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Use case modelling

Topic 3

ICT284 Systems Analysis and Design

About this topic

In the previous topic, we introduced the concept of functional and non-function requirements and information gathering techniques. In the next few topics we focus on techniques for defining and documenting functional requirements.

We begin by identifying use cases, which provide a description of system functions from the perspective of the user in terminology they understand. Identifying and modelling use cases is central to capturing user requirements.

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Unit learning outcomes addressed in this topic

1. Explain how information systems are used within organisations to fulfil organisational needs
2. **Describe the phases and activities typically involved in the systems development life cycle**
3. Describe the professional roles, skills and ethical issues involved in systems analysis and design work
4. Use a variety of techniques for analysing and defining business problems and opportunities and determining system requirements
5. **Model system requirements using UML, including use case diagrams and descriptions, activity diagrams and domain model class diagrams**
6. Explain the activities involved in systems design, including designing the system environment, application components, user interfaces, database and software
7. Represent early system design using UML, including sequence diagrams, architectural diagrams and design class diagrams
8. Describe tools and techniques for planning, managing and evaluating systems development projects
9. Describe the key features of several different systems development methodologies
10. **Present systems analysis and design documentation in an appropriate, consistent and professional manner**

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Topic learning outcomes

After completing this topic you should be able to:

- Understand how models are used to represent requirements
- Explain why identifying use cases is the key to defining functional requirements
- Identify use cases using the user goal technique
- Identify use cases using the event decomposition technique
- Document use cases using a brief description
- Describe the notation and purpose of use case diagram components
- Document use cases using use case diagrams

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Resources for this topic

READING

- Satzinger, Jackson & Burd, Chapter 3
- Satzinger, Jackson & Burd, Chapter 2 pp.58-60 (Models and modelling)

- There is an interesting article by Jacobson, Spence and Kerr (2016) on the history and current use of use cases on My Unit Readings – read for additional background if you are interested

Except where otherwise referenced, all images in these slides are from those provided with the textbook: Satzinger, J., Jackson, R. and Burd, S. (2016) *Systems Analysis and Design in a Changing World*, 7th edition, Course Technology, Cengage Learning: Boston. ISBN-13 9781305117204

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Tutorial 3 –

Use case modelling

In the previous tutorial we introduced the Conference Coordinator Information System (CCIS), a new information system that is being developed to handle the paper submission and review process for the inaugural Conference on Green IT. As part of project initiation we considered the scope and requirements for the new system in general terms.

In today's tutorial, you will begin to go further into analysis by identifying the functional requirements for the new system with **use case modelling**. You will gain practice with both the user goal technique and the event decomposition technique for identifying use cases, and finally represent them in a **use case diagram**.

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Topic outline

- Defining requirements using models
- Use cases and user stories
- Identifying use cases
  - The User Goal technique
  - The Event Decomposition technique
- Representing and documenting use cases
  - Brief use case descriptions
  - Use case diagrams in UML

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Defining requirements using models

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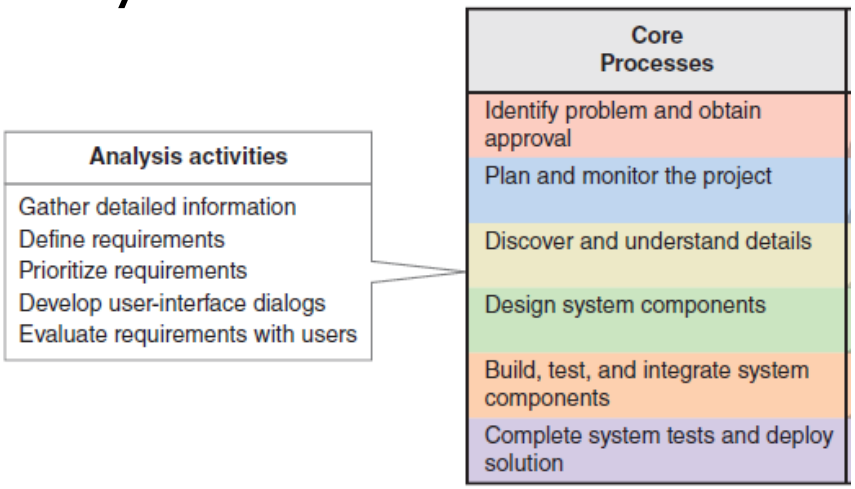
Requirements definition as part of system analysis activities

- In Topic 2 we discussed the activities of systems analysis, including functional and non-functional requirements, information gathering techniques and the role of modelling
- In Topics 3,4,5 we will focus on techniques for *defining and documenting* functional requirements using a variety of *models*



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Models and modelling

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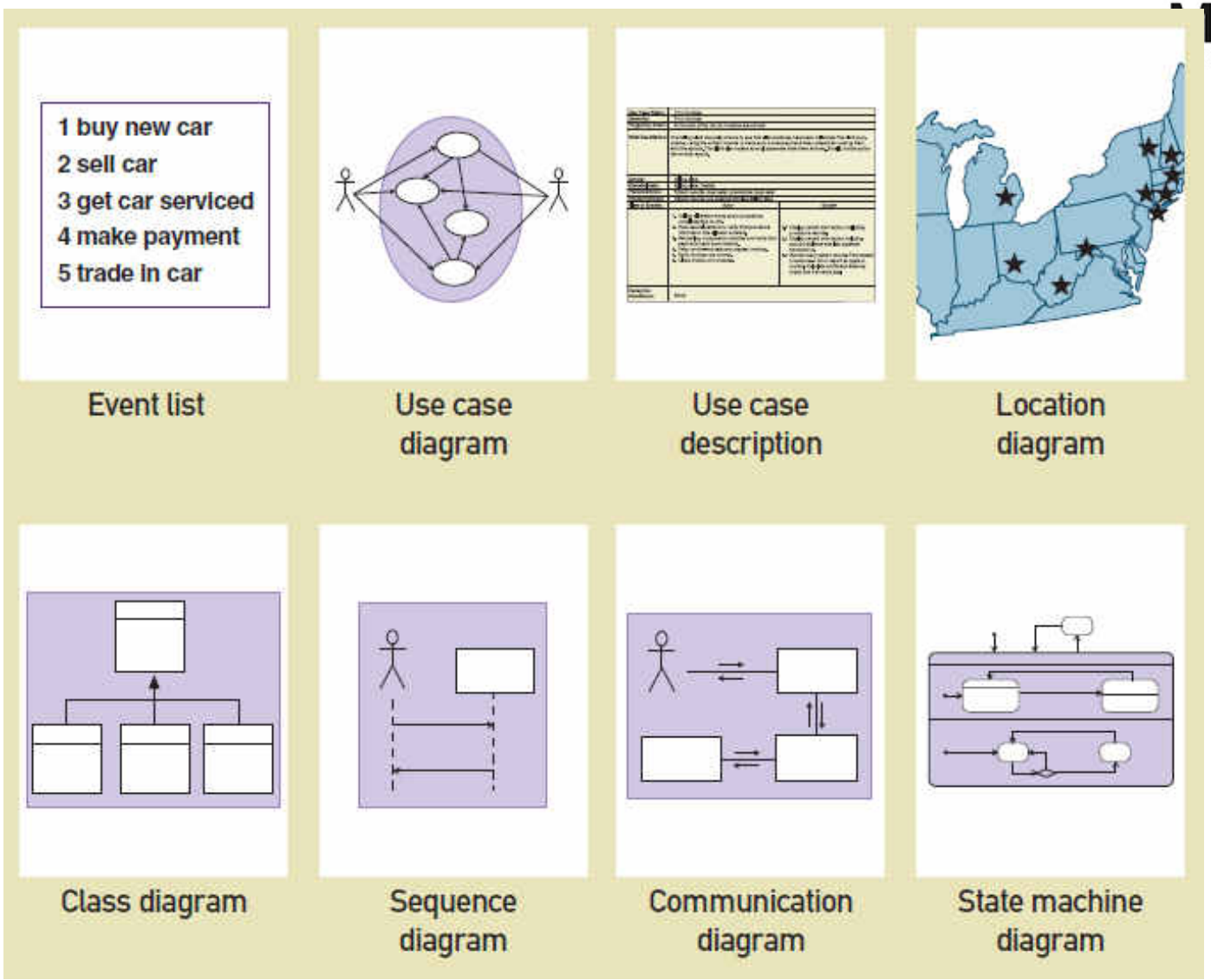
- How do we define requirements? After collecting information, we create **models**
- Model – a representation or abstraction of some aspect of the system being built
- Types of Models
  - Textual model– something written down, described
  - Graphical models– diagram, schematic
  - Mathematical models– formulas, statistics, algorithms
- Unified Modeling Language (UML)
  - Standard graphical modeling symbols/terminology used for information systems

Some analysis and design models



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Reasons for modeling

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- Learning from the modeling process
- Reducing complexity by abstraction
- Remembering all the details
- Communicating with other development team members
- Communicating with a variety of users and stakeholders
- Documenting what was done for future maintenance/enhancement

Summing up…

- A **model** is a representation or abstraction of some aspect of the system being built
- Systems analysis and design involves building many models to define requirements and represent the solution
- Models can help elicit and clarify complex requirements; provide a means of communication among the team and with stakeholders; and provide useful documentation.

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User stories and use cases

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User-centered development

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In recent years there has been a move towards user-centered development and user centered design, partly in order to reduce the number of failed development projects

> **User-centered development** is based on understanding primarily the needs of the stakeholders and the reasons why the system should be developed. Users are heavily involved

User centered development is facilitated by techniques such as **user stories** and **use case modelling**

User stories

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- A **user story** is a single short sentence that states what the user does as part of their work and what they want the system to do
- A standard format is:

"As a **<role >,** I want to **<goal>** so that **<benefit>**"

e.g.

"As a **student**, I want to **enrol in a tutorial** so that **I don't have any clashes**"

- *Acceptance criteria* identify the features that must be present at the completion of the task
- A feature of Agile development approaches

Example of a user story

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User Story

As a shipping clerk, I want to ship an order as accurately as possible as soon as the order details are available.

Acceptance Criteria:

1. *Available order details must pop up on the screen when available.*
2. *Portable display and scan device would cut time in half.*
3. *Sort the items by bin location.*
4. *Indicate number of items in stock for each item and mark backorder for those not available.*
5. *Recommend shipper based on weight, size, and location.*
6. *Print out shipping label for selected shipper.*

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Use cases

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- Whereas user stories are quite brief, **use cases** are usually documented in much more detail by the systems analyst
- A use case is an activity that the system performs in response to a request by the user
- Use cases define the *functional requirements* of the information system

Use cases

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- A **use case** represents a single goal of a system and describes a sequence of activities and user (more generally, actor) interactions in trying to accomplish the goal
- Use cases provide a description of system functions from the perspective of the users in terminology they understand
- A use case will normally describe a *single business task*
    - Open a bank account
    - Order a textbook
    - Buy a drink from a vending machine

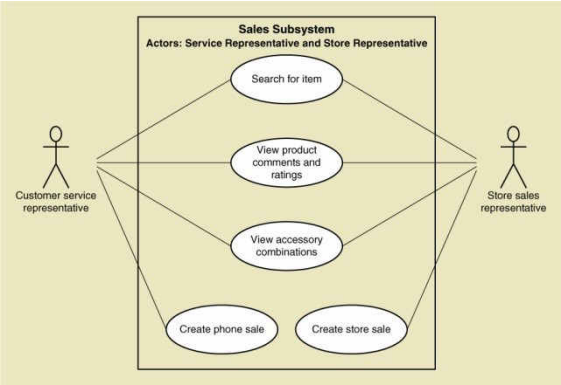
Documenting use cases

1. Use case diagrams

- Graphically depict who will use the system and in what ways the user expects to interact with the system
- Communicate at a high level the scope of the business events that make up the use case

2. Use case descriptions

- Detailed textual descriptions of business events and how users will interact with the system to accomplish tasks



Use case name:	*Create customer account.*	
Scenario:	Create online customer account.	
Triggering event:	New customer wants to set up account online.	
Brief description:	Online customer creates customer account by entering basic information and then following up with one or more addresses and a credit or debit card.	
Actors:	Customer.	
Related use cases:	Might be invoked by the *Check out shopping cart* use case.	
Stakeholders:	Accounting, Marketing, Sales.	
Preconditions:	Customer Account subsystem must be available. Credit/debit authorization services must be available.	
Postconditions:	Customer must be created and saved. One or more Addresses must be created and saved. Credit/debit card information must be validated. Account must be created and saved. Address and Account must be associated with Customer.	
Flow of activities:	**Actor**	**System**
	1. Customer indicates desire to create customer account and enters basic customer information.	1.1 System creates a new customer. 1.2 System prompts for customer addresses.
	2. Customer enters one or more addresses.	2.1 System creates addresses. 2.2 System prompts for credit/debit card.
	3. Customer enters credit/debit card information.	3.1 System creates account. 3.2 System verifies authorization for credit/debit card. 3.3 System associates customer, address, and account. 3.4 System returns valid customer account details.
Exception conditions:	1.1 Basic customer data are incomplete. 2.1 The address isn't valid. 3.2 Credit/debit information isn't valid.	

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Identifying use cases

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Two main techniques:

User goal technique

- Describe from the point of view of what the user is trying to achieve – how the system must respond to this

Event decomposition technique

- Describe from the point of view of how the system must respond to external, temporal and state change events

Both techniques can be used to gain a more complete picture of requirements

Summing up…

- **Use cases** are a way of representing and documenting the functional requirements of a system
- Use case modelling is an important technique in user-centered development
- Use cases provide a description of system functions from the perspective of the users in terminology they understand
- A use case will normally describe a *single business task*
- The **user goal** and **event decomposition** techniques can be used for eliciting use cases, and they can be documented with **use case diagrams** or **use case descriptions.**

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Identifying use cases – user goal technique

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User goal technique

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- This technique is the most common in industry
- Simple and effective
- Identify all of the potential categories of users of the system
- Interview and ask them to describe the tasks the computer can help them with
- Probe further to refine the tasks into specific user goals, "I need to *Ship items*, *Track a shipment*, *Create a return*"

User goal technique

Some RMO CSMS Users and Goals

User	User goal and resulting use case
Potential customer	Search for item Fill shopping cart View product rating and comments
Marketing manager	Add/update product information Add/update promotion Produce sales history report
Shipping personnel	Ship order Track shipment Create item return

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User goal technique:
Specific steps

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1. Identify all the potential users for the new system
2. Classify the potential users in terms of their functional role (e.g., shipping, marketing, sales)
3. Further classify potential users by organizational level (e.g., operational, management, executive)
4. For each type of user, interview them to find a list of specific goals they will have when using the new system (current goals and innovative functions to add value)

Looking for users (actors)

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Consider 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?

Looking for user goals

Consider 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?

User goal technique
Specific steps (continued)

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5. Create a list of preliminary use cases organized by type of user. State in the form 'verb-noun' (e.g. 'update order')

Think of it stated in the form 'the [actor] uses the system to…'

6. Look for duplicates with similar use case names and resolve inconsistencies
7. Identify where different types of users need the same use cases
8. Review the completed list with each type of user and then with interested stakeholders

What level of detail?

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"Enter name" ?

"Enrol in unit" ?

"Do end-of-month banking" ?

- Look for use cases that correspond to a single identifiable task or *elementary business process* (EBP)

Elementary business process EBP

- EBP is a fundamental business process performed by one person, in one place, in response to a business event, and which leaves the system in a stable and consistent state
- A useful question to ask is whether there can be any long intervals within the task, or if it must be completed without interruption

Manage job schedule →

Schedule jobs, reschedule jobs

Example use case list

CSMS Sales Subsystem	
Use cases	**Users/actors**
Search for item	Customer, customer service representative, store sales representative
View product comments and ratings	Customer, customer service representative, store sales representative
View accessory combinations	Customer, customer service representative, store sales representative
Fill shopping cart	Customer
Empty shopping cart	Customer
Check out shopping cart	Customer
Fill reserve cart	Customer
Empty reserve cart	Customer
Convert reserve cart	Customer
Create phone sale	Customer service representative
Create store sale	Store sales representative

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Summing up…

- The **user goal technique** identifies potential use cases from the point of view of each type of **user** (actor)
- Think of it stated in the form ‘the [actor] uses the system to…’
- Use cases are expressed in the form ***verb-noun***
- The level of detail is important - look for use cases that correspond to a single identifiable task or **elementary business process** (EBP)

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Identifying use cases – event decomposition technique

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Event decomposition technique

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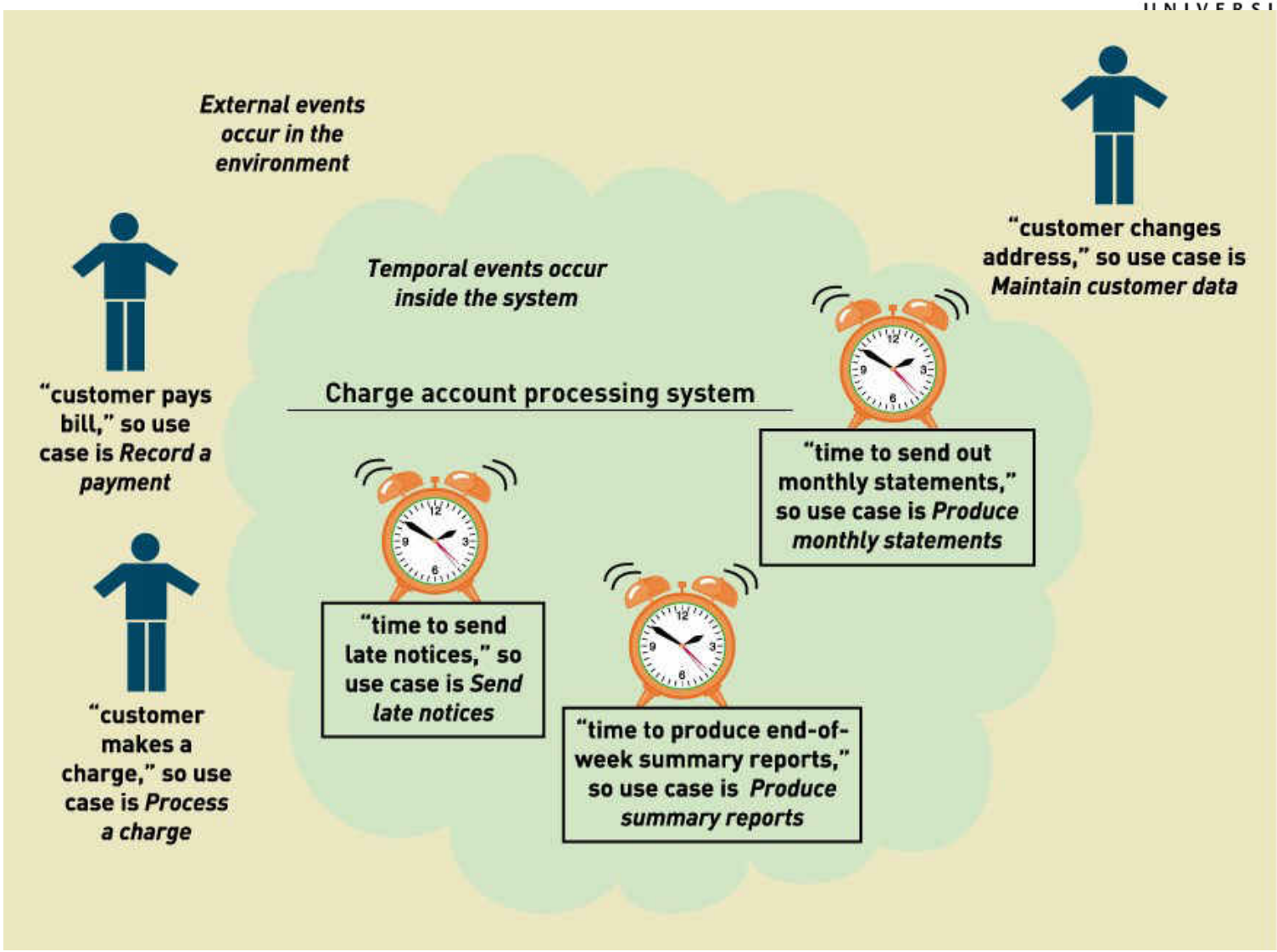
- More comprehensive and complete technique
- Identify the **events** that occur to which the system must respond.
- Event – something that occurs at a specific time and place, can be described, and should be remembered by the system
- For each event, name a use case (verb-noun) that describes what the system does when the event occurs

Events and resultant use cases



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Three types of events

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External event

- an event that occurs *outside the system*, usually initiated by an external agent or actor
- e.g. Customer buys a product, Sales manager wants update on production plans

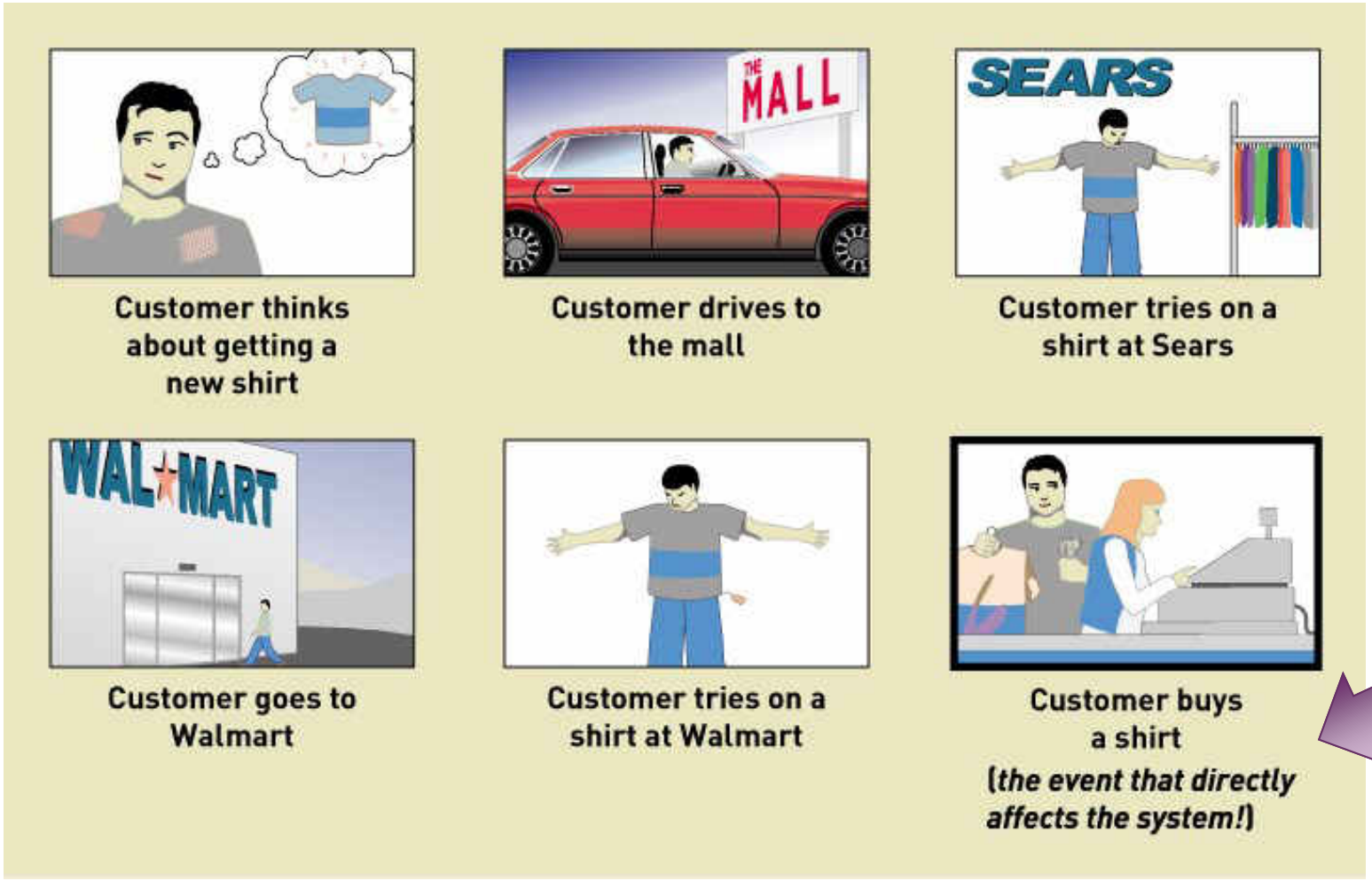
Temporal event

- an event that occurs as a result of *reaching a point in time*
- e.g. Payroll operations, regular reporting

State event

- an event that occurs when something happens *inside* the system that triggers some process
- e.g. reorder point is reached for inventory item

Finding the actual event that affects the system



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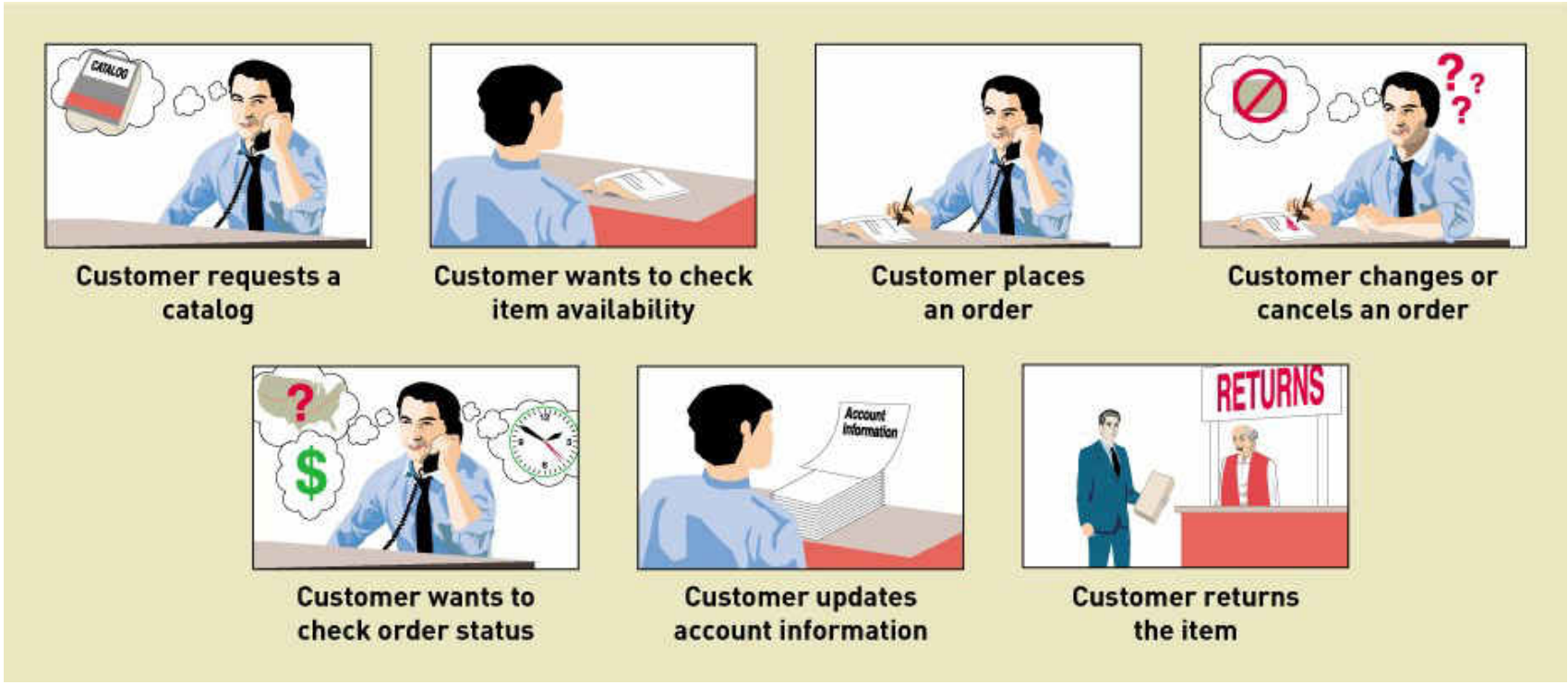
Tracing a sequence of transactions resulting in many events



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Event decomposition technique: Specific Steps

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1. Consider the external events in the system environment that require a response from the system.
2. For each external event, identify and name the use case that the system requires

External event checklist

- External agent or actor wants something resulting in a transaction

  … Customer buys a product

- External agent or actor wants some information

  … Customer wants to know product details

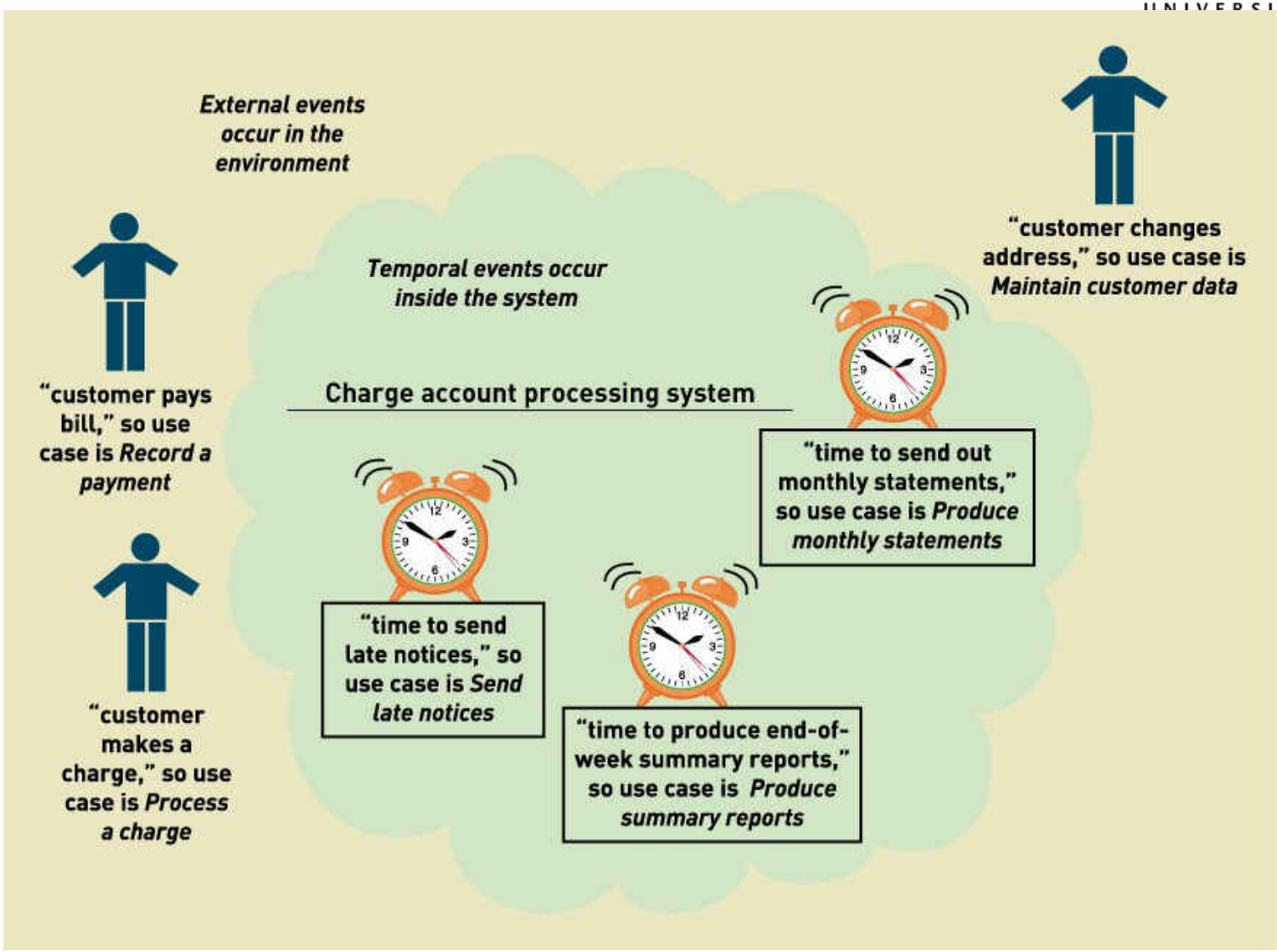
- External data changed and needs to be updated

  … Customer has new address and phone

- Management wants some information

  … Sales manager wants update on production plans

External and temporal events



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Quick quiz:

Which of the following is an example of an **external** event?

a. Month end billing is started

b. User logs into the system

c. Customer updates address

d. Inventory reorder occurs

Event decomposition technique: Specific Steps cont'd

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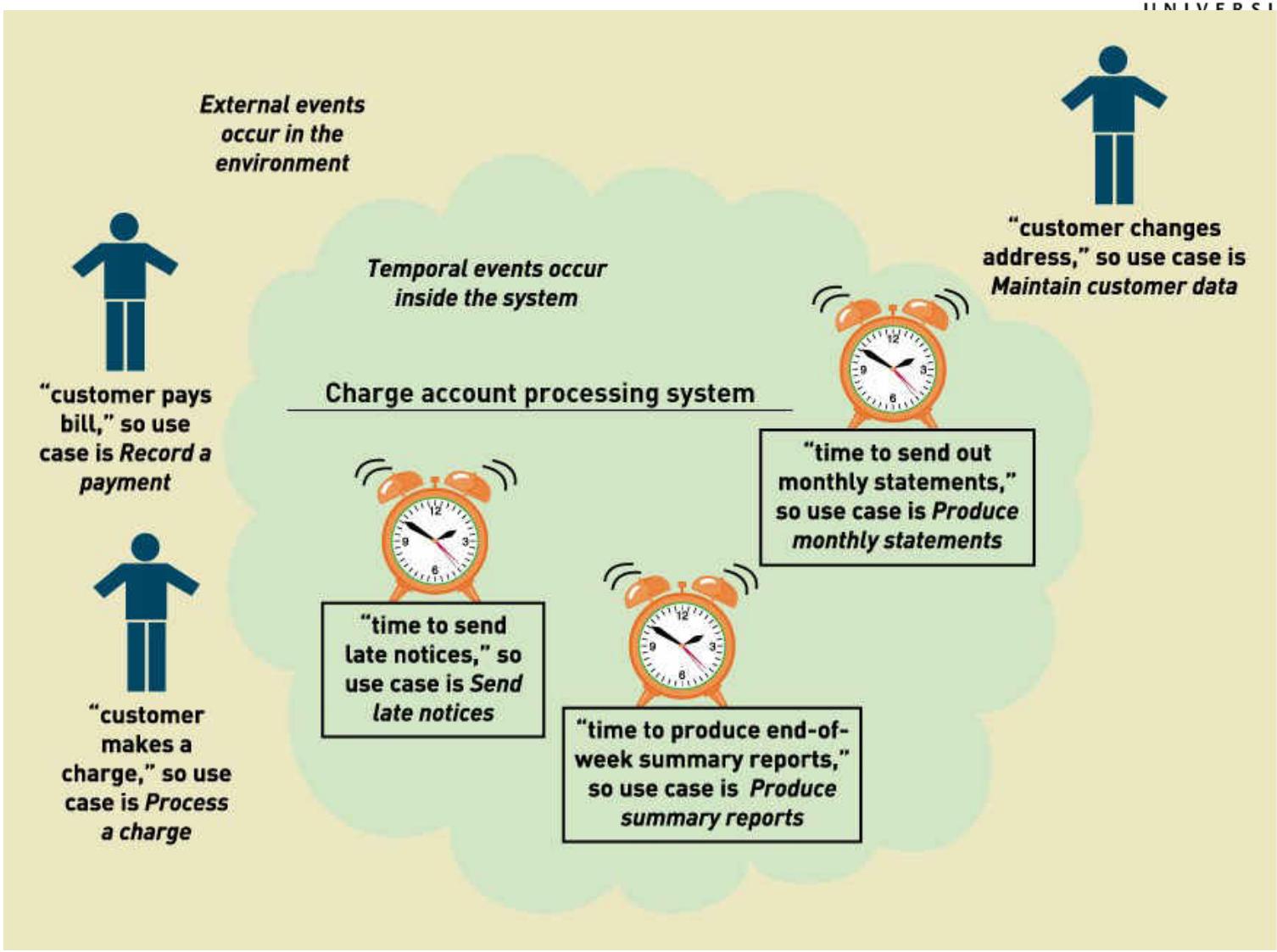
3. Consider the temporal events that require a response from the system.
4. For each temporal event, identify and name the use case that the system requires and then establish the point of time that will trigger the use case

Temporal event checklist

- Internal outputs needed at points in time
  - … Management reports (summary or exception)
  - … Operational reports (detailed transactions)
  - … Internal statements and documents (including payroll)
- External outputs needed at points of time
  - … Statements, status reports, bills, reminders

External and temporal events



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Quick quiz:

Which of the following is an example of a **temporal** event?

a. Month end billing is started

b. User logs into the system

c. Customer updates address

d. Inventory reorder occurs

Event decomposition technique:
Specific Steps cont'd

5. Consider the **state events** that the system might respond to, particularly if it is a real-time system in which devices or internal state changes trigger use cases.
6. For each state event, identify and name the use case that the system requires and then define the state change.

Quick quiz:

Which of the following is an example of a **state** event?

a. A customer places an order

b. It is time to send a late notice

c. Management checks order status

d. Inventory reorder point is reached

Event decomposition technique:
Specific Steps cont'd

7. When events and use cases are defined, check to see if they are required by using the **perfect technology assumption**. Do not include events that involve such system controls as login, logout, change password, and backup or restore the database, as these are put in later

Perfect technology assumption

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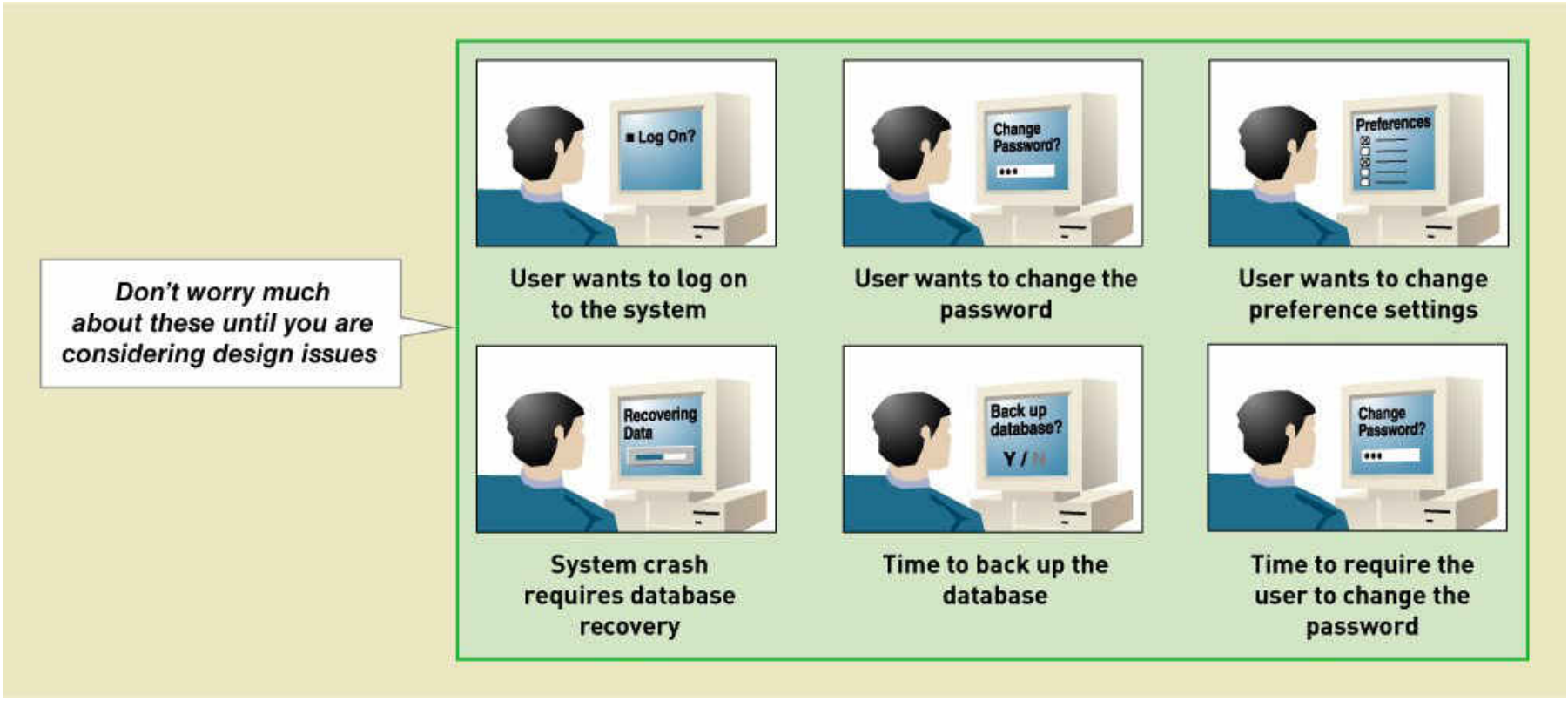
Don’t worry about functions built into system because of limits in technology and people. Wait until design.



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Event decomposition technique: Benefits

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- Events are broader than user goals: capture temporal and state events
- Help decompose at the right level of analysis: the *elementary business process* (EBP)
- Uses perfect technology assumption to make sure functions that support the users work are identified and not additional functions for security and system controls

Documenting use cases identified by the event decomposition technique

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- Event – name of the event
- Event type – external, temporal, state
- Trigger – what tells the system that an event has occurred
- Use case – how the system responds to the event

Summing up…

- The **event decomposition technique** is more comprehensive than the user goal technique for identifying use cases
- It identified use cases by identifying the **events** that occur to which the system must respond – the response is the use case
- An **event** is something that occurs at a specific time and place, can be described, and should be remembered by the system
- There are three types of events: **external** (triggered by a user); **temporal** (triggered by time) and **state** (triggered by some internal state of the system)

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Documenting use cases – use case descriptions

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Documenting with use case descriptions

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- A textual description of the use case
- Document first at high level to quickly obtain an understanding of the events and magnitude of the system – i.e. **brief description**
- Then expand to a fully-developed business requirement use case description.
  - Include both the use case's typical course of events and its alternative courses

Brief use case descriptions

A brief use case description is often a one sentence description showing the main steps in a use case

Use case	Brief use case description
Create customer account	User/actor enters new customer account data, and the system assigns account number, creates a customer record, and creates an account record.
Look up customer	User/actor enters customer account number, and the system retrieves and displays customer and account data.
Process account adjustment	User/actor enters order number, and the system retrieves customer and order data; actor enters adjustment amount, and the system creates a transaction record for the adjustment.

The brief description will eventually be expanded to a more detailed one (later slide and topic)

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Example of a use case list with brief descriptions

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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)

Image from Whitten, J.L., Bentley, L.D. & Dittman, K.C., (2004), Systems Analysis and Design Methods, 6th Edition, McGraw-Hill. Figure 7.10

Fully-developed use case description

Use case name:	*Create customer account.*	
Scenario:	Create online customer account.	
Triggering event:	New customer wants to set up account online.	
Brief description:	Online customer creates customer account by entering basic information and then following up with one or more addresses and a credit or debit card.	
Actors:	Customer.	
Related use cases:	Might be invoked by the *Check out shopping cart* use case.	
Stakeholders:	Accounting, Marketing, Sales.	
Preconditions:	Customer Account subsystem must be available. Credit/debit authorization services must be available.	
Postconditions:	Customer must be created and saved. One or more Addresses must be created and saved. Credit/debit card information must be validated. Account must be created and saved. Address and Account must be associated with Customer.	
Flow of activities:	**Actor**	**System**
	1. Customer indicates desire to create customer account and enters basic customer information. 2. Customer enters one or more addresses. 3. Customer enters credit/debit card information.	1.1 System creates a new customer. 1.2 System prompts for customer addresses. 2.1 System creates addresses. 2.2 System prompts for credit/debit card. 3.1 System creates account. 3.2 System verifies authorization for credit/debit card. 3.3 System associates customer, address, and account. 3.4 System returns valid customer account details.
Exception conditions:	1.1 Basic customer data are incomplete. 2.1 The address isn't valid. 3.2 Credit/debit information isn't valid.	

(More in topic 5)

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Summing up…

- Use cases can be documented in textual form, providing at least the use case name and a brief description
- Additional information about the use case can be added, and eventually a fully-developed use case description is developed for complex use cases

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Documenting use cases – UML use case diagrams

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Use case diagrams

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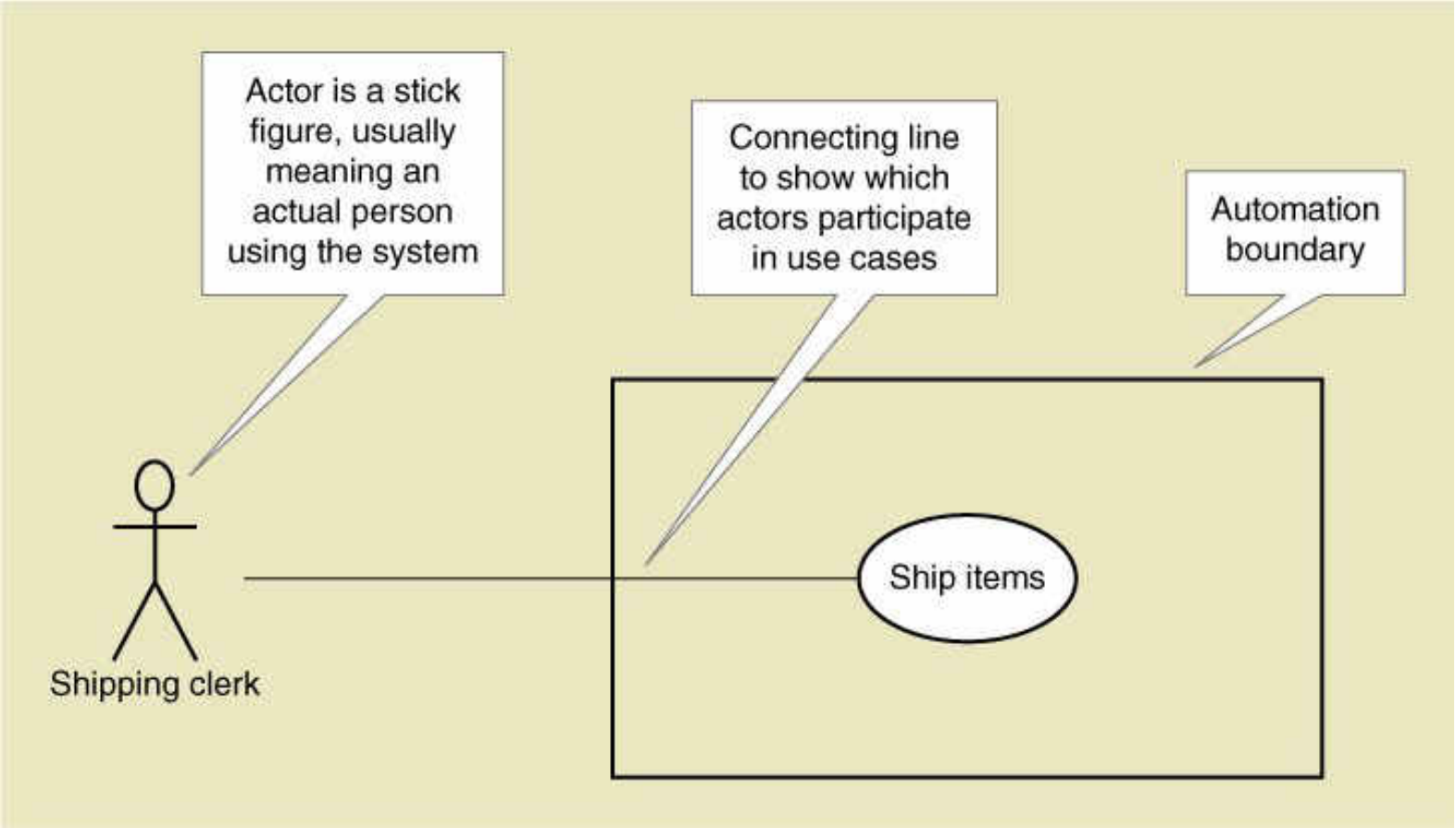
- Use case diagram— a UML model used to graphically show use cases and their relationships to **actors**
- *Actor* is the UML name for a end user
- Automation boundary or system boundary - the boundary between the system itself and the actors who use it

Use case diagrams - Symbols



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Drawing use case diagrams

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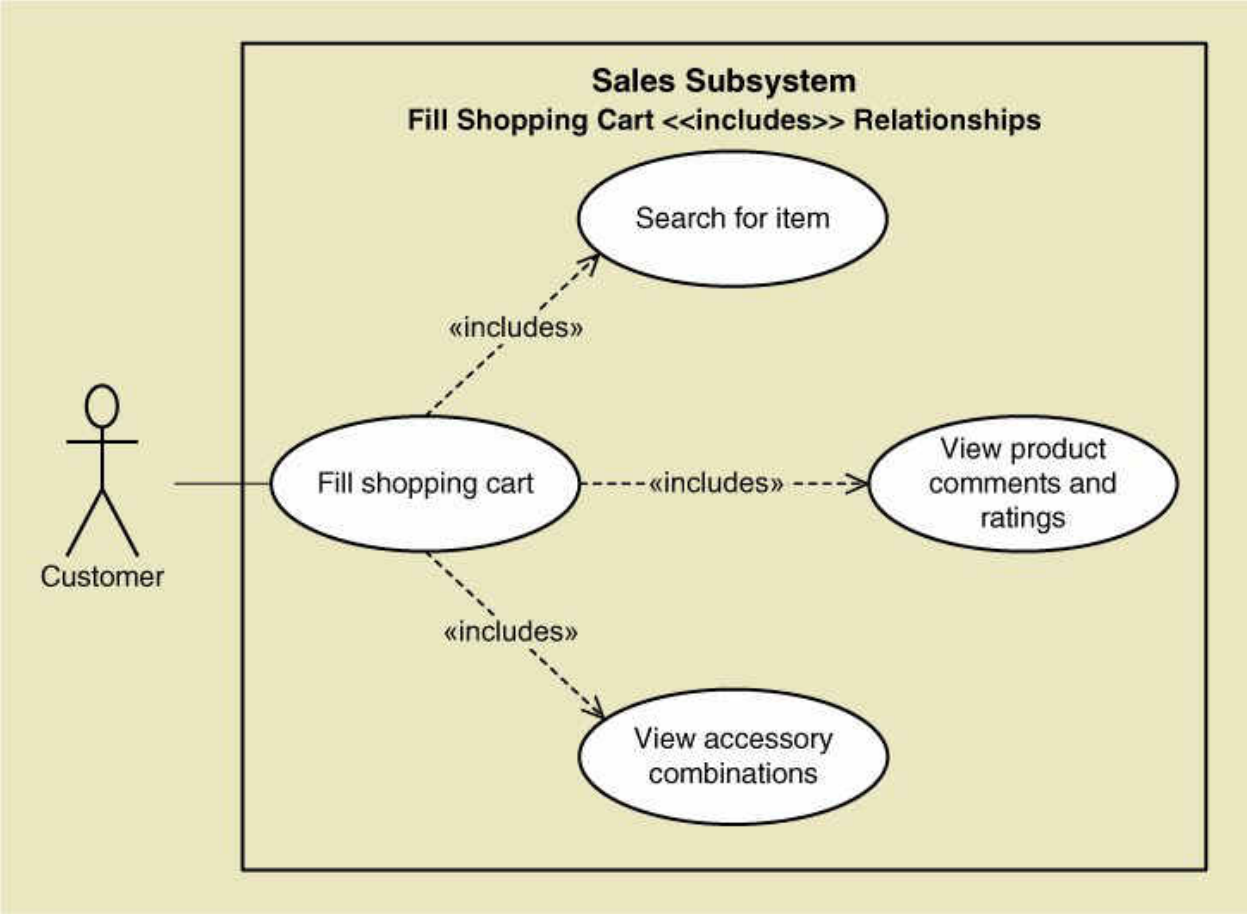
- Always include the name of the system or subsystem
- Name actors for roles rather than individuals where possible
- Name the use case *verb-noun* and use meaningful names
- Suggest importance or sequence by top-bottom, left-right for readability
- Relationships between use cases:

  <<include>>

  << extend>>

Use case diagrams
The <<include>> relationship

- A relationship between use cases where one use case is stereotypically included within the other use case— like a called subroutine. Arrow points to subroutine



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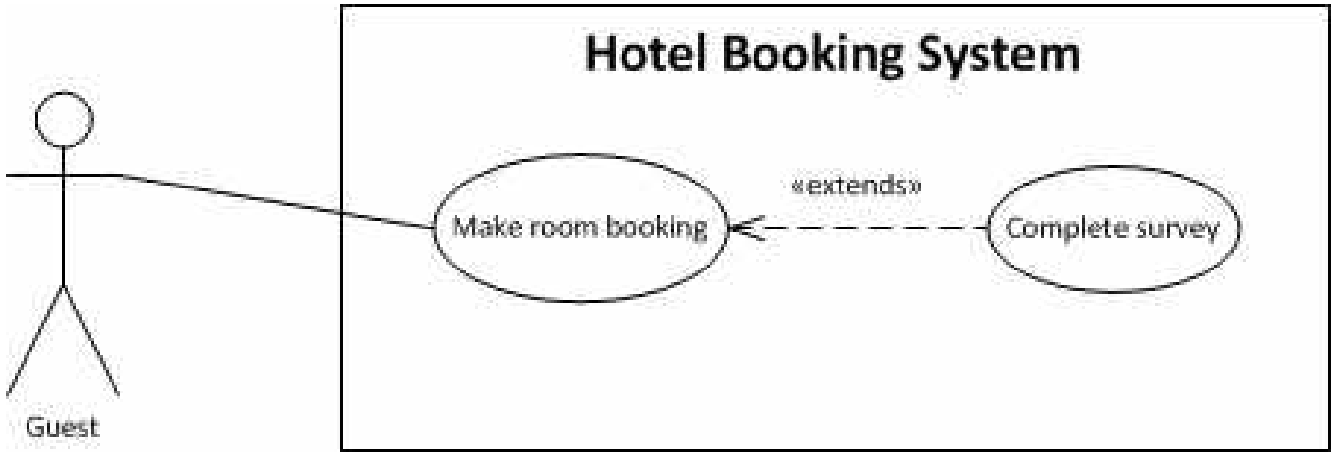
Use case diagrams
The <<extend>> relationship

- A relationship between use cases where the behaviour of the use case can be extended by another (optional) use case. Arrow points towards extended use case



Own image. See also http://www.uml-diagrams.org/use-case-extend.html

Using use case diagrams to confirm requirements

1. Identify all the stakeholders and users who would benefit by seeing a use case diagram
2. Determine what each stakeholder or user needs to review in a use case diagram
3. For each potential communication need, select the use cases and actors to show and draw the use case diagram
4. Name each use case diagram and then note how and when the diagram should be used to review use cases with stakeholders and users

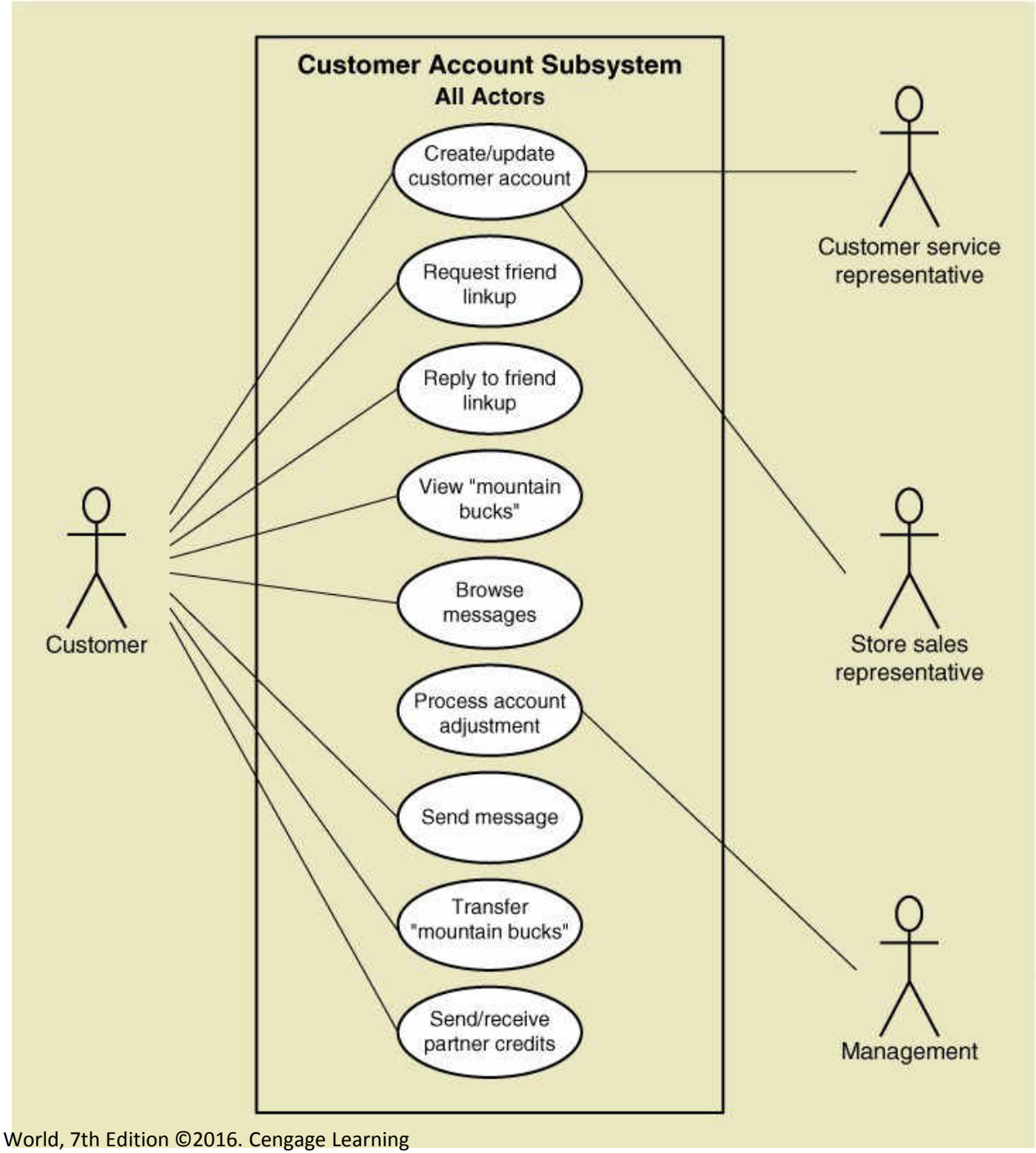
Using use case diagrams to confirm requirements

Some possibilities are shown on the next few slides:

- Individual subsystems
- Use cases for particular actors
- Use cases shared by different actors

Use case diagrams

Draw for each subsystem



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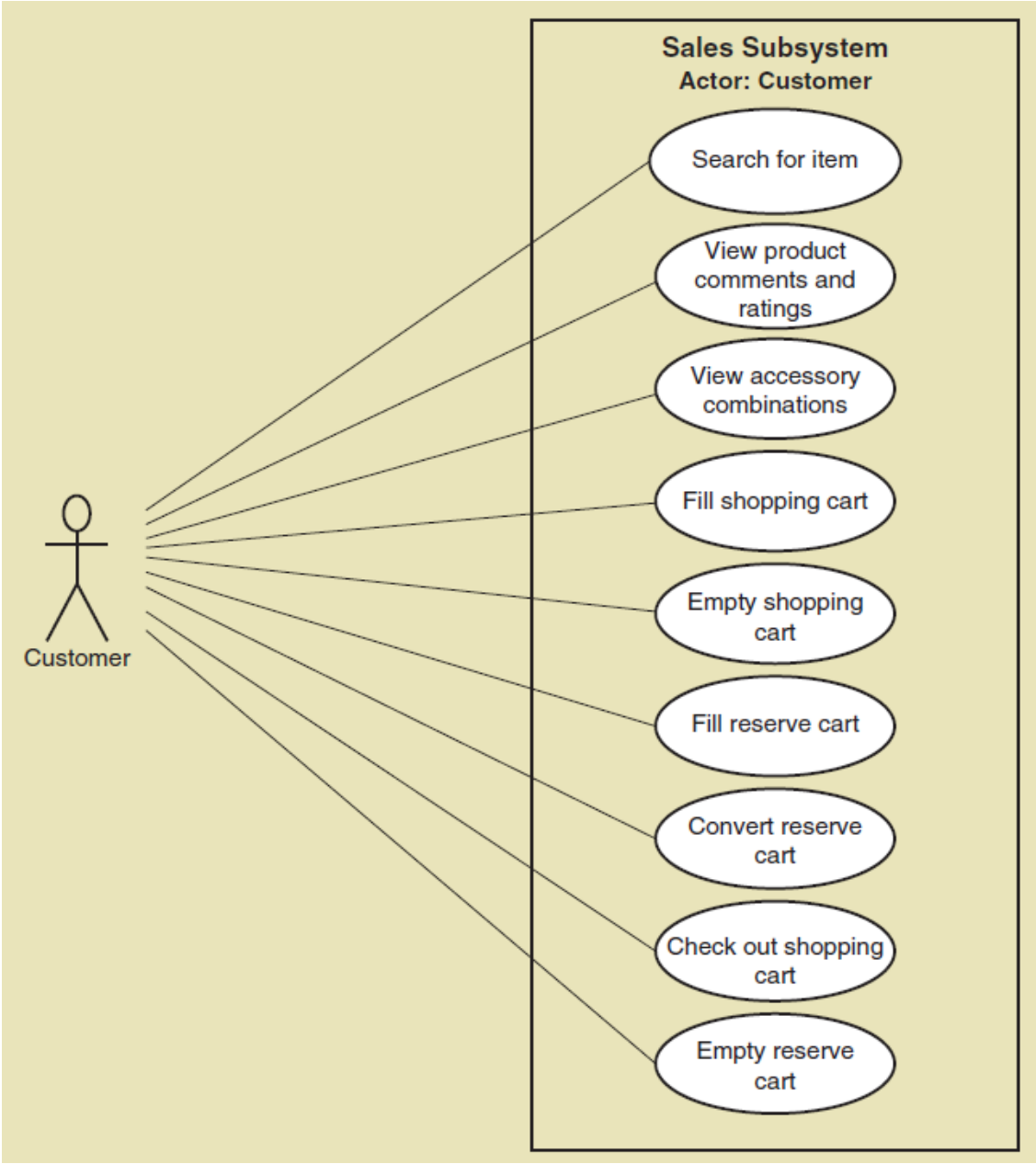
Use case diagrams

Draw for particular actor, such as customer



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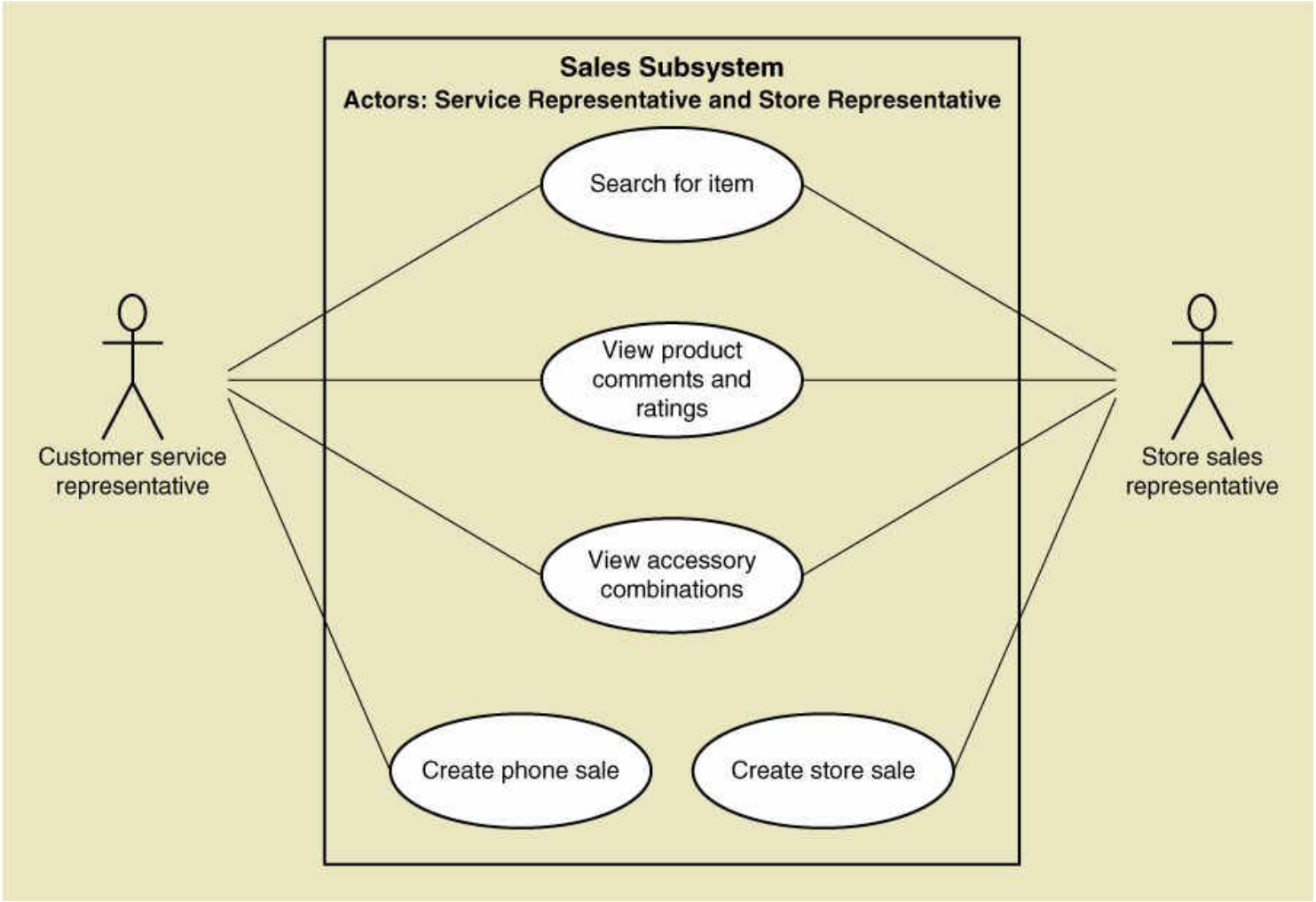
Use case diagrams
Draw for actors within a department



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Summing up…

- Use case diagrams are a very simple technique that show the use cases in the system together with participating actors
- A use case diagram can be a very useful communication tool as it can be drawn for specific users/roles/subsystems to confirm requirements
- The basic symbols are the actor, use case, connecting line, system boundary
- Additional types of relationships such as <<include>> or <<extend>> can be added to provide more information about the use cases

Topic learning outcomes revisited

After completing this topic you should be able to:

- Understand how models are used to represent requirements
- Explain why identifying use cases is the key to defining functional requirements
- Identify use cases using the user goal technique
- Identify use cases using the event decomposition technique
- Document use cases using a brief description
- Describe the notation and purpose of use case diagram components
- Document use cases using use case diagrams

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What’s next?

In this topic, you learned techniques for discovering and documenting the functional requirements of a system using use case modelling. The other key concept in defining requirements is domain modelling, used to identify the ‘things’ in the system that we need to keep track of and store information about. In the next topic you’ll learn some tools and techniques for domain modelling.