Object oriented analysis & design notes

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Contents

Chapter 1

Method

Concepets

Object	Entity with identity, state and behaviour
Class	Describes a collection of objects sharing structure, behavioural patterns and attributes
Problem domain	Part that is administrated, monitored or controlled by a system
Application domain	The organization that administrates the problem domain Where the user is
System	A collection components that implements modeling requirements, functions and interfaces
Context	Problem domain and application domain

Describe problem- and application domain better

Der er eksempler bag i bogen

Problem domain

Class structure and behaviour

Application domain

Usage functions and interfaces

Method

Purpose, concepts, principles and results.

1.1 Objects and classes

Objects - *Entity with identity, state and behaviour*

Each object serves as a seperate function. The object could be a customer, where specific people are treated as customers. The object contains that specific customers identity, state and behaviour

Class - *Describes a collection of objects sharing structure*

The class contains multiple objects, meaning a customer class will contain multiple data points. The class also contains multiple different customers and their data points.
When describing a class it's important to choose the right granularity. Gravel pit should not be described by the individual grains of sand, instead by the type, whereas a warehouse the individual packages should be described.

Analysis - outside the system

In analysis the object's behaviour is described by its events it performece and experiences that happens in definite points in time. Eg. customers ordering and shipping goods.

Design - inside the system

In design the object's behaviour is described by the operations it can perform and make available to other objects in the system. Eg. add order etc.
This allows the update of eg. the customers object state. The design object encapsulates the internal representation of the object state through its operations.

1.2 Principles

The 4 principles:

Model the context - Useful systems fit the context, so model both application and problem domain during analysis and design.

Emphasize the architecture - Understandable architecture makes collaboration between programmers and designers possible. Flexible architecture makes modifications and improvements affordable

Reuse patterns - Building on well-established ideas and pretested components

Tailor the method to suit specific project - Must be tailored to the specific needs of the analysis and design situation

Model

Model is a representation of the state in the problem domain. How often the model is updated is a design decision
Problem domain -¿ model -¿ application domain.

Chapter 2

System Choice

Define the system in its context problem domain + application domain.
Using the F.A.C.T.O.R system.
F: Functionality - System functions that support the AP tasks.

A: Application domain - The organization that administrates the problem domain. Where the user is

C: Condtion - The conditions under which the system will be developed

T: Technology - Both the technology used to develop the system and the technology which the system will run.

O: Objects

R: Responsibility

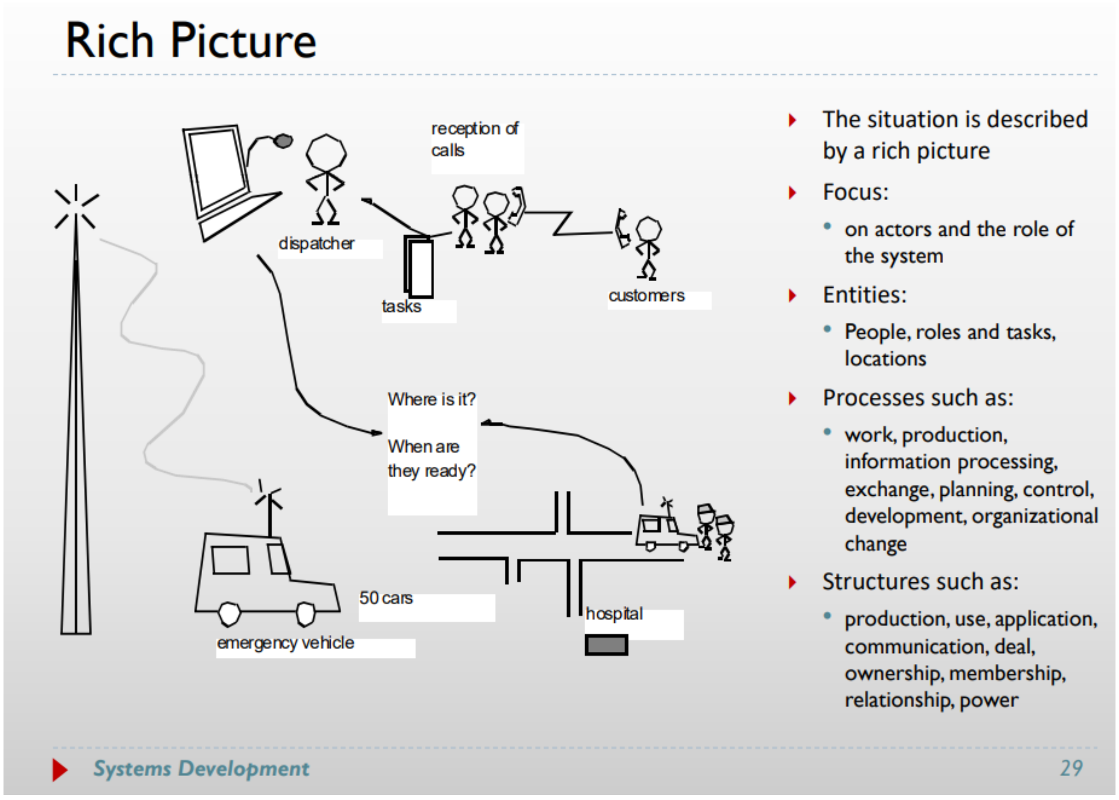
2.1 System definition

Situation

Describe the situation based on the context of the system. Described in a rich picture. Which is the described by its focus, entities, procceses and structure.

Ideas

Examples - eg. Study preexisting systems.



Rich Picture

reception of calls
dispatcher
tasks
customers
Where is it?
When are they ready?
50 cars
hospital
emergency vehicle

- The situation is described by a rich picture
- Focus:
  - on actors and the role of the system
- Entities:
  - People, roles and tasks, locations
- Processes such as:
  - work, production, information processing, exchange, planning, control, development, organizational change
- Structures such as:
  - production, use, application, communication, deal, ownership, membership, relationship, power

Systems Development 29

System definition

Not to be confused with *system*. A concise description of a computerrized system expressed in natural language.

Context

2.2 Problem Domain Analysis

The result of a problem domain analysis is a class diagram describing classes and structure.

Event

An event in the problem analysis is:
- Atomic
- An incident involving one or more objects

- Instantaneous

System Model

The system's model of the problem domain
- Represents the state of the problem domain
- Provides information to users in the application domain about the problem domain

Chapter 3

Classes (OOAD P. 51)

To model the problem domain, starting with class activity.

3.1 Class Activity

Abstraction, classification and selection are the primary tasks in the class activity.

Abstraction

Abstracting the problem domain phenomena by seeing them as objects and events.

Classification

Then classifying the objects and events.

Principle *- Classify objects in the problem domain*

Step 1: Abstraction and classification should lead to identifying all relevant objects, which should be develop a rich list of potentially relevant classes for the problem-domain model. In a parallel activity, identify and develop a similar list of events.

Selection

Then selection which classes and events the system will maintain information on. Each class is characterized by a set of specific events.

Step 2: Systematically evaluate the candidates and select relevant classes and events to be included in the problem-domain model. Finally relate events to classes.

Event table (OOAD P. 52)

Classes **Events**	Customer	Assistant	Apprentice	Appointment	Plan
Reserved	✓	✓		✓	✓
Cancelled	✓	✓		✓	
Treated	✓			✓	
Employed		✓	✓		
Graduated			✓		
Agreed		✓	✓		✓

Figure 3.1: Event table for Hair Salon System (P. 52)

3.2 Classification of Objects and Events (OOAD P. 52)

Object

During the problem analysis an object is an abstraction of a phenomena in that problem domain. An object should be indetifiable be an independent entity, which is delimited. Using events is emphasized by:

Principle - *Characterize objects through their events*

Event

Events specify the qualities of problem-domain objects. An event is defined as:

Event - *An instantaneous incident involving one or more objects*

An event is an abstraction of a problem-domain activity or process that is perfomed or experienced by one or more objects.

Class

Classes contain objects and event. These are identify all the objects and events to be included in a relevant problem-domain model. The class concept refers and describse all the objects in a specific class:

Class - *A secription of a collection of objects sharing structure, behavioral pattern, and attributes*

Object's structure, behavioral pattern, and attributes are described in general terms by the appopriate class deiniftion. Where all classes are different.

Find Classes (OOAD p. 57)

Class selection is the first and most basic for building problem-domain model. It's important to write down all potentially relevant classes, without evaluating them in detail. Do this using own perception, pre-existing decriptions and definitions, including prospective users by interviewing and observing them work. This can be further expanded by using pre-existing system, and using the experience as an advantage. This also include regulations in the are of the operation of the system. This should in a list of class candidates, with easy to understand name, that references in the problem domain.

Event

Find Events (OOAD p. 59)

Using the same fundamental principle as the **find classes section**.

Evalute Systematically (OOAD p. 62)

Fundamental evaluation rule: a class or event should be included in the problem-domain model *iff* system functions use information about it. Basic criteria rules:

- Is the class or event within the system definition?
- Is the class or event relevant for the problem-domain model?

Only classes and events within the problem-domain should be selected. These classes and events should refer to phenomena that will be administrated, monitored and controlled by future users in their work.

Users are usually not part of the problem domain, unless the users are being registered within the system, in eg. the case of restricted access.

Evaluation Criteria for Classes (OOAD p. 63)

As a rule, these questions should be answered when evaluating classes:

- Can you identify objects from the classes?
- Does the class contain unique information?
- Does the class encompass multiple objects?

- Does the class have a suitable and manageable number of events?

An object should be unambiguously be indetifyalbe from a class. Typically a class will contain multiple objects and should contain an appropriate amount of unique information. Events are realated to classes in order to characterize them. This is expressed through an event table. Classes can be further specified than their name by descriping their responsibilities, this limits confusion when the system is developed. This is done through plain text and can specify why it differs from other classes.

Evaluation Criteria for Events (OOAD P. 65)

As a rule, these questions should be answered when evaluating events:

- Is the event instantaneuou?
- Is the event atomic?
- Can the event be identified when it happens?

It should be defined as instantaneous to make it clear when it happens. If the incident happens over a period a stop and start event can be used. Defining and naming an event determines the granularity of the time model. Each event should be identifiable when it happens.

Relating Classes and Event (OOAD P. 66)

When selecting a class, one also has to define the events that the class objects are involved in. From event to objects should also be defined. As a rule, these questions should be answered when relating:

- Which events is this class involved in?
- Which classes are involved in this event?

These should be summarized in an event table. Which can also be used to evluate the quality of class and event candidates.

Summarized principles can be seen on OOAD P. 66

Chapter 4

Structure (OOAD p. 71)

In the structure activity an extension of the problem-domain description to include structural relations between classes. Including relations between objects. The result of the structure activity is a class diagram.

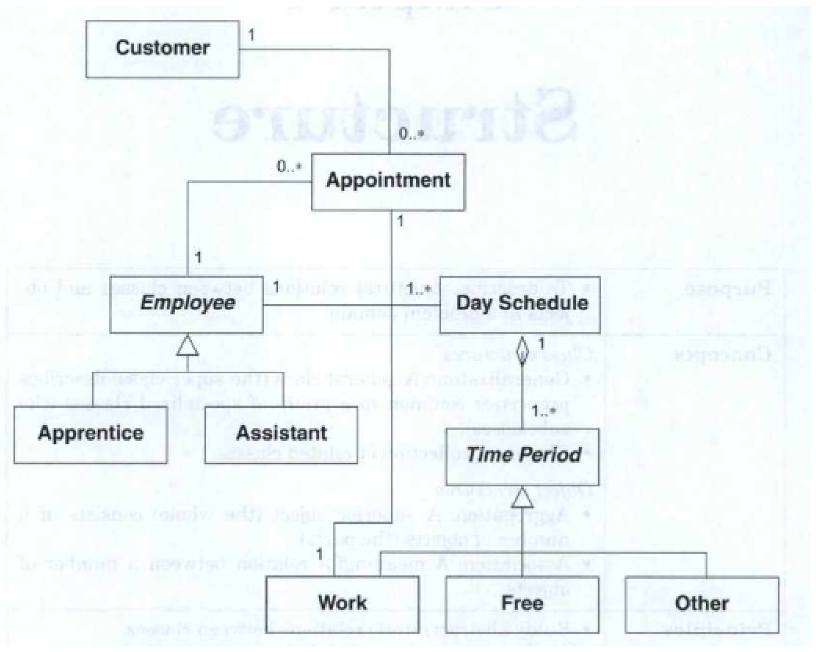


Figure 4.1: Class diagram example (OOAD p. 72)

4.1 Class Structure

Class structures express static, conceptual relations between classes. They connect classes, and the relationship doesn't change unless the description itself changes.

Generalization

A general class(super-class) that describes properties common to a group of specialized classes(sub-classes). It's a relation between two or more specialized classes(sub-class) and a general class(super-class). Everything that holds true for the super-class also hold for any sub-classes. Programmingvise its inheritance/extending a super class.
This can be tested with "is-a", eg. "doctor is a person" etc.

Cluster

A collection of related classes. Classes within a structure is usually connected by a generalization class, eg. cars like in the example below. Alternatively connected through aggregation structure.

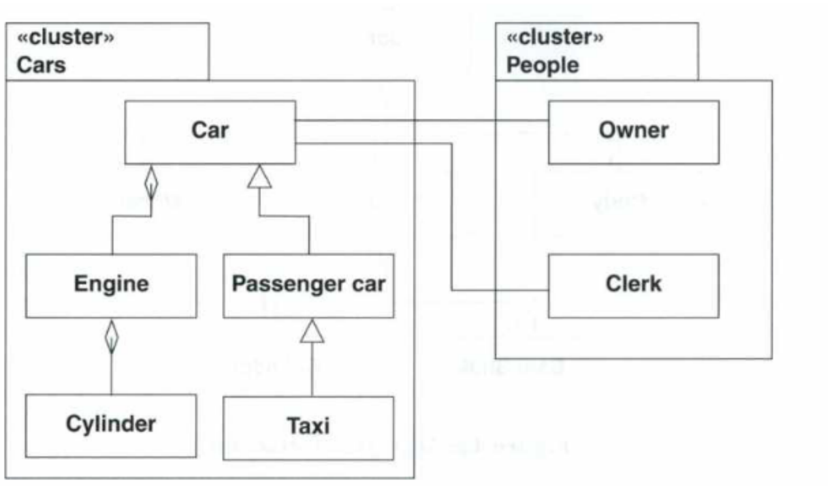


Figure 4.2: Example of clusters and cluster structure (OOAD P. 77)

4.2 Object Structure

Object structures express dynamic, concrete relations between objects. Theses relationship can change dynamically without changing the underlying description.

Aggregation

A superior object (the whole) consists of anumber of objects (the part). It's a relation between two or more objects. It expresses that one object is a fundamental and defining part of the other.

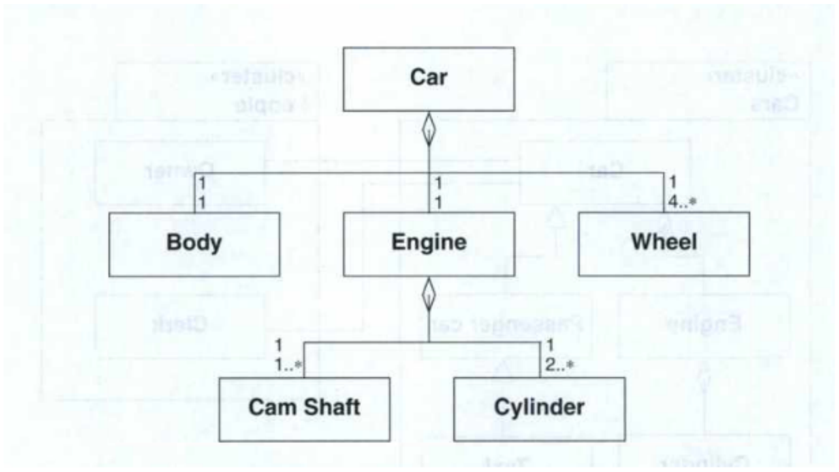


Figure 4.3: Aggregation structure example (OOAD P. 78)

Association

A meaningful relation between a number of objects. Objects are not a defining part of an object. The association structure does not define ranking

4.3 The Activity

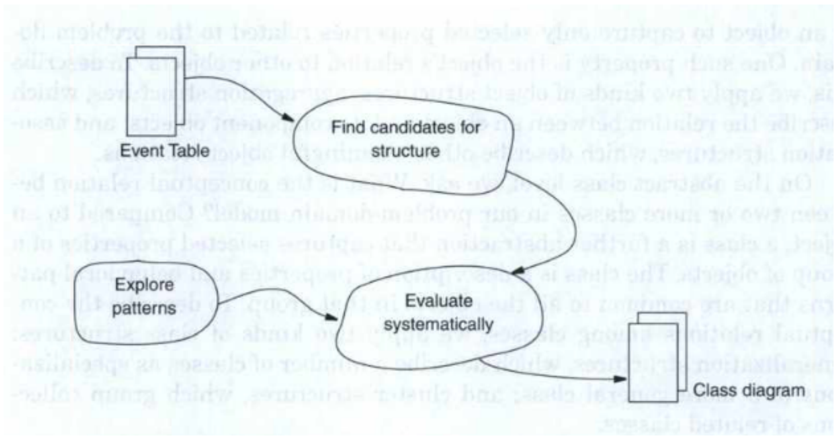


Figure 4.4: Sub-activities involved in the structure activity (OOAD P. 74)

4.4 Finding Structure (OOAD P. 79)

Finding Candidates

Similarly to selecting classes and events, it all starts with selecting candidates by brainstorming or other means.

Identify Generalization (OOAD P. 80)

Do this by taking all classes and pair them to see if one is a generalization of the other.
Then determine whether it's a relevant relation.
Then try to create a relevant specialized or generalized class.

Identify Aggregation (OOAD P. 80)

Find classes with objects that has a decomposition[1] object of the other classes. The whole is considered to be superior to its parts, as is reflected in the class diagram by the vertical placement.
Determine if it's relevant to aggregate the objects of a selected class into a new one.
Our third approach is to determine if each class can be decomposed few relevant classes that do not yet exist in the model. Alternatively, consider aggregating the objects of a selected class into a new class.

[1]Decomposit: The combining of distinct parts or elements to form a whole

Softer definitions of aggregation:

- Whole-part, in which the whole is the sum of the parts, if adding or removing any part, the whole fundamental changes.
- Container-Content, in which the whole is a container for the parts, if adding or removing any content, the fundamental properties of the whole doesn't change.
- Union-Member, in which the whole is an organized union of members. It doesn't change the union fundamentally by adding or removing a few members. However, there is a lower limit on the number of members, as it is artificial to model a union without members.

Identify Associations

See if the remaing class pairs can be meaningfully related. This is done when the relation needs to be administrated, monitored or controlled.

Identify Clusters

Increase class diagrams clarity by organizing conceptually related classes into clusters. A class is not allowed to be in two different clusters.

4.5 Explore Patterns (OOAD p. 82)

The Relation Pattern

Used when a relation between two objects carry it's own properties.

The Hierarchy Pattern

When the relation is between multiple objects and are in a hierarchy, where each level organizes into the hierachy. Eg. Student is related to a class which is related to a semester... etc.
A variation of this can also have objects related to multiple on a higher level. In this situation the elements are not mutually exclusive.

The Item-Descriptor Pattern

Where a descriptor class defines specific properties shared by all related objects. This is important in situation where multiple copies are treated as seperate entities, but still share specific properties between them.

4.6 Evaluate Systematically (OOAD P. 86)

Principle* - *Model only the neccessary structural relations

When evaluating structural relations, it's beneficial to follow certain criteria:

- Structures must be used correctly (OOAD P. 86) .
- Structures must be conceptually true (OOAD P. 87) .
- Structures must be simple (OOAD P. 88) .