Practical Use Case Guide

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Introduction to Practical Guides

This set of Practical Guides is the result of hands-on experience gained by Modeliosoft consultants. Each guide is designed to facilitate model construction and to help you get the most out of the Modelio tool in a given context. The practical guides are deliberately short, since the aim is to provide essential practical information in just a few pages. The Modeliosoft consulting team is at your service to help with enterprise architecture definition, business process and software architecture modeling, SOA, and to provide any other assistance you may need in your IT projects.

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At www.modeliosoft.com, you can download the Modelio Free Edition tool, a user-friendly and unlimited tool for UML modeling and business modeling (Enterprise Architecture, BPM, SOA logical architecture and software architecture), completely free of charge.

At www.modeliosoft.com, you can also evaluate and purchase Modelio Enterprise Edition, and discover the full functional richness of this tool: teamwork support, goal analysis, dictionary definition, requirements analysis, code generation, documentation generation throughout the entire project lifecycle, and so on.

The Practical Guides currently available are as follows:

- Practical Use Case Guide
- Practical Business Process Guide
- Enterprise Architecture: Practical Guide to Logical Architecture
- Practical Company Organization Modeling Guide

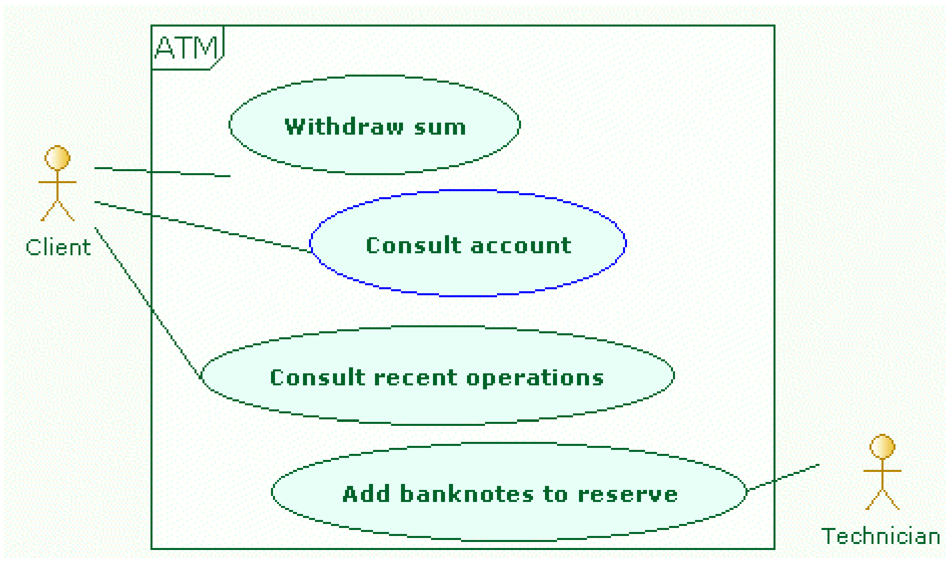
Other practical guides will be available soon. Please check our website for details.

What are use cases?

A UML use case model describes and formalizes relationships between the software system to be developed and the outside world.

Use case models describe an external point of view (black box) and never deal with the internal structure of the software. The aim is to specify the boundaries of the system and the different interactions implemented in the realization of business requirements.

Use case models are made up of two main types of UML element – Actors and Use Cases (see figure below). The container that appears in the diagram (in rectangular form) represents the system. Use cases are presented inside the system and actors outside it.



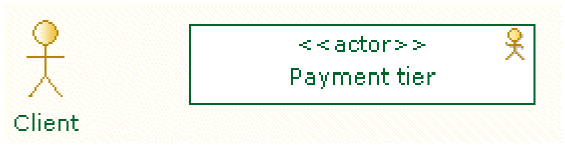
Example of a use case with one actor and three use cases

Often used during the initial phases of the development process, use case models are a basic tool used to formalize functional requirements. They are particularly helpful during dialog with users.

Actors

An actor is an entity outside the system that needs to directly interact with it. An actor can represent a human user or any material or software device.

Examples: User, Client, Invoicing Software Application, Production Machine.

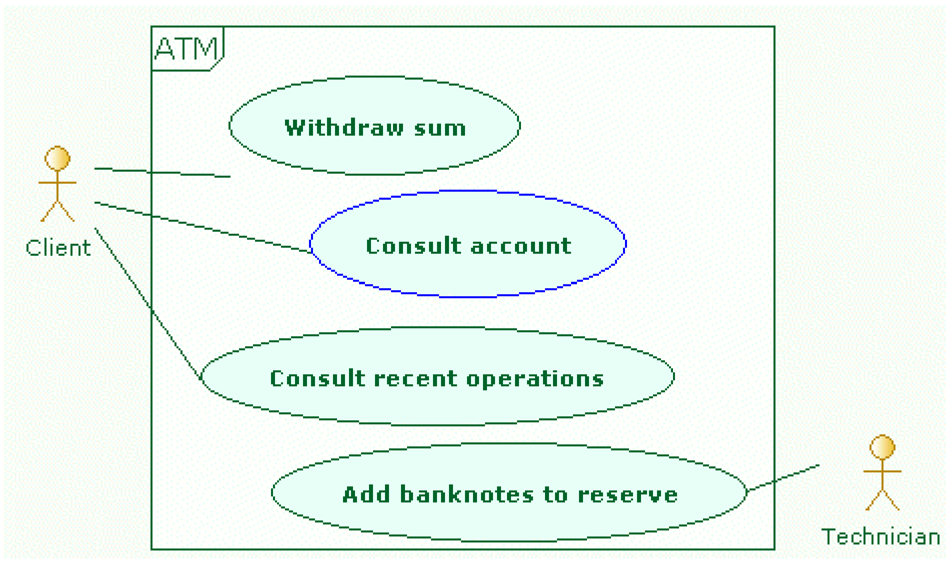


An actor represents a role played in the context of the system. A physical user can play several different roles successively depending on how the system is used.

For example, a systems administrator is in charge of installing the latest version of a training course in a classroom. He will first play his usual role (**Administrator Actor**) during the actual installation of the new version on the training machines, before connecting as a student (**Student Actor**) in order to check that the new version is working properly. In this case, there is only one concrete external entity, the systems administrator. However, there are two distinct actors – the administrator and the student.

In a use case model, the aim is to identify all the actors that interact with the system, both the **main actors** (those which justify the construction of the system) and the secondary actors necessary to the smooth running of the system (administrators, repair staff, and so on).

In use case diagram representation, main actors are represented on the left of the system and secondary actors on the right of the system.



The Client and Technician actors

In the example above, the technician responsible for regularly replenishing the stock of banknotes (secondary actor) is absolutely essential and has an important impact on the design of the ATM.

Validation rule

- Every actor must be linked to at least one use case.

Use cases

A use case represents an interaction between actors and the system, with the aim of meeting a fundamental requirement. It is described by a set of scenarios that specify the dialog between the system and the actors.

A use case **must render a real and complete service** that provides the actor with an added value. This is its essential characteristic. Conversely, functions such as "Enter PIN code" or "Choose amount" are probably not use cases.

A use case is an atomic element, which must meet the following criteria:

- **Unicity of time**. A scenario must play out in a relatively short timespan. Conversely, an interaction cannot last several months.
- **Unicity of place**. A scenario must take place in only one place (it cannot begin in the office and finish at home, for example).
- **Unicity of actor (one beneficiary actor)**. The service is rendered for a single actor (main actor), which is often the source that triggers the use case. Other actors who interact with the use case are secondary actors. They take part in the scenarios but are not the beneficiaries of the service.
- **Non-interruptible**. A scenario cannot be interrupted and then continued later (in normal usage). The scenario stops once the service has been rendered. Typically, an actor will not "take a vacation" while a scenario is playing out.

The above criteria emphasize the atomic nature of use cases. They are not formal criteria, but they do help in understanding, constructing and validating use cases. They also enable use cases to be distinguished from other types of element, such as business processes, operations or functions.

Tip: The following quick test is often used to check the essential criterion (must render a real and complete service). Imagine that the actor stops just after the end of the scenario. If the result is ridiculous, then there is probably an identification error. For example, if we consider the "log on" scenario, which consists of entering your login and password, if the user leaves the room to do something else, this would not make much sense. The "log on" use case would not be retained.

Validation rules

- Every use case must be linked to at least one actor(*).
- Every use case must contain at least one scenario.

(*) Except for "false use cases" (see "Relationships between use cases").

Scenarios

A use case's scenarios make up a sequence that describes the dialog between the system and one or several actors.

Scenarios are most often expressed textually. However, there are no rules in the UML standard regarding this point. For example, activity diagrams, sequence diagrams or any other means can also be used to express scenarios.

For a use case, there must be at least one main (or nominal) scenario, which represents the use case's most meaningful interaction (sequence where "everything goes smoothly"). Other scenarios can be added to describe other possible interactions.

Example:

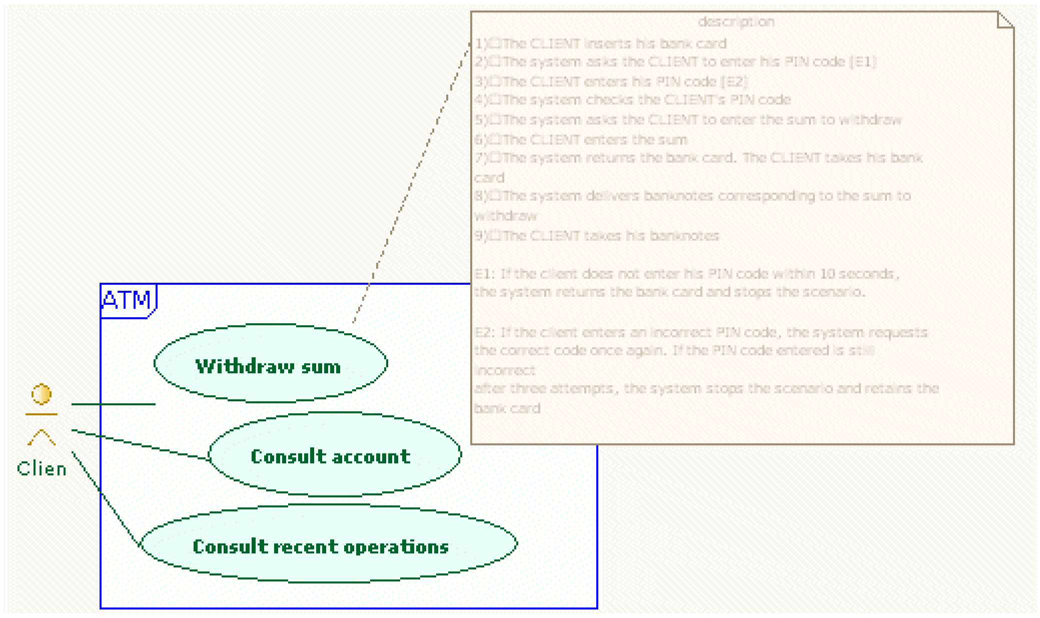
```
   1)  The CLIENT inserts his bank card
   2)  The system asks the CLIENT to enter his PIN code [E1]
   3)  The CLIENT enters his PIN code [E2]
   4)  The system checks the CLIENT's PIN code
   5)  The system asks the CLIENT to enter the sum to withdraw
   6)  The CLIENT enters the sum
   7)  The system returns the bank card. The CLIENT takes his bank card
   8)  The system delivers banknotes corresponding to the sum to withdraw
   9)  The CLIENT takes his banknotes
```

Errors, exceptions and special cases can be added to scenarios in the form of links associated with a particular sequence.

Examples:

```
E1: If the client does not enter his PIN code within 10 seconds, the system
returns the bank card and stops the scenario.

E2: If the client enters an incorrect PIN code, the system requests the
correct code once again. If the PIN code entered is still incorrect after
three attempts, the system stops the scenario and retains the bank card.
```



1) The CLIENT inserts his bank card
2) The system asks the CLIENT to enter his PIN code [E1]
3) The CLIENT enters his PIN code [E2]
4) The system checks the CLIENT's PIN code
5) The system asks the CLIENT to enter the sum to withdraw
6) The CLIENT enters the sum
7) The system returns the bank card. The CLIENT takes his bank card
8) The system delivers banknotes corresponding to the sum to withdraw
9) The CLIENT takes his banknotes

E1: If the client does not enter his PIN code within 10 seconds, the system returns the bank card and stops the scenario.

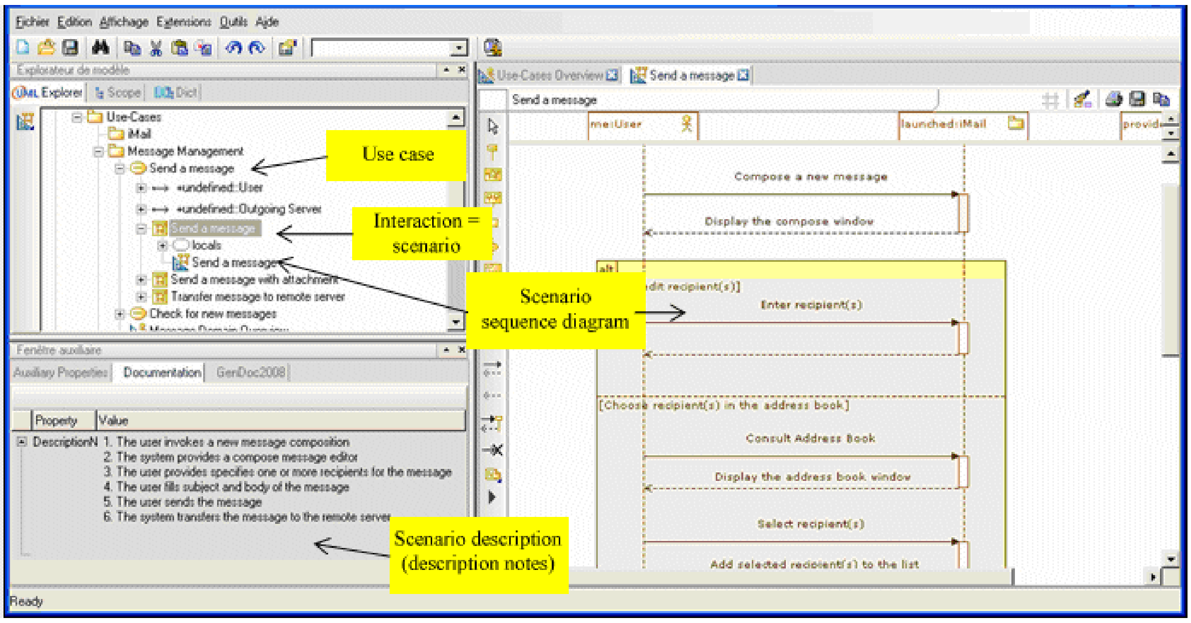
E2: If the client enters an incorrect PIN code, the system requests the correct code once again. If the PIN code entered is still incorrect after three attempts, the system stops the scenario and retains the bank card

Scenario represented by a note associated with the use case

In practice, most use cases are described by a scenario (nominal with links for errors and exceptions).

The notion of scenario does not exist in UML. We recommend that you create an interaction to the use case to represent the scenario.

Sequence diagrams (linked to the interaction) can be used to model the scenario. In practice, most scenarios are simply described textually through "description" notes in Modelio.



Property	Value
DescriptionN	1. The user invokes a new message composition 2. The system provides a compose message editor 3. The user provides specifies one or more recipients for the message 4. The user fills subject and body of the message 5. The user sends the message 6. The system transfers the message to the remote server

Defining a scenario in Modelio

Scenarios must not include GUI (Graphical User Interface) directions or technical elements:

Recommended	Forbidden
The operator requests the list of files. The system returns the list of open files.	The operator clicks on the "List" button. The system displays the list in green in the "files" window.
The system records the member's profile.	The system writes the profile of the member in the Oracle 8.1 database using an SQL INSERT statement.

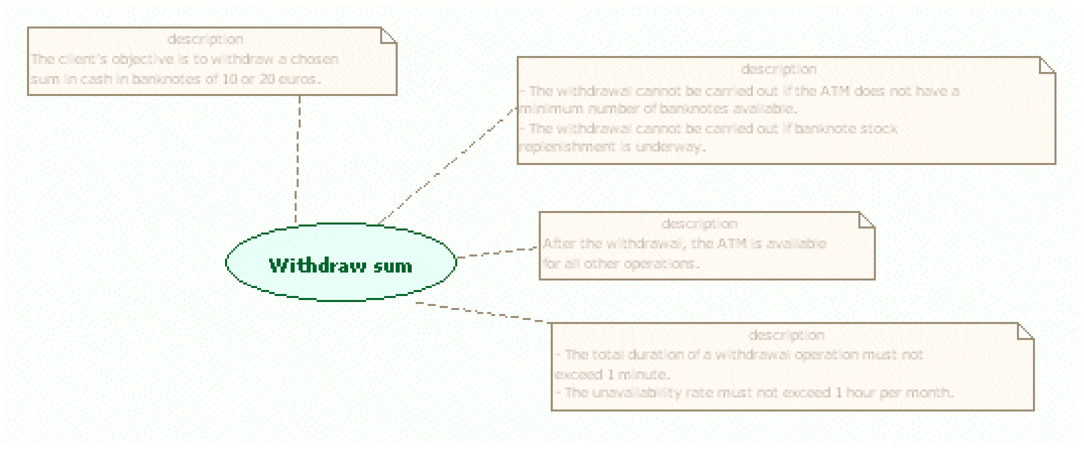
Detailed use case file

As well as scenarios, every use case is described by a detailed file containing a set of characteristics:

- Expected service
- Pre-condition
- Post-condition
- Non-functional constraints
- Applicable business rules
- Running frequency

This list is not exhaustive and can be adapted and enriched in accordance with the realities of the project or the terms usually employed (see *A. Cockburn. Writing Effective Use Cases. Addison-Wesley Longman Publishing Co).*

These elements can be entered through notes associated with use cases (see figure below) or in an external document.



The client's objective is to withdraw a chosen sum in cash in banknotes of 10 or 20 euros.

- The withdrawal cannot be carried out if the ATM does not have a minimum number of banknotes available.
- The withdrawal cannot be carried out if banknote stock replenishment is underway.

After the withdrawal, the ATM is available for all other operations.

- The total duration of a withdrawal operation must not exceed 1 minute.
- The unavailability rate must not exceed 1 hour per month.

Characteristics of a use case defined using notes

The structure and characteristics taken into account in use case files are not part of the UML standard. We recommend that you clearly define a framework content that will be used for a group of projects within the company, in order to ensure consistent formulation.

By default, Modelio provides the following note types for use cases:

- Description
- Pre-Conditions
- Post-Conditions
- Exceptions
- Functional Constraints
- Non-Functional Constraints

Expected service

For every use case, a description of the service expected by the actor who is the beneficiary of the service.

Example:

- The client's objective is to withdraw a chosen sum in cash (notes in euros) from his current account.

Pre and post-conditions

Pre-conditions describe the conditions that must be respected before a scenario can be triggered.

Example:

- The withdrawal cannot be carried out if the ATM does not have a minimum number of banknotes available.
- The withdrawal cannot be carried out if banknote stock replenishment is underway.

Post-conditions describe the conditions checked after a scenario has stopped (except in the case of errors or exceptional processing).

Example:

- After the withdrawal, the ATM is available for all other operations

Other pre and post conditions can be defined for each scenario, in order to define specific conditions that must be met.

Non-functional constraints

Non-functional constraints specify a set of additional requirements. These requirements are linked to performance, availability, size, runtime, and so on.

Examples:

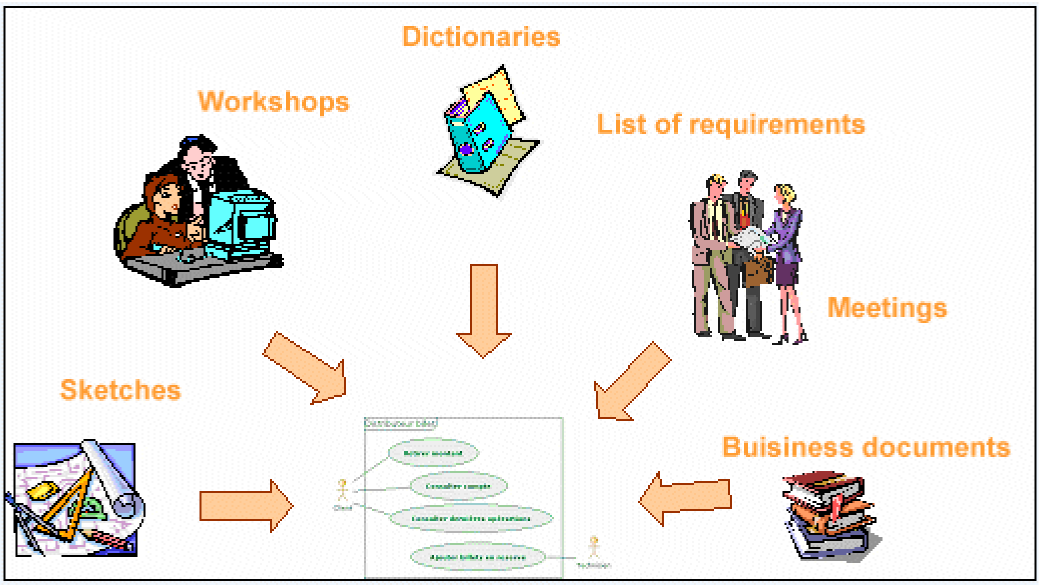
- The total duration of a withdrawal operation must not exceed 1 minute.
- The unavailability rate must not exceed 1 hour per month.

Elaborating a use case model

Use case models are elaborated in close collaboration with IT services (business and user aspects). Different business resources, dictionaries or requirement lists can be used (if they exist) without being considered as unique sources of knowledge. The *Modelio Scope Manager* module is used to define and model requirements and to trace them to the rest of the model, notably use cases. For every functional requirement, it must be determined whether it corresponds to a use case (see the previously provided rules).

If you have a business process model (see the process modeling user guide), all identified activities that are supported by the system are candidates to become use cases.

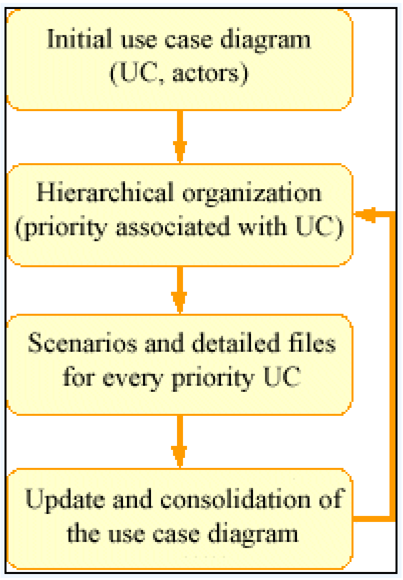
The necessary dialog takes place using whatever means is best adapted to the situation, with the accent on direct communication (meetings, workshops, sketches, and so on).



Use cases can also be used as a support without imposing UML formalism, if participants are reticent. For example, textual scenarios can be exchanged as is, without the UML use case diagrams.

On the whole, this elaboration will be carried out progressively using a breadth-first schema rather than a depth-first schema. This means we can avoid breaking work down according to an element-driven order (first the actors, then the use cases and finally the scenarios). Actors, use cases and scenarios are closely linked and are constructed alongside one another.

Depending on the volume (number of use cases), it is better to break work down according to the priority assigned to each use case (first the client-oriented use cases, linked to the main actors), all the while continuing to communicate with IT services. The aim is to gradually converge on a consistent, valid model that is consistent with the business vision.


Initial use case diagram (UC, actors)
Hierarchical organization (priority associated with UC)
Scenarios and detailed files for every priority UC
Update and consolidation of the use case diagram

General approach for elaborating use cases

During the elaboration of initial models, we recommend against using relationships between use cases (incude, extend or inheritance). Scenarios should be used instead.

Identifying and naming actors

It is not always simple, and can sometimes be downright difficult, to correctly identify and name actors.

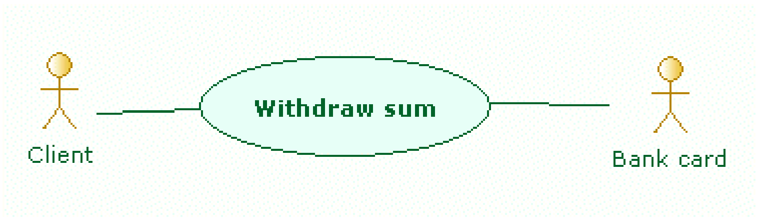
Actors represent the roles that an external entity can play at a given time. An entity can play several different roles according to the circumstances.

The distinction between the notion of role and the notions of position or function within a company can be confusing. In practice, you don't necessarily wait for actors to be definitively named before constructing the model with use cases. For example, temporary names can be used (using occupied posts, for example). These will be replaced later by more adapted terminology.

All the participating actors cannot necessarily be immediately identified. Use case scenarios are used to control and possibly add missing actors. For example, in the use case scenario "Withdraw sum":

```
   1) The CLIENT inserts his bank card
   2) The system asks the CLIENT to enter his PIN code
   3) The CLIENT enters his PIN code
   4) The system checks the CLIENT's PIN code
   5) The system asks the CLIENT to enter the sum to withdraw
```

Step 4 implies that it is the system that checks the client's PIN code. However, after discussion with IT services, it turns out this is wrong. In reality, the system asks the bank card to check the PIN code (the bank card itself contains its checking software). If you consider that the bank card is not part of the system (the ATM), then a new actor must be added.



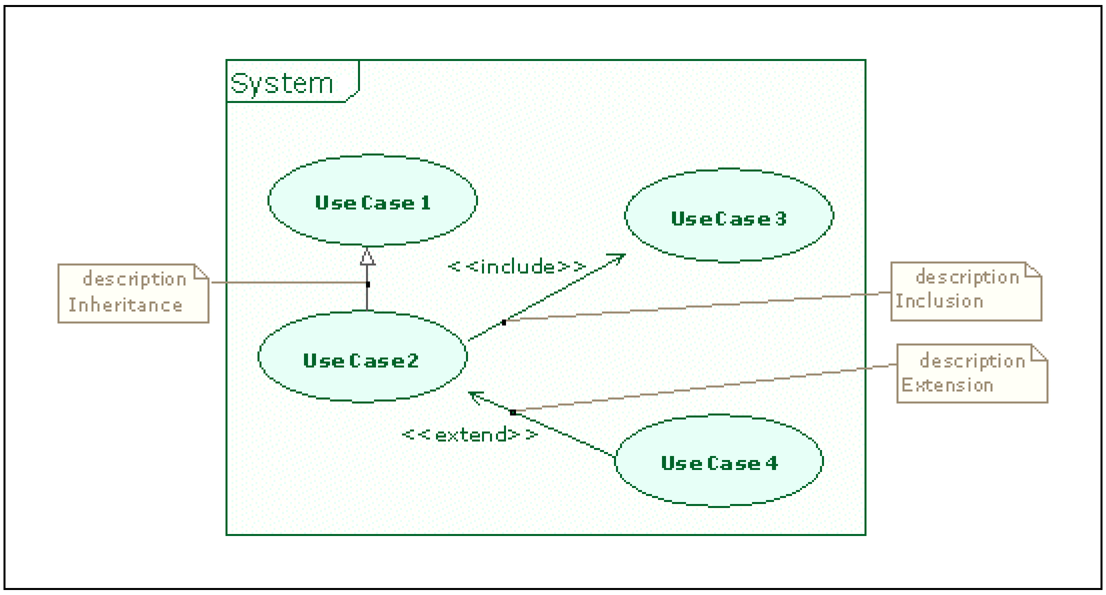
The scenario is reformulated as follows:

```
   1)  The CLIENT inserts his bank card
   2) The system asks the CLIENT to enter his PIN code
   3) The CLIENT enters his PIN code
   4) The system checks the CLIENT's PIN code
   4.1) The system asks the BANK CARD to check the PIN code
   5)  The system asks the CLIENT to enter the sum to withdraw
```

Relationships between use cases

The UML standard defines a set of relationships between use cases:

- Inclusion relationships (« include »)
- Extension relationships (« extend »)
- Inheritance links

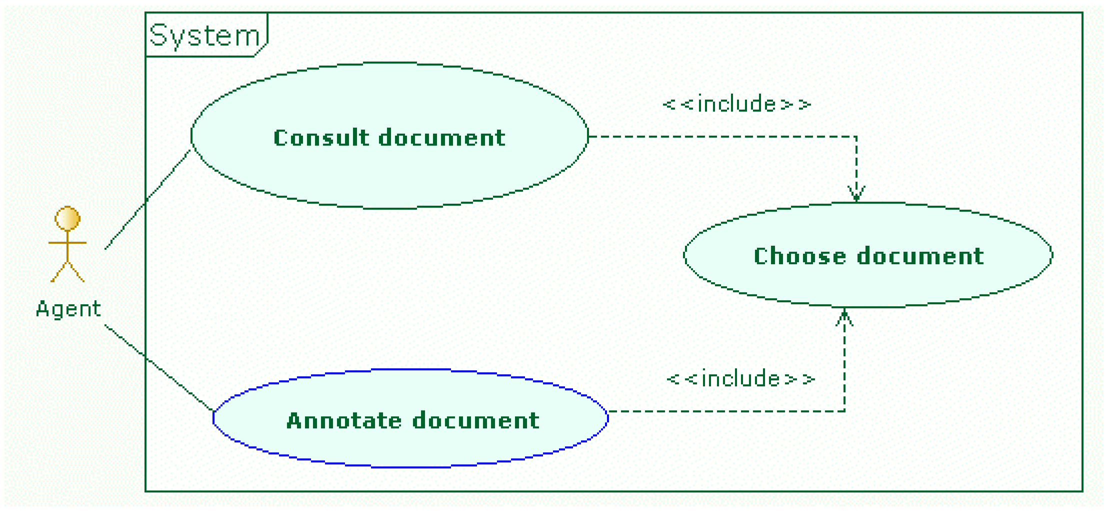


Relationships between use cases: UC2 inherits from UC1, UC2 includes UC3, UC4 extends UC2

Although they are an integral part of the standard, the use of these relationships is not clear and can lead to difficulties. We strongly recommend that you limit their use (see the Recommendations and Limitations chapter).

Inclusion relationships

Inclusion can be used where several use cases contain identical strings of sequences. A new use case that declares and factorizes this common part can then be referenced by other use cases.



"include" relationship between use cases

In the example above, the scenarios of the two use cases "Consult document" and "Annotate document" start with the same sequences:

```
1) The Agent requests the list of available documents
2) The Agent selects a document in the list
3) The Agent views the contents of the document
x) …
y) …
```

In order to avoid repetition, the "Choose document" use case declares the first three sequences in its scenario, and then the scenarios of the other two use cases are modified to reference this.

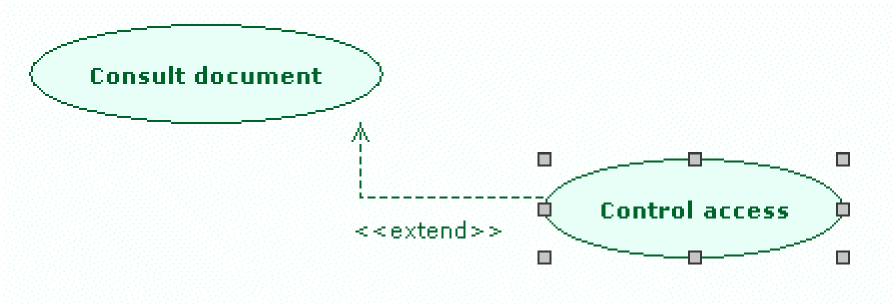
```
1) include: Choose document
x) …
y) …
```

Note: The UML standard does not indicate a language or technique for referencing a use case in a scenario.

Extension relationships

Extensions relationships introduce a particular path into a scenario, often associated with an exceptional condition (threshold effect, special case…) called an exception point.

A use case contains this exceptional sequence and extends the initial use case.



"extend" relationship between use cases

In the example above, if a critical document is concerned, an extension point (PEA) is inserted into the scenario of the "Consult document" use case.

```
1) include: Choose document
(PEA) If critical document
2)
x) …
y) …
```

The corresponding sequence is defined in the scenario of the "Control access" use case.

```
(PEA)
1) The system requests the password from the Agent
2) The Agent enters the password
3) The system checks the password
```

Note: The UML standard does not indicate a language or technique for inserting or defining an extension point.

In practice, extensions between use cases are to be avoided (see Recommendations and Limitations chapter).

Inheritance relationships

Inheritance between use cases is represented in the same way as inheritance between classes. Inheritance can be used to define "sub-use cases".

In practice, inheritance between use cases should be avoided (see Recommendations and Limitations chapter).

For grouping use cases (by functional category, for example), the Package is used (see Structured Use Cases chapter).

Recommendations and limitations

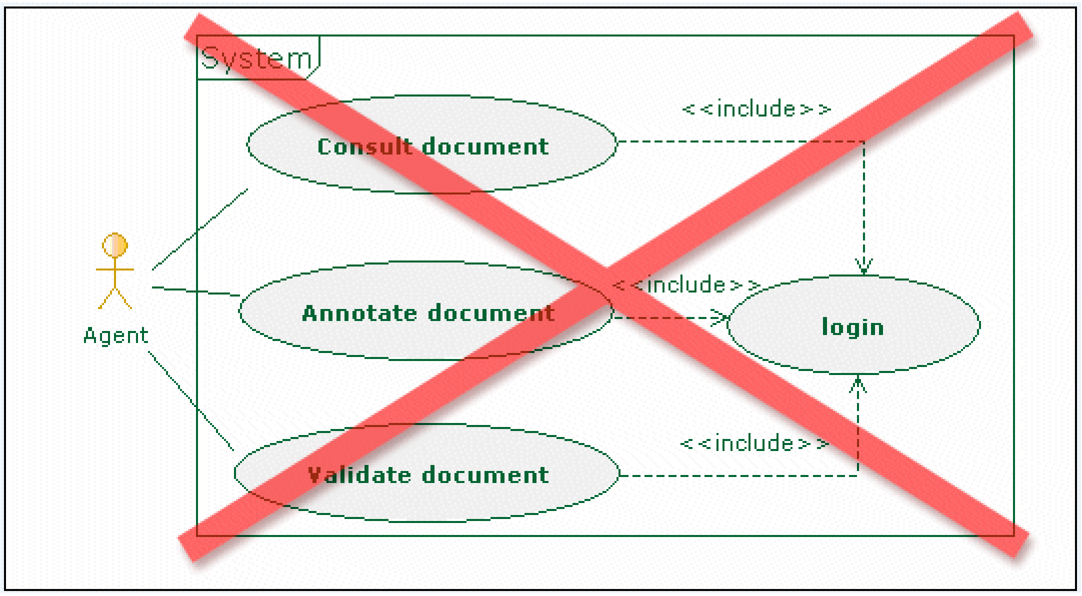
Avoid the use of extension relationships and inheritance links. Their semantics are not sufficiently rigourous, and the absence of a standard language tends to increase the risk of confusion. Extensions can be represented in most cases simply through links in scenarios.

"I strongly suggest that you ignore them (extend and inheritance). I've seen too many situations in which teams can get terribly hung up on when to use different use case relationships, and such energy is wasted." UML Distilled third edition, Martin Fowler, Addison-Wesley.

Inclusion relationships can be used where there is real factorization. However, this type of use must remain occasional and must bring added value.

Furthermore, the use of these relationships tends to clutter diagrams with the introduction of "false use cases", which do not respect the properties previously presented.

For example, in the frequently encountered case of authentication (login password) that is systematic every time the software is used, the following schema is avoided. In this case, it is better to indicate access security elements at the beginning of the document.



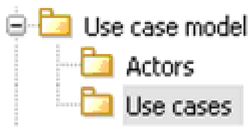
Schema to be avoided

The "Login" use case is not a real use case (there is no complete service provided to the user).

Structuring use cases

A structure adapted to the volume of the problem to be handled should be chosen.

At the root, two container packages are defined for actors and use cases.



Use cases are then grouped into functional packages, according to how many there are.

Documenting use cases

Modelio provides a document template ("UseCases") dedicated to use cases. To implement it, follow the instructions below:

- Document use case diagrams ("description" notes on diagrams)
- Document use cases ("description" and "pre-condition" notes on use cases, and so on)
- Document actors ("description" notes)
- Create interactions for scenarios inside use cases
- Document les scenarios ("description" notes) or possibly model them using sequence diagrams

Then simply generate documentation from a package including the use case model and obtain a document that is consistent with the approach.