SED Lecture 2
Describing Functional Requirements with Actors, Scenarios and Use Cases

Objectives
To understand how functional requirements can be described using actors, use case diagrams, actors’ goals and use cases, and to know the purpose of each of these. To be able to propose actors and scenarios for a new system. To be able to read, understand, modify and write a use case.

Key Points
1. Requirements Analysis formalises the problem statement originally elicited from the stakeholders of a new system. It takes analysis of the problem as far as possible before moving (in System Design) to the solution domain. Lectures 2 to 6 cover techniques used in requirements analysis.
2. Actors represent external entities that interact with the system. An actor can be a human or external system. Actors are role abstractions and do not necessarily map directly to persons.
3. Use case diagrams are a UML notation which identifies the actors in a system, the boundaries of the system, and the functionality of the system accessible to each actor.
4. A scenario is a story about the intended behaviour of a system. It represents a concrete sequence of interactions between one or more actors and the system. Scenarios are usually gathered from customers and users during requirements elicitation, and then generalized into full use cases during requirements analysis.
5. Use cases describe general sequences of interactions between one or more actors and the system. A use case is a generalization of a scenario. A use case is often presented using a standard template which includes entry and exit conditions, to ensure that most common questions are addressed.
6. Do not confuse the two terms, “use case” and (UML) “use case diagram”

Core Reading
Bruegge & Dutuoit (2nd ed), 2.2.1 Use case diagrams, 2.3.5 object oriented modelling, 2.4.1 use case diagrams, 2.4.1 use cases, 4.4.1 identifying actors, 4.4.2 identifying scenarios, 4.4.3 identifying use cases, 4.4.4 refining use cases, 4.4.5 identifying relationships among actors and use cases

Sommerville (7th ed) 7.2.1 scenarios

Pressman (5th ed) 20.1 The O-O paradigm, 20.2 O-O concepts, 21.4.1 Use cases

Cockburn, Use case template and example


Ian Sommerville, Petrol Pump Requirements Definition (see attached)
Further reading


Alistair Cockburn, *Use Cases, Ten Years Later*, STQE magazine, Mar/Apr 2002
http://alistair.cockburn.us/Use+cases,+ten+years+later

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**ACTORS AND USE CASE DIAGRAMS EXAMPLE**

Read the Petrol Pump Requirements Definition (attached). Can you identify 4 actors and 3 use cases? Complete the following use case diagram for the system.
Petrol Pump System Requirements Definition

The system is intended to provide a 24-hour petrol dispensing service to customers with unattended operation.

**Rationale** The rationale for introducing this system is to reduce the costs of providing a 24-hour service and, at the same time, increase the security of the operations by ensuring that no cash is held on the premises.

There are four functions to be provided for this system.

**Credit Validation** The customer swipes their credit card through the card reader and their credit limit is established.

**Petrol Delivery** The fuel required by the customer is dispensed

**Account Updating** The appropriate accounts are updated

**Payment Limit** The maximum amount of fuel which can be dispensed is subject to a limit of #25.

### Credit Validation

1. The system is activated by the user pressing a start button and swiping their credit card through the card reader.
2. If the reader fails to read the card, the customer should be requested to re-try. Up to three re-tries should be allowed.
3. If there are more than three read failures, the transaction should be terminated and the customer informed that petrol cannot be dispensed.
4. Once the card has been read correctly, communication should be made with the credit card company computer to establish the customer’s credit limit.
5. If the credit limit is more than #25, the customer should be informed that up to #25 worth of fuel can be dispensed.
6. If the credit limit is between #5 and #25, the customer should be informed that an amount of fuel up to the credit limit may be dispensed.
7. If the credit limit is less than #5, the customer should be informed that no petrol can be dispensed and the transaction should be terminated.

### Petrol Delivery

1. The customer should confirm their intention to continue the transaction by choosing a grade of petrol to be dispensed. When the choice is made, the system informs the customer of the number of maximum number or litres which can be dispensed and should print a message asking them to remove the pump nozzle.
2. If the fuel grade is not selected within 20 seconds of the credit limit message being displayed, the transaction should be terminated.

**Rationale** We need a way of confirming the intention to proceed and of selecting the fuel grade. Combining these operations allows this to be done in a way which is natural to the user. Customers will sometimes change their mind. Using a time limit means that they do not have to explicitly tell the system about this. The short time limit means that there is not sufficient time for another customer to fraudulently use the checked credit.

3. The user should then remove the pump nozzle from its holster and this should activate the pump motor.
4. If the nozzle is not removed within 1 minute of pressing the accept button the transaction should be terminated. An appropriate message should be printed.
**Rationale** We need a way of detecting if a customer has simply decided to give up at this stage. The time limit should be longer than before to allow people who are unfamiliar with the operation of the pump to read the instructions.

5. The customer presses the pump trigger to dispense petrol. Petrol is dispensed while the trigger is pressed and the credit limit has not been reached and the nozzle pressure sensor is below its critical limit.
6. If the nozzle pressure sensor goes above its limit then the petrol flow should be stopped. It may be restarted by the customer pressing the pump trigger.
7. The transaction is terminated either when the user’s credit limit is reached or when the pump nozzle is returned to its holster.
8. The pump motor should be switched off when the pump nozzle is returned to its holster.

**Account Updating**

1. When the transaction is terminated, the user’s credit card account is debited by the cost of the petrol dispensed. This involves sending a transaction to the credit card company computer with the following information:
   1. Merchant identifier.
   2. Credit card number
   3. Cost of petrol
   4. Date and time of transaction
   5. The validation code returned by the credit card company when the transaction was authorised.
2. The following information should be recorded on the transaction log
   1. Credit card number
   2. Date and time of transaction
   3. Grade of petrol dispensed
   4. Number of litres of petrol dispensed
   5. Total cost of petrol dispensed.
   6. Date and time of transaction

**Rationale** Used for accounting purposes. Also used to update the stock register.

3. A receipt should be printed for the user with the same information as recorded on the transaction log plus:
   1. The VAT number of the supplier.
   2. The address of the supplier.
   3. The telephone number of the supplier.
   4. The number of litres of petrol dispensed.
   5. The grade of petrol dispensed.

**Rationale** Providing the address and phone number makes it easy for the customer to contact the supplier in case of charging problems. The VAT number is necessary for customers who can reclaim VAT.

**Payment Limit** The payment limit is intended to limit losses through fraud so that if a card is stolen, it is impossible to take an unlimited amount of fuel.