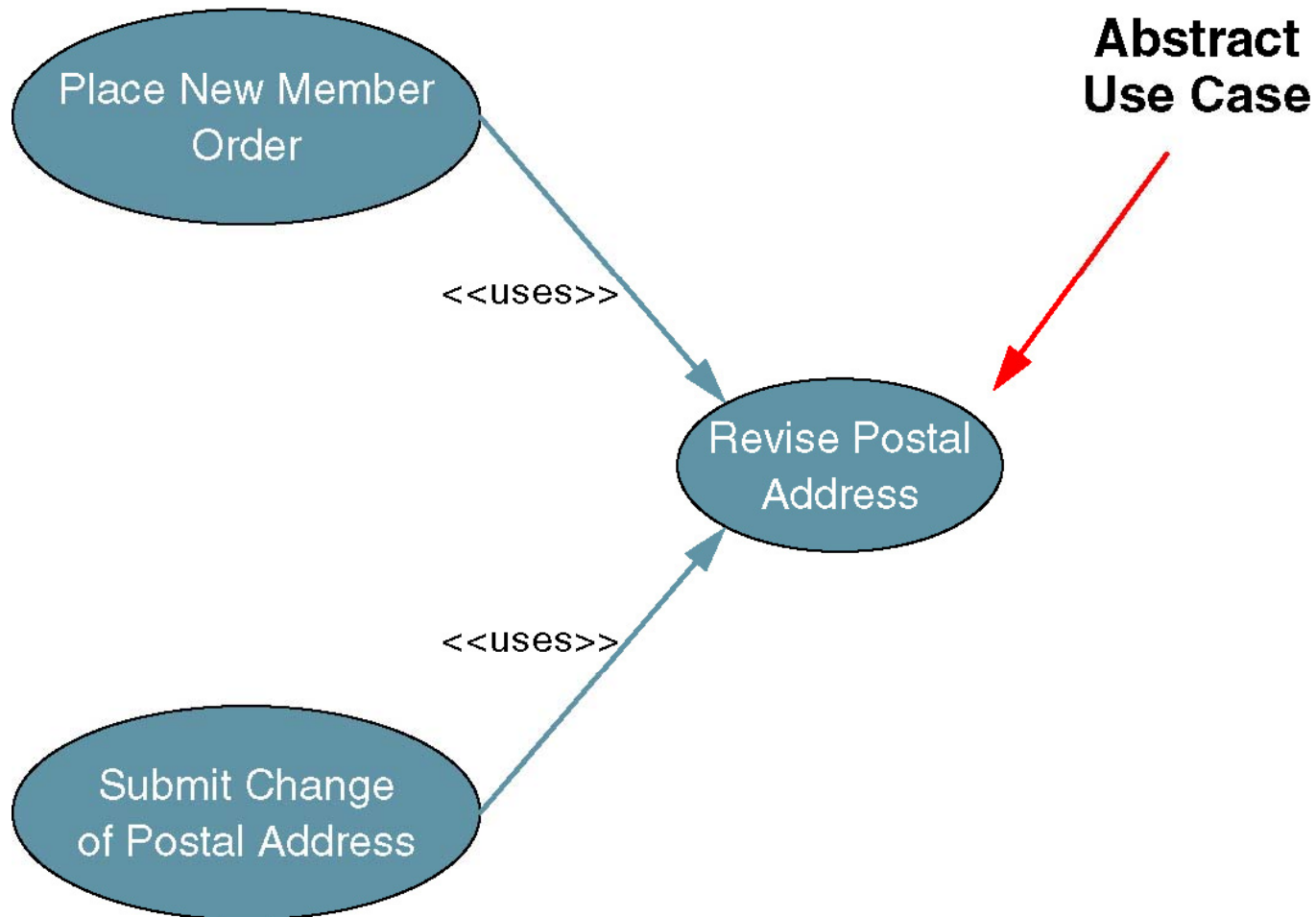
'Uses' Relationship
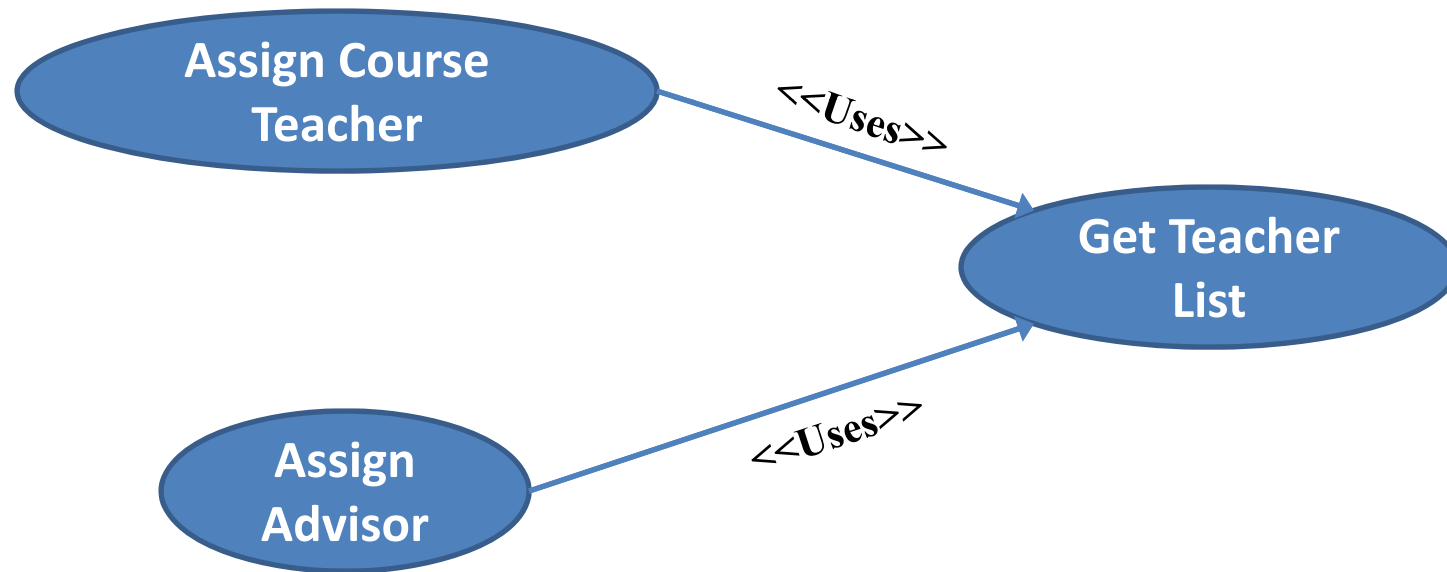
'Depends' On Relationship

Depends On – a 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 an arrow headed line beginning at one use case and pointing to a use case it is dependent on.

- Each depends on relationship line is labeled "<<depends on>>."

'Depends' On Relationship
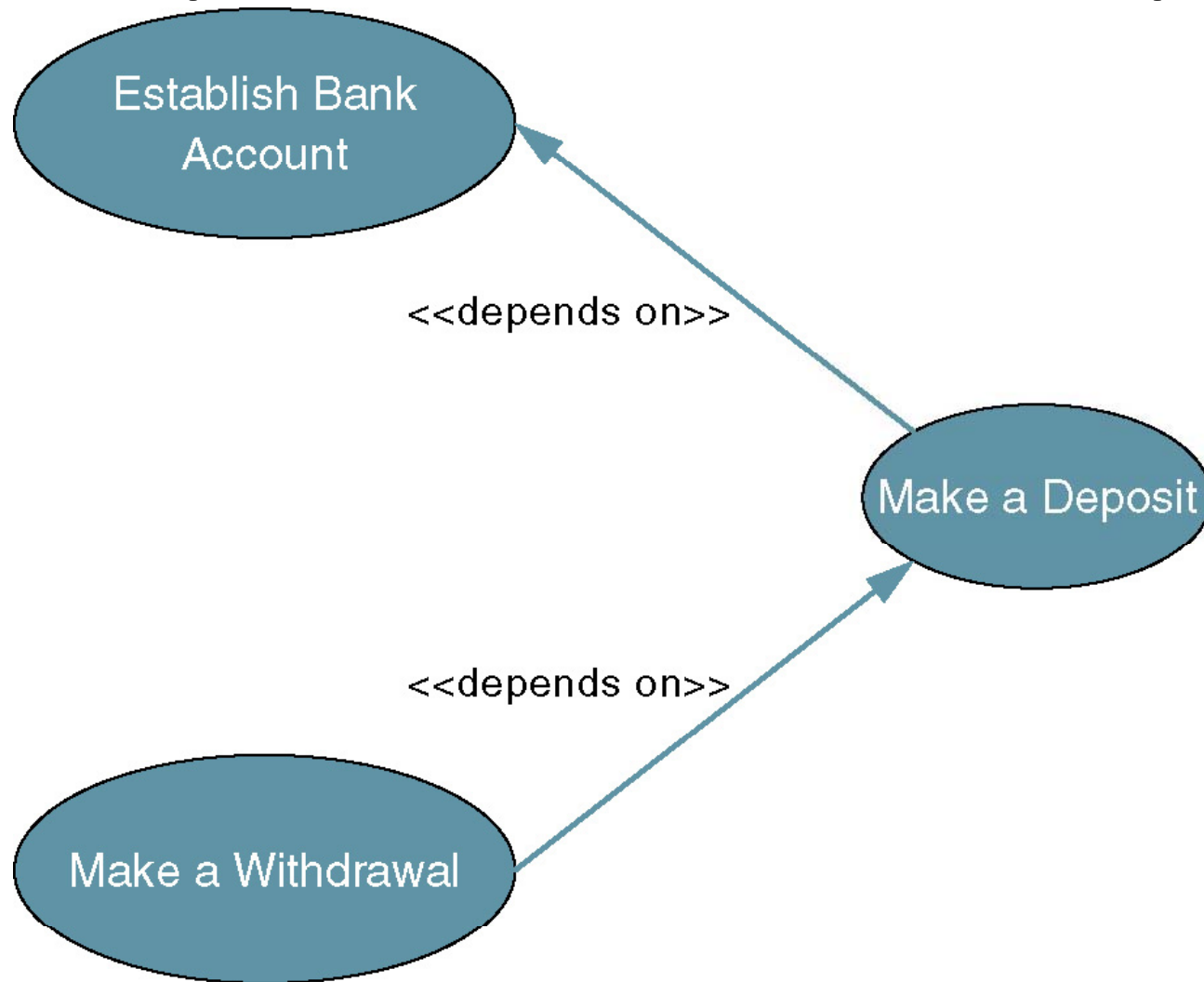
'Inheritance' Relationship

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 headed line beginning at one actor and pointing to the abstract actor whose interactions the first actor inherits.

'Inheritance' Relationship

Before

After
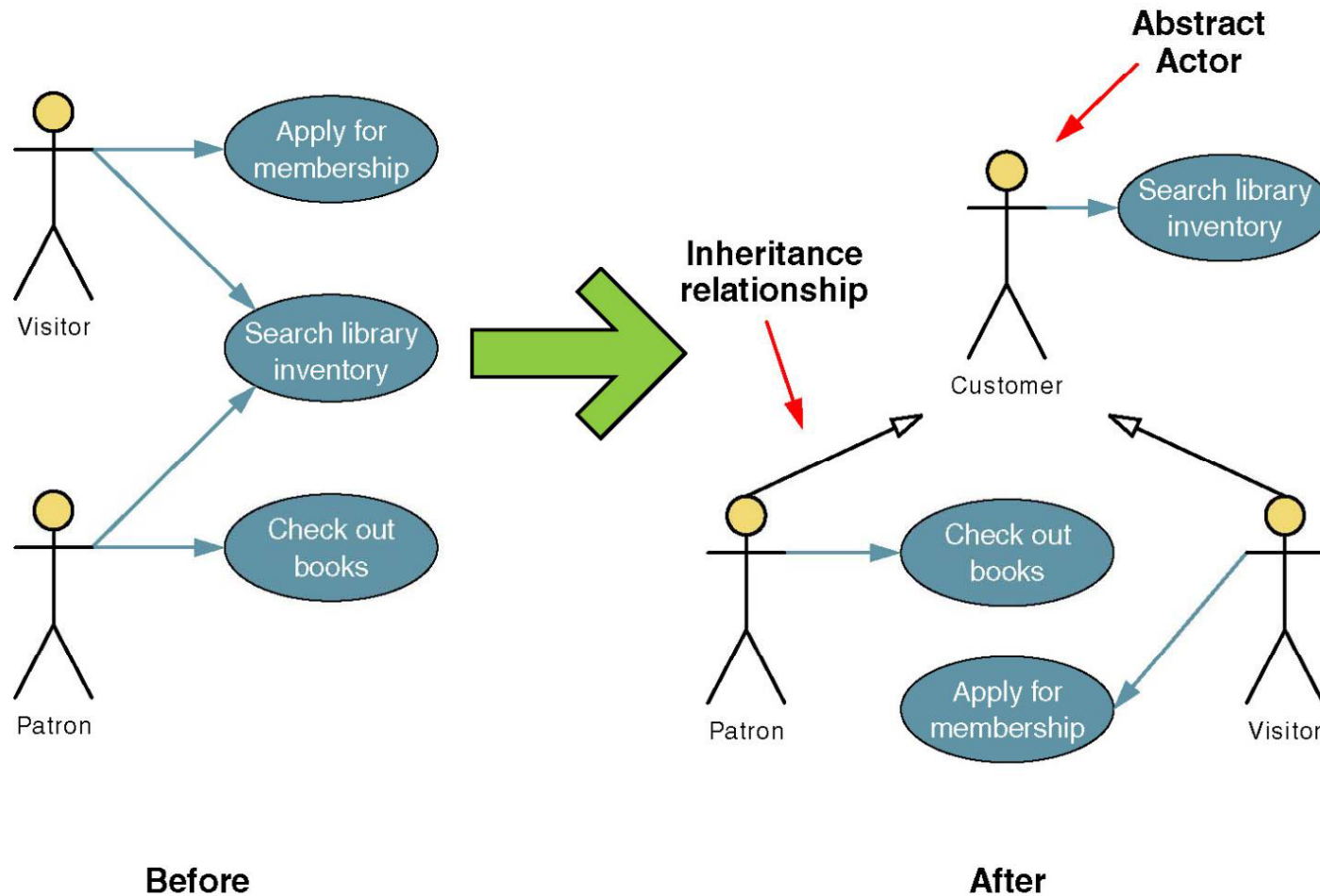
The Process of Requirements Use-Case Modeling

- 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 the system will be built or implemented.

- Steps
  1. Identify business actors.
  2. Identify business use cases.
  3. Construct use-case model diagram.
  4. Document business requirements via 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?

Step 2: Identify Business Requirements Use Cases

- During requirements analysis, strive to identify and document only the most critical, complex, and important use cases, often called *essential* use cases.
- When looking for use cases, ask the following questions:
  - What are the main tasks of the actor?
  - What information does the actor need from 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?

Sample Context Diagram

Member Services Context Diagram

Club Member

- Submit Member Order
- Inquire Account (order & payment history)
- Generate Inquiry Responses
- Send Promotion Offer

Marketing

Sales

- Submit Promotion Information
- Submit Subscription Program
- Generate Various Subscription Reports
- Generate Various Promotion Reports
- Generate Various Sales Reports

Potential Club Member

- Submit Subscription Order (apply for membership)
- Send Subscription Offer

Member Services System

- Send Packing Order

Past Member

- Submit Subscription Renewal
- Send Resubscription Offer

Accounts Receivable

- Submit Member Credit Status Response

- Generate Various Member Reports

Member Services

Distribution Center (Warehouse)

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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)

Step 3: Construct Use-Case Model

Order Subsystem
- Place New Order
- Revise Order
- Cancel Order
- Make Product Inquiry

Subscription Subsystem
- Submit Member Profile Changes
- Submit Subscription Order
- Submit Subscription Program Changes
- Submit Subscription Renewal Order
- Establish Past Member Resubscription Program
- Establish New Memer Subscription Program

Operations Subsystem
- Make Purchase History inquiry
- Generate Daily10-30-60 Day Default Agreement Report

Promotion Subsystem
- Submit New Promotion
- Revise Promotion

Club Member · Potential Member · Past Member · Marketing · Time

initiates

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-

Member Services System

Author (s): _____ ①

Date: _____ ②

Version: ③

		Use-Case Type
Use-Case Name:	Place New Order ④	
Use-Case ID:	MSS-BUC002.00 ⑥	**Use-Case Type**
Priority:	High ⑦	**Business Requirements:** ☑
Source:	Requirement — MSS-R1.00 ⑧	⑤
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-

Member Services System

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

Version:

		Use-Case Type
Use-Case Name:	Place New Order	**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 the entire development effort.

- Project manager or systems analyst uses business requirements use cases to plan (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 the use cases, will create:
  - Use-case ranking and evaluation matrix
  - Use-case dependency diagram

Use-Case Ranking and Priority Matrix

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

- Evaluates use cases on a scale of 1 to 5 against six criteria.
  - Significant impact on the architectural design.
  - Easy to implement but contains significant functionality.
  - Includes risky, time-critical, or complex functions.
  - Involves significant research or new or risky technology.
  - Includes primary business functions.
  - 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** – a 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