

CHAPTER

7

MODELING SYSTEM REQUIREMENTS WITH USE CASES

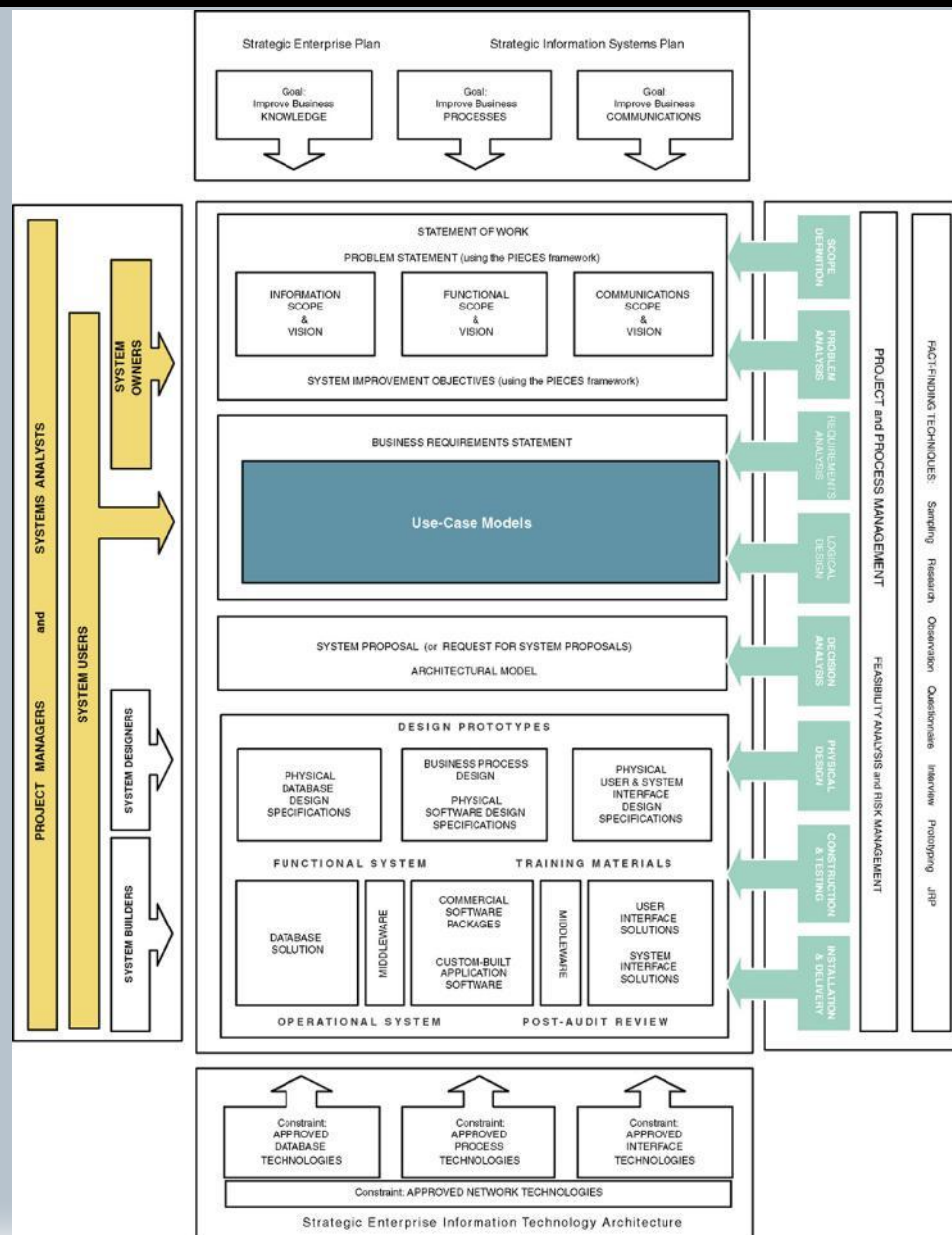


Chapter 7 – Modeling System Requirements with Use Cases

- 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.



Chapter Map



An Introduction to Use-Case Modeling

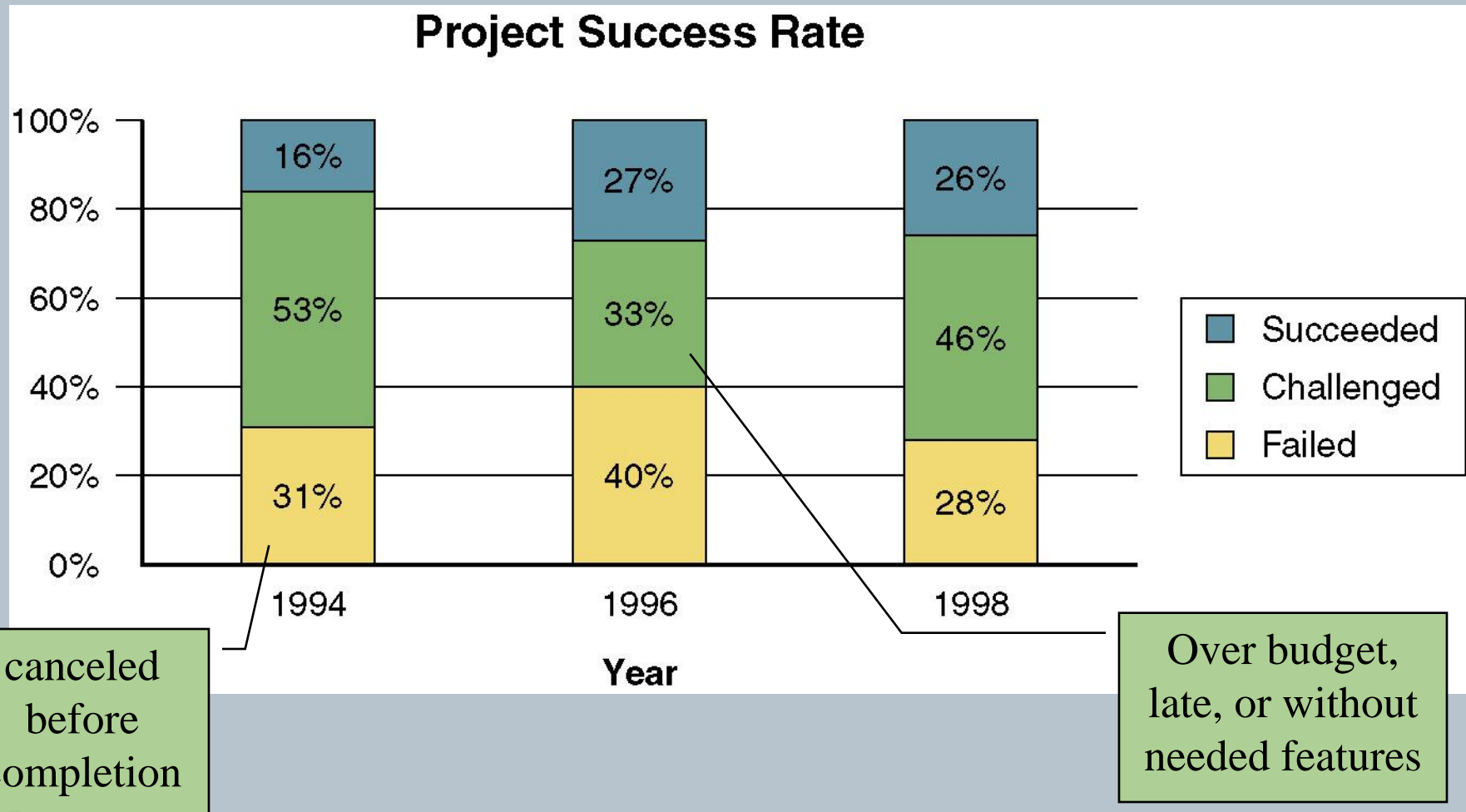
- One of the primary challenges in a system design process is the ability to elicit the correct and necessary system requirements from the stakeholders and specify them in a manner understandable to them so those requirements can be verified and validated.
 - Data and process models, prototypes, requirement specifications.
 - Understood by designers but not by users.
 - Leads to scope creep, schedule creep, cost overruns.

The hardest single part of building a software system is deciding precisely what to build. No other part of the conceptual work is as 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.
- Gained popularity in nonobject development environments because of its usefulness in communicating with users.
- Compliments traditional modeling tools.



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.
- 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.

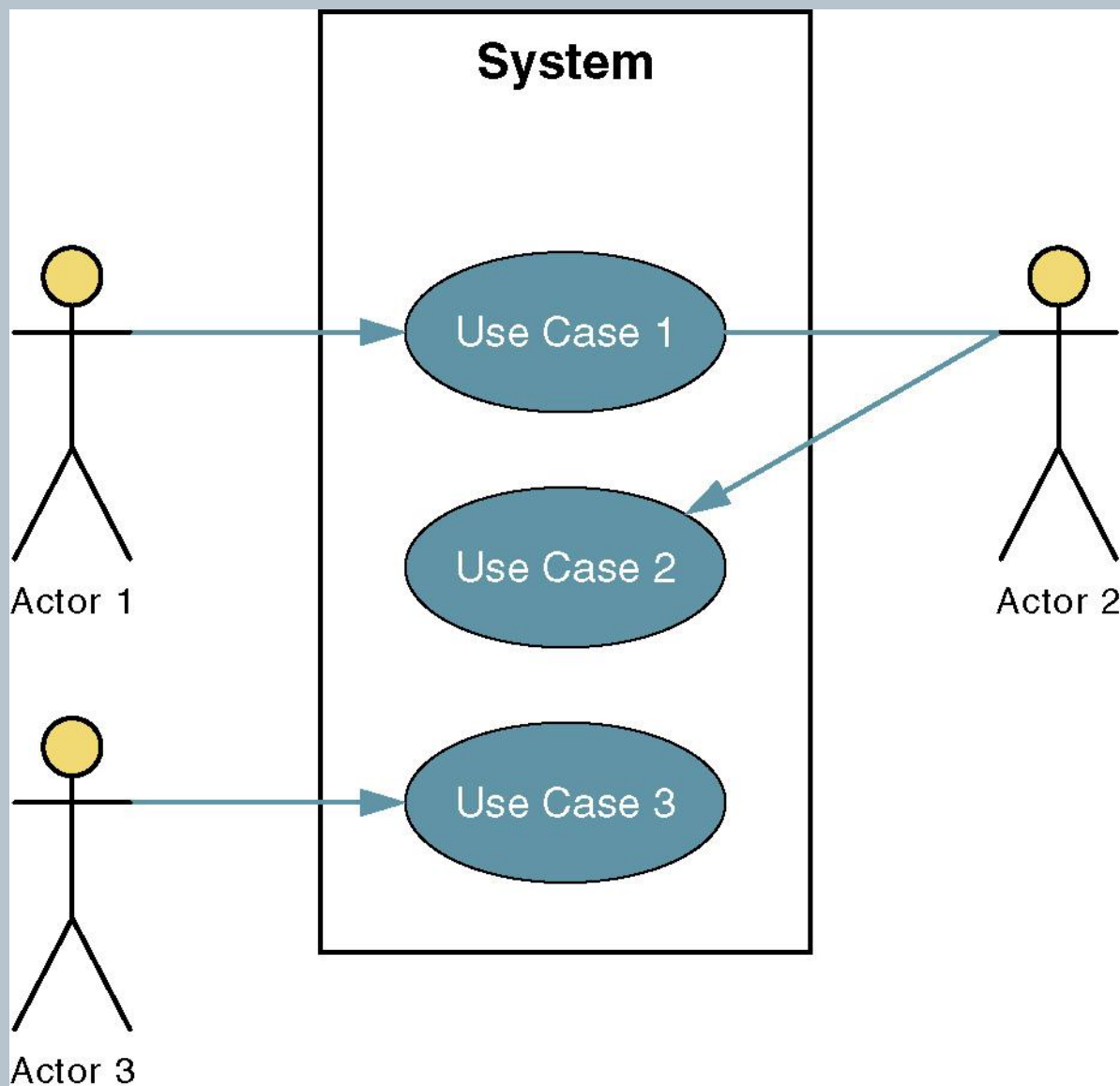
Use-case narrative – a textual description of the business event and how the user will interact with the system to accomplish the task.

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.



Use Case
Symbol

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.



Actor Symbol

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.

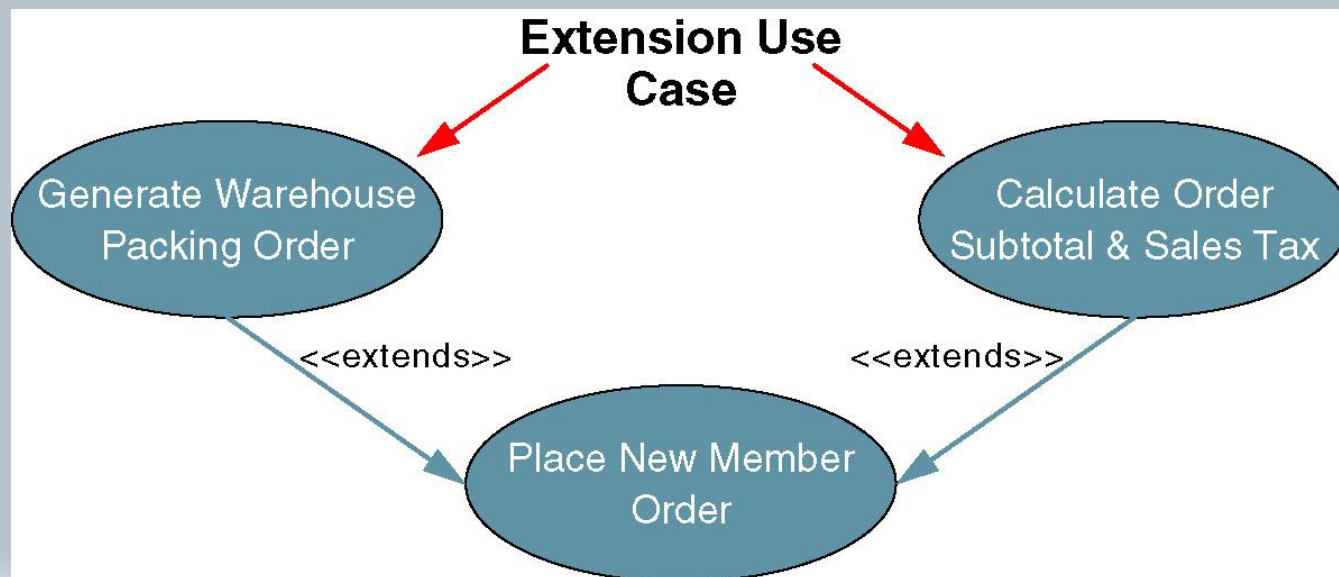
- Association modeled as a solid line connecting the actor and the use case.
- Association with an arrowhead touching the use case indicates that the use case was initiated by the actor.
- Association lacking arrowhead indicates a server/receiver actor.
- Associations may be bidirectional or unidirectional.



Use Case 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.

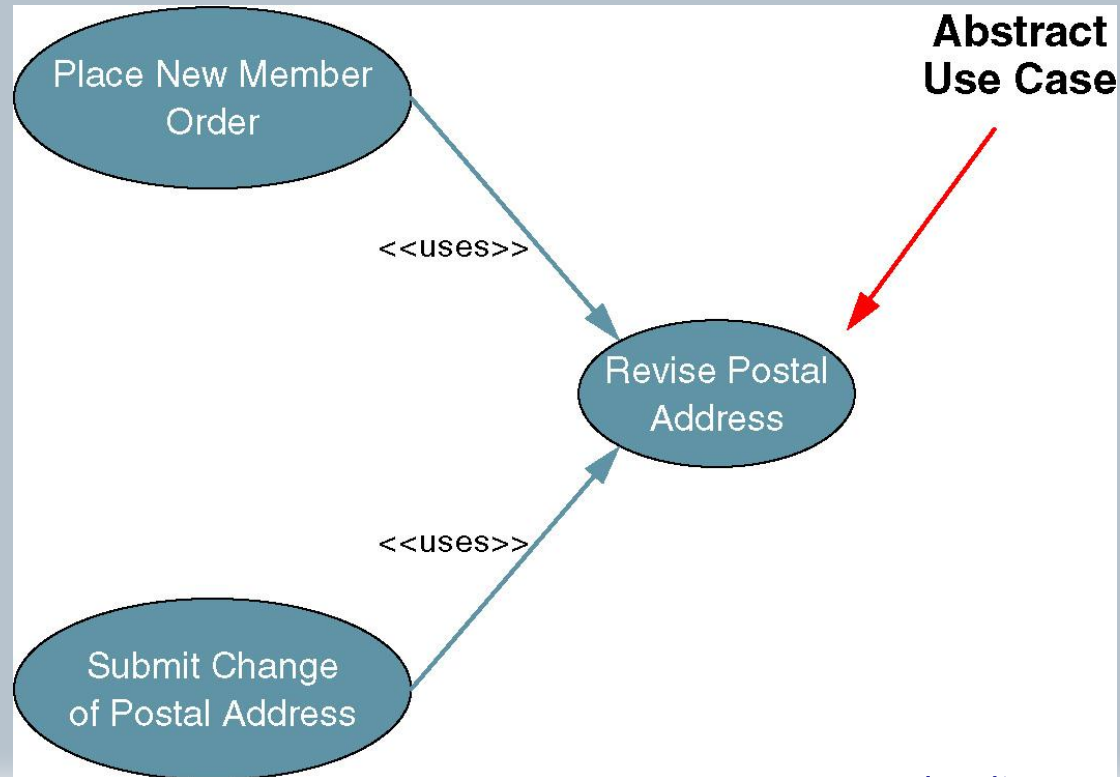
- Relationship between the extension use case and the use case it is extending is called an *extends* relationship.
- Represented as an arrowheaded line beginning at the extension use case and point to the use case it is extending.
- Each extends relationship line is labeled “<<extends>>.”



Use Case 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.

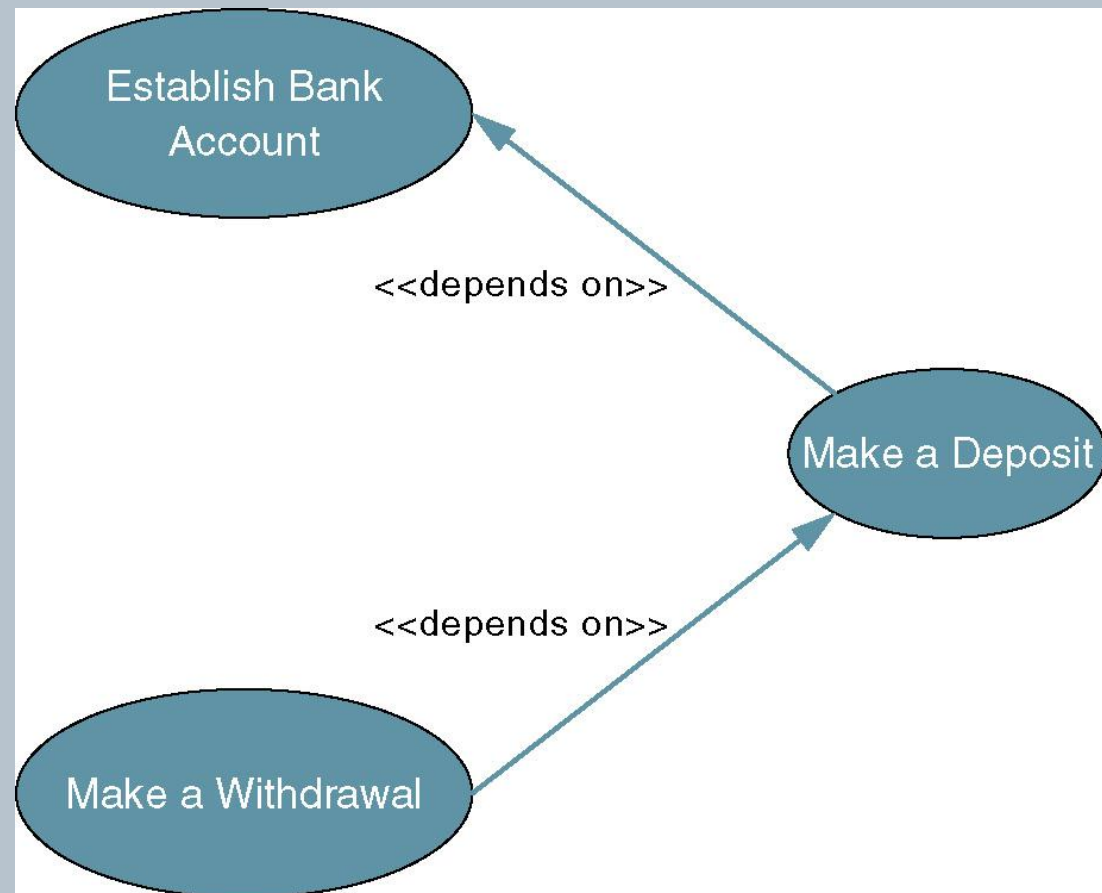
- An abstract case is available for use by any other use case that requires its functionality.
- Relationship between the abstract use case and the use case that uses it is called a *uses* (or *includes*) relationship.
- Depicted as an arrowheaded line beginning at the original use case and pointing to the use case it is using.
- Each uses relationship line is labeled “<<uses>>.”



Use Case Depends On Relationship

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

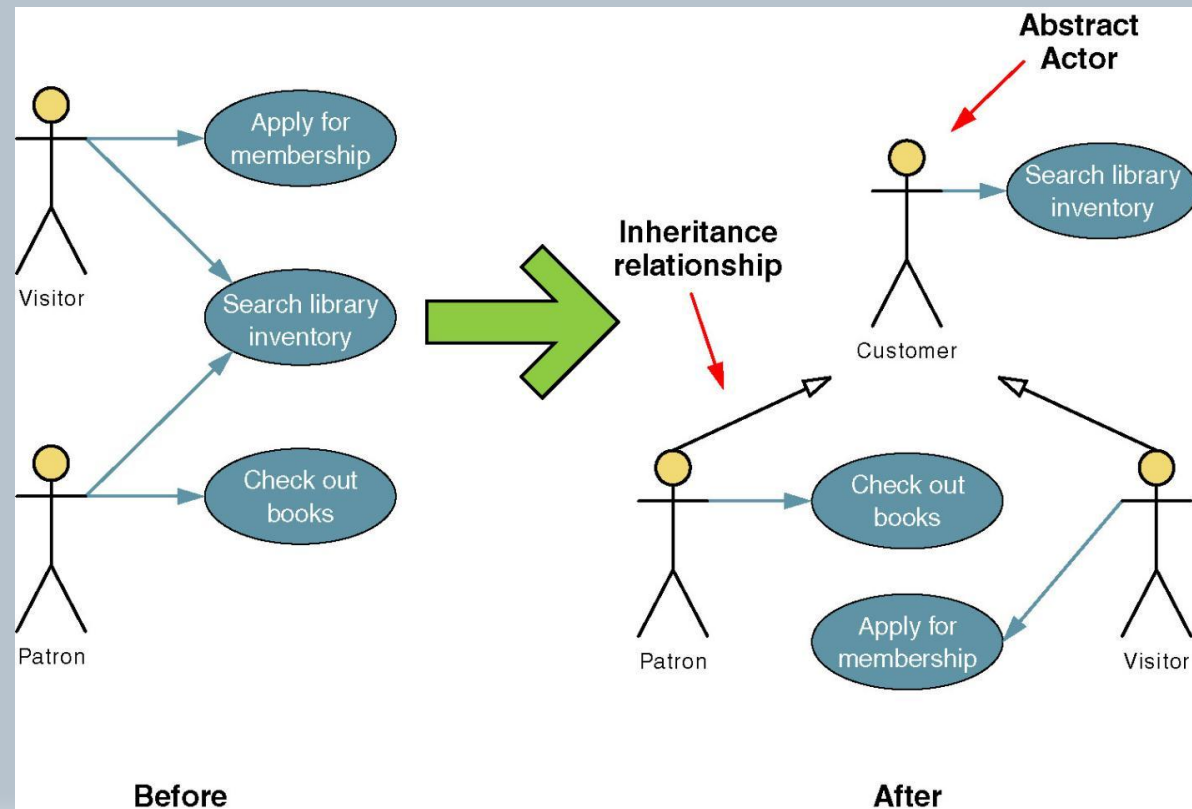
- Can help determine sequence in which use cases need to be developed.
- Depicted as an arrowheaded line beginning at one use case and pointing to a use case it is dependent on.
- Each depends on relationship line is labeled “<<depends on>>.”



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



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.
- To effectively estimate and schedule project, may need to include preliminary “system 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?



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.

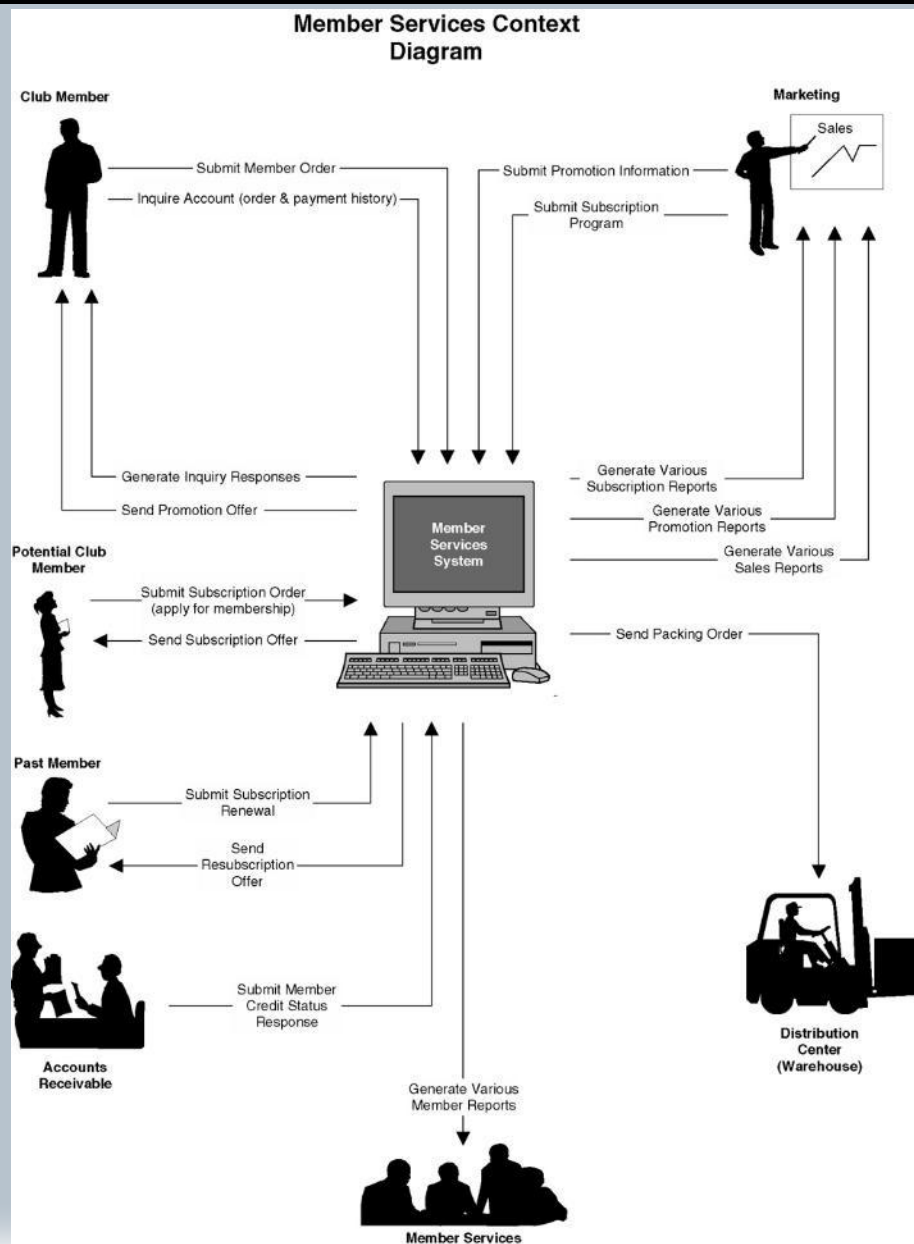


Step 2: Identify Business Requirements Use Cases

- 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



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.")	<ul style="list-style-type: none"> 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.")	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Club member (primary business)
Place New Order	This use case describes the event of a club member submitting an order for SoundStage products.	<ul style="list-style-type: none"> Club member (primary business) Distribution Center (external receiver) Accounts Payable/Receivable (external server)

continued



Sample Use-Case Glossary (continued)

Revise Order	This use case describes the event of a club member revising an order previously placed. (Order must not have shipped.)	<ul style="list-style-type: none"> • 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.)	<ul style="list-style-type: none"> • 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.)	<ul style="list-style-type: none"> • 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.)	<ul style="list-style-type: none"> • Club member (primary business)
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	<ul style="list-style-type: none"> • 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).	<ul style="list-style-type: none"> • Marketing (primary business)

continued



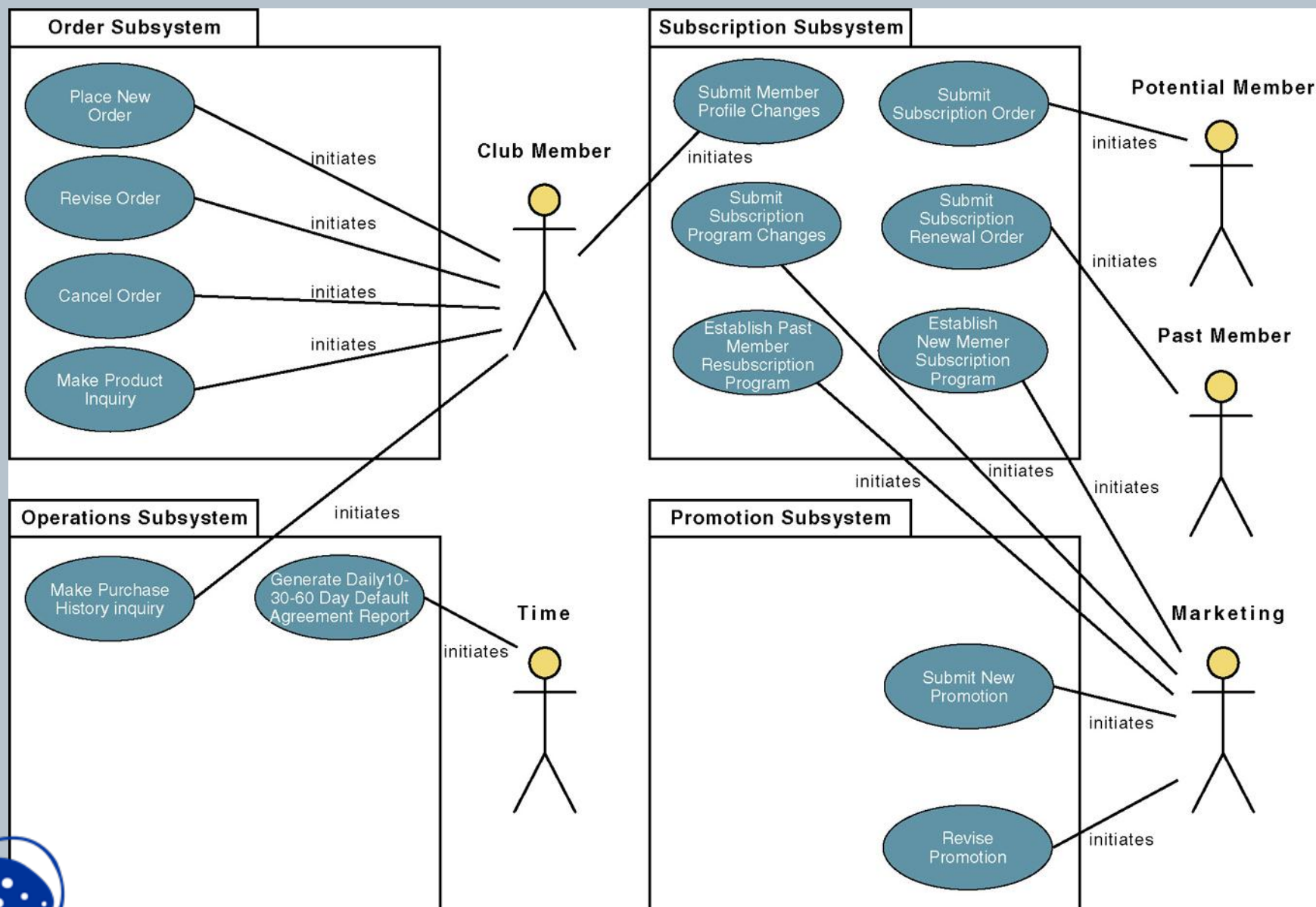
Sample Use-Case Glossary (concluded)

Establish Past Member Resubscription Program	This use case describes the event of the marketing department establishing a resubscription plan to lure back former members.	<ul style="list-style-type: none"> 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.)	<ul style="list-style-type: none"> Marketing (primary business)
Revise Promotion	This use case describes the event of the marketing department revising a promotion.	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Time (initiating actor) Member Services (primary* — external receiver)

* Considered primary because it receives something of measurable value.



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: <input checked="" type="checkbox"/> 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:	<ul style="list-style-type: none"> Warehouse (external receiver) Accounts Receivable (external server) 10 	
Other Interested Stakeholders:	11 <ul style="list-style-type: none"> 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 <p>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.</p>	



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: <input checked="" type="checkbox"/>
Use-Case ID:	MSS-BUC002.00	
Priority:	High	
Source:	Requirement — MSS-R1.00	
Primary Business Actor:	Club member	
Other Participating Actors:	<ul style="list-style-type: none"> • Warehouse (external receiver) • Accounts Receivable (external server) 	
Other Interested Stakeholders:	<ul style="list-style-type: none"> • 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:	<p>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.</p>	
Precondition: ❶	The party (individual or company) submitting the order must be a member.	
Trigger: ❷	This use case is initiated when a new order is submitted.	

continued



Sample Expanded Version of a Use-Case Narrative (cont)

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

continued



Sample Expanded Version of a Use-Case Narrative (cont)

Alternate Courses:	<p>4</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Alt-Step 5: If the quantity ordered of the product is not available, a back order is created.</p> <p>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.</p> <p>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.</p>
Conclusion:	<p>5 This use case concludes when the club member receives a confirmation of the order.</p>
Postcondition:	<p>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.</p>
Business Rules:	<p>7</p> <ul style="list-style-type: none"> 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:	<p>8</p> <ul style="list-style-type: none"> GUI to be provided for Member Services associate, and web screen to be provided for club member.
Assumptions:	<p>9 Procurement will be notified of back orders by a daily report (separate use case).</p>
Open Issues:	<p>10</p> <ol style="list-style-type: none"> 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

- 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 a scale of 1 to 5 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 – 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

