



Systems Development



Lecture 1: Introduction and System Choice

Contents

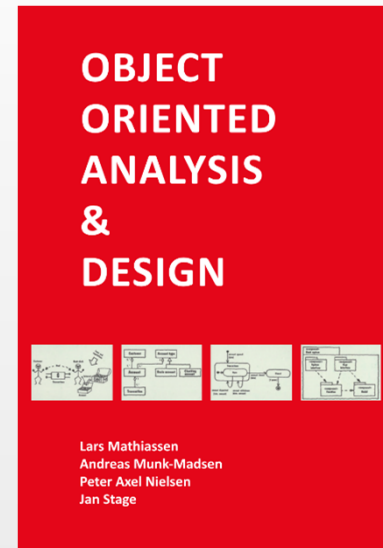
- ▶ Introduction to the course
- ▶ Object-oriented analysis and design
- ▶ System Choice
- ▶ Varying system definition elements
- ▶ Challenges in this activity

Contents

- ▶ Introduction to the course
 - Lecturer and teaching assistants
 - Course overview
- ▶ Object-oriented analysis and design
- ▶ System Choice
- ▶ Varying system definition elements
- ▶ Challenges in this activity

Lecturer

- ▶ MSc in Computer Science, Aalborg University, 1984
Master thesis on Methods for Analysis
In collaboration with Mentor informatik
- ▶ PhD in Informatics, University of Oslo, 1989
Thesis on Work practices for analysis and design in
system development
- ▶ Teacher and researcher, Department of Computer
Science, Aalborg University, 1988-
- ▶ Guest researcher at SUNY Binghamton (1991) and
University of Auckland (2002-2003)
- ▶ Research and teaching in:
 - System development and system development methods
 - Object-oriented methods – OOA&D
 - Prototyping
 - Usability evaluation
 - Interaction design



Teaching Assistants

- ▶ Four teaching assistants
 - A
 - A
 - A
 - A
- ▶ They will
 - assist during exercise hours
 - mark submitted assignments
 - Comment on lxD5 exercises

Course Overview

▶ 5 ECTS – 12 lectures

▶ Knowledge:

Students should achieve knowledge on the following theories and methods:

- Object-oriented modelling in analysis and design
- Modelling with patterns
- System development methods
- Systems practices

▶ Skills:

The student should achieve the following skills:

- be able to explain accurately, using the concepts and modelling language of the discipline
- be able to model the requirements to a system, its context and all its various parts (model, features and interfaces)
- be able to model a system design at component level and describe relations between components

▶ Competencies:

The student should be able to apply concepts, patterns and modelling language to describe a specific system that solves a well-defined task

Form

- ▶ Lectures and discussion
- ▶ Small exercises during lectures
- ▶ Individual exercises and quizzes
- ▶ Group exercises (next slide)
- ▶ Submitted assignment
- ▶ Trial exams
- ▶ Exam:
 - Written exam
 - 4 hours
 - June
 - Open book
 - Computers and mobile phones are NOT permitted
 - Internal censor
 - Graded by the 7 point scale

Group Exercises

Analysis and design of systems in all exercises

- ▶ General exercises (as an offer)
- ▶ A specific group project (focus on this)
- ▶ Dat3 and SW3
 - Your group project
- ▶ iDA7
 - September: Kaj's Cars
 - October: Your group project (P7)
- ▶ IxD5
 - Fisk til døren (Fish to your door)
 - Comments to solution from TAs

Workload

▶ 5 ECTS \approx 150 hours

▶ Distribution of effort

• Lectures	24 h
• Preparation (reading and individual exercises)	48 h
• Group exercises	24 h
• Submitted assignments	21 h
• Preparation for exam and exam	33 h

Literature

Primary literature:

- ▶ Mathiassen, L., Munk-Madsen, A., Nielsen, P. A. and Stage, J. (2018) *Object-Oriented Analysis and Design*. Metodica. (OOA&D)

Secondary literature:

- ▶ A number of papers and excerpts from textbooks

Contents

- ▶ Introduction to the course
- ▶ Object-oriented analysis and design
 - Activities and method
 - Basic concepts
 - Principles
 - Method
- ▶ System Choice
- ▶ Varying system definition elements
- ▶ Challenges in this activity

System Development: Activities and Method

▶ Analysis:

- Understand a system, its context, and the conditions for its implementation
- To determine system requirements

▶ Design:

- Produce a system design without significant uncertainties

▶ Implementation:

- Realize a design on a technical platform

▶ Method:

- Guidelines for carrying out system development activities

▶ Example

- Guidelines for work processes (OOA&D)
- Guidelines for documentation (UML)

▶ A method can be applied under different approaches

- Waterfall
- Iterative

What is Object-Orientation?

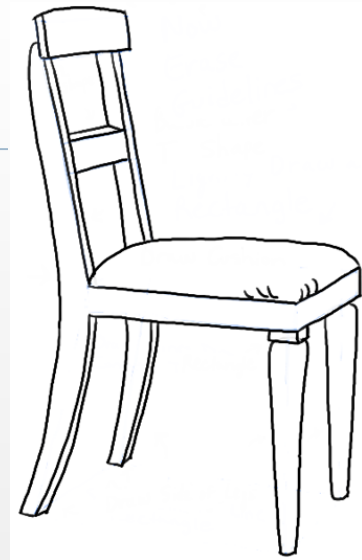
- ▶ Object:
 - An entity with:
identity, state, and behavior
- ▶ An object belongs to a class
- ▶ Class:
 - A description of a collection of objects sharing:
structure, behavioral pattern, and attributes
- ▶ Each class contains a set of objects
 - We refer to them as the objects of the class



Example: Object and Class

► Object:

- identity: myChair
- state: by dining table, free
- behaviour: bought, moved to, ... , sat down on, got up from, ..., moved to, ..., sold



► Class:

- structure: has an owner
- attributes: position, vacant
- behavioural pattern: buy + {move | sit down on + get up from}* + sell



Example: Warehouse

- ▶ A large collection of articles stored in separate positions
- ▶ An article can be entered into, moved within and removed from the warehouse
- ▶ Describe an object and the relevant class



Example: Gravel Pit

- ▶ In the gravel pit, dirt is sorted into sand, gravel and rocks
- ▶ The sorted materials are stored in piles
- ▶ Describe an object and the relevant class



Objects in Analysis and Design

► Analysis

- Phenomena outside the computer system
- Identity: identifies an object
- Behavior: the events an object has performed or suffered

► Design (and implementation)

- Phenomena inside the computer system
- Identity: get access to an object
- Behavior: the operations an object can perform on request and offers to other objects

Model the Context

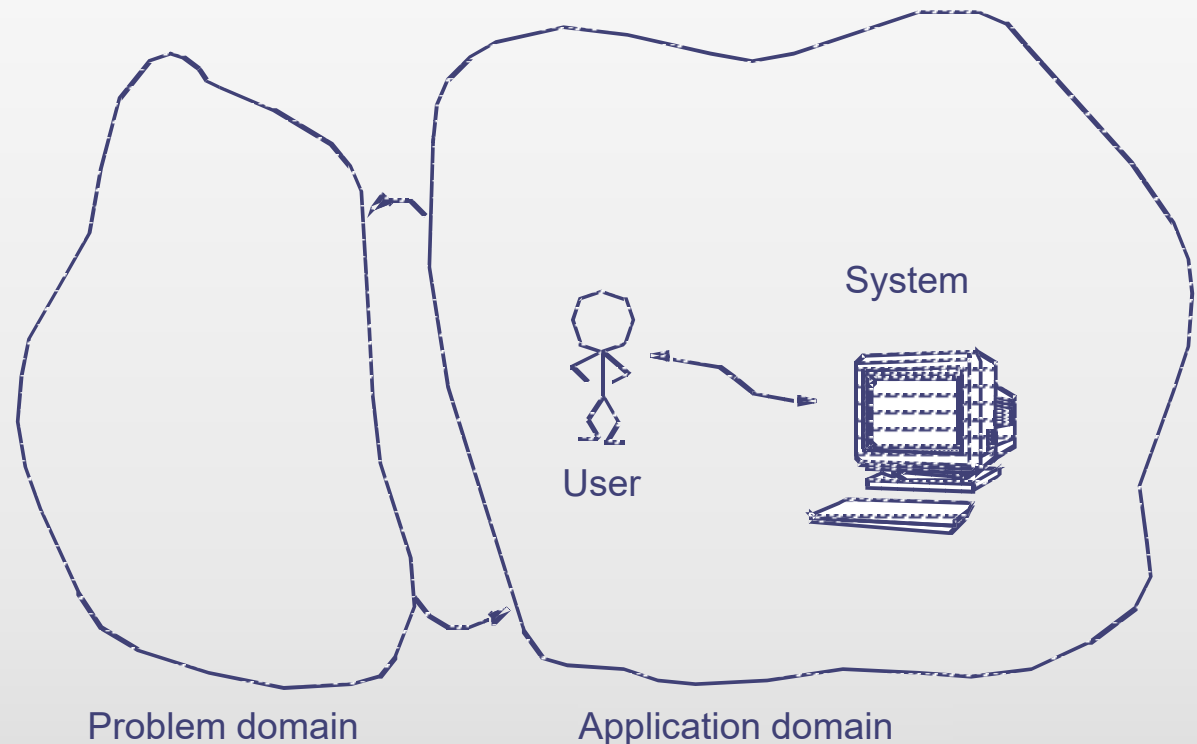
Focus on an IT system
and its context

Problem domain:

That part of a context
that is administrated,
monitored, or controlled
by a system

Application domain:

The organization that
administrates, monitors,
or controls a problem
domain



A Model of the Problem Domain

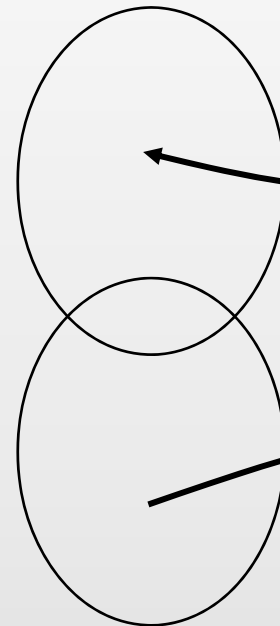
Model:

An updated representation of the state in the problem domain

User:

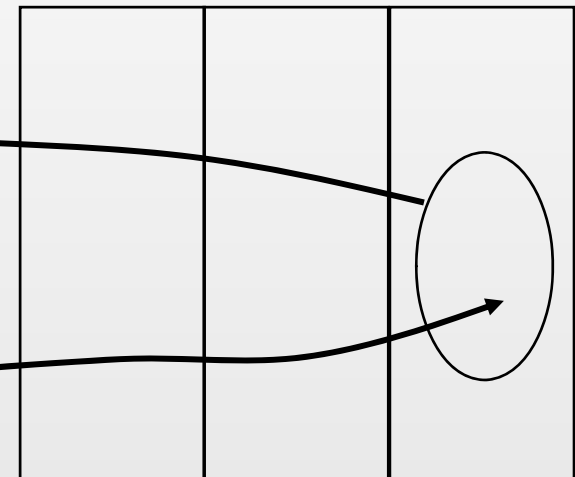
Is in the application domain and gets information about the problem domain mediated through the model.

Application domain



Problem domain

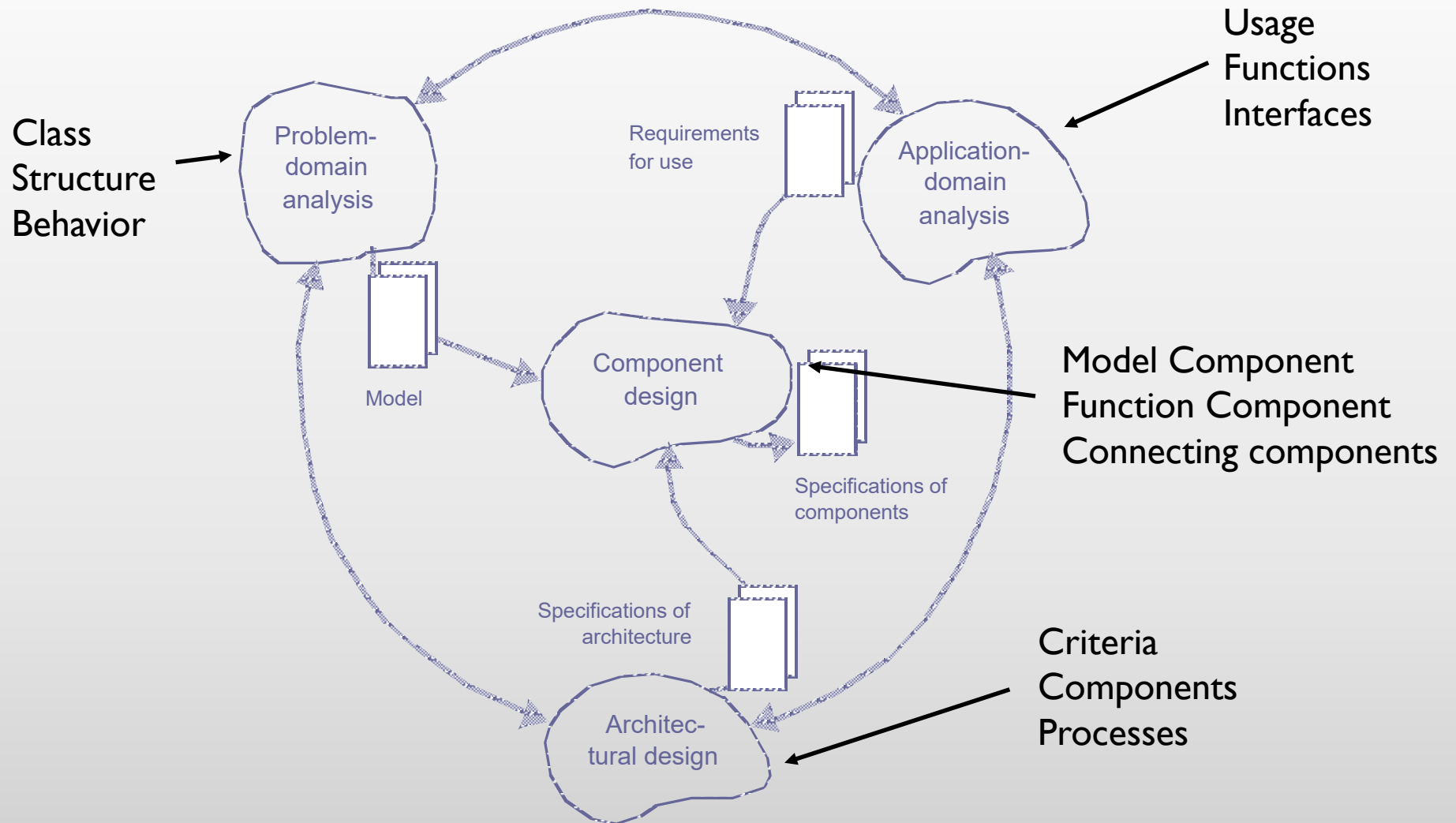
Model



Exercise

- ▶ Describe a system by its problem domain, application domain and the interplay based on the model

The Method as a Whole



The OOA&D Method

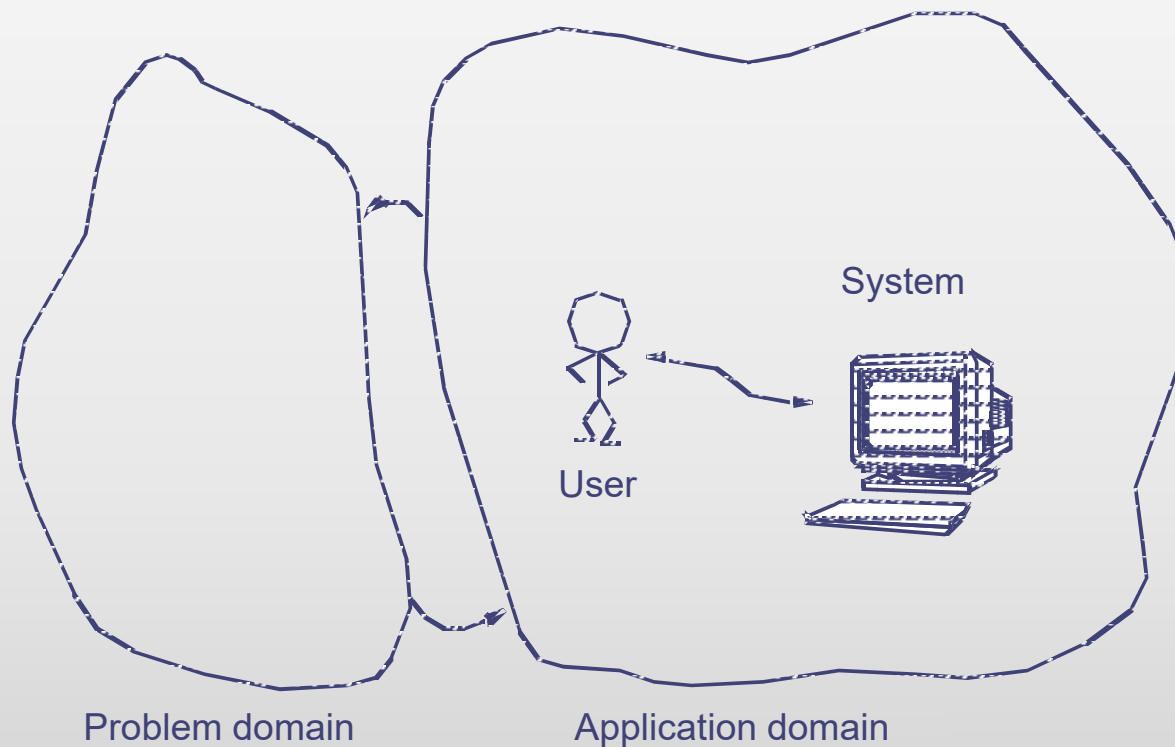
Purpose	<ul style="list-style-type: none">• To determine system requirements.• To produce a system design without significant uncertainties.• To understand a system, its context, and the conditions for its implementation.
Concepts	<ul style="list-style-type: none">• Object: An entity with identity, state, and behavior.• Class: A description of a collection of objects sharing structure, behavioral pattern, and attributes.• Problem domain: That part of a context that is administrated, monitored, or controlled by a system.• Application domain: The organization that administrates, monitors, or controls a problem domain.• System: A collection of components that implements modeling requirement functions, and interfaces
Principles	<ul style="list-style-type: none">• Model the context.• Emphasize the architecture.• Reuse patterns.• Tailor the method to suit specific projects.
Results	<ul style="list-style-type: none">• An analysis document and a design document.

Contents

- ▶ Introduction to the course
- ▶ Object-oriented analysis and design
- ▶ System Choice
 - Purpose, activities and result
 - Situation and rich pictures
 - Create new ideas
 - Define systems
- ▶ Varying system definition elements
- ▶ Challenges in this activity

The System's Context

- ▶ The purpose of the System Choice activity is to define the system in its context

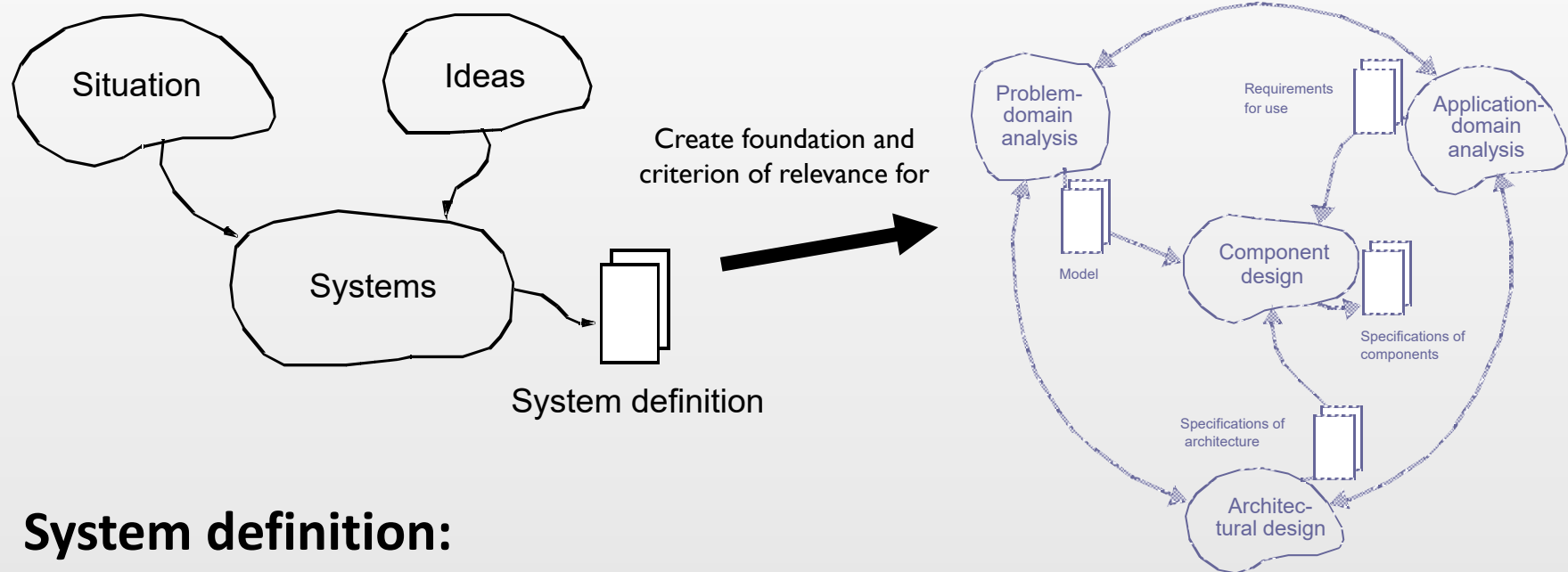


System Choice: Result

► **System definition:**

A computerized system used to prepare and plan an IFIP conference, with emphasis on administration of participants, articles, and the program itself. The system should primarily be an administrative tool, but secondarily serve as a communication medium for the program committee, the organizing committee, and the local administrative personnel to help them manage the conference. The system should be based on a cheap PC with current tools. The system should also be able to function in different types of environments, including use by volunteers who have great enthusiasm and greatly variable administrative experience.

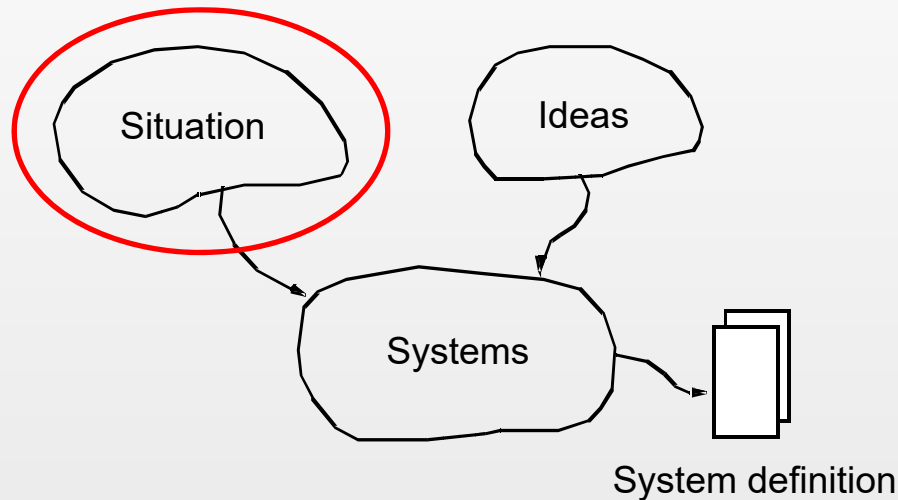
System Choice: Purpose and Activities



System definition:

A concise description of a computerized system expressed in natural language

Situation

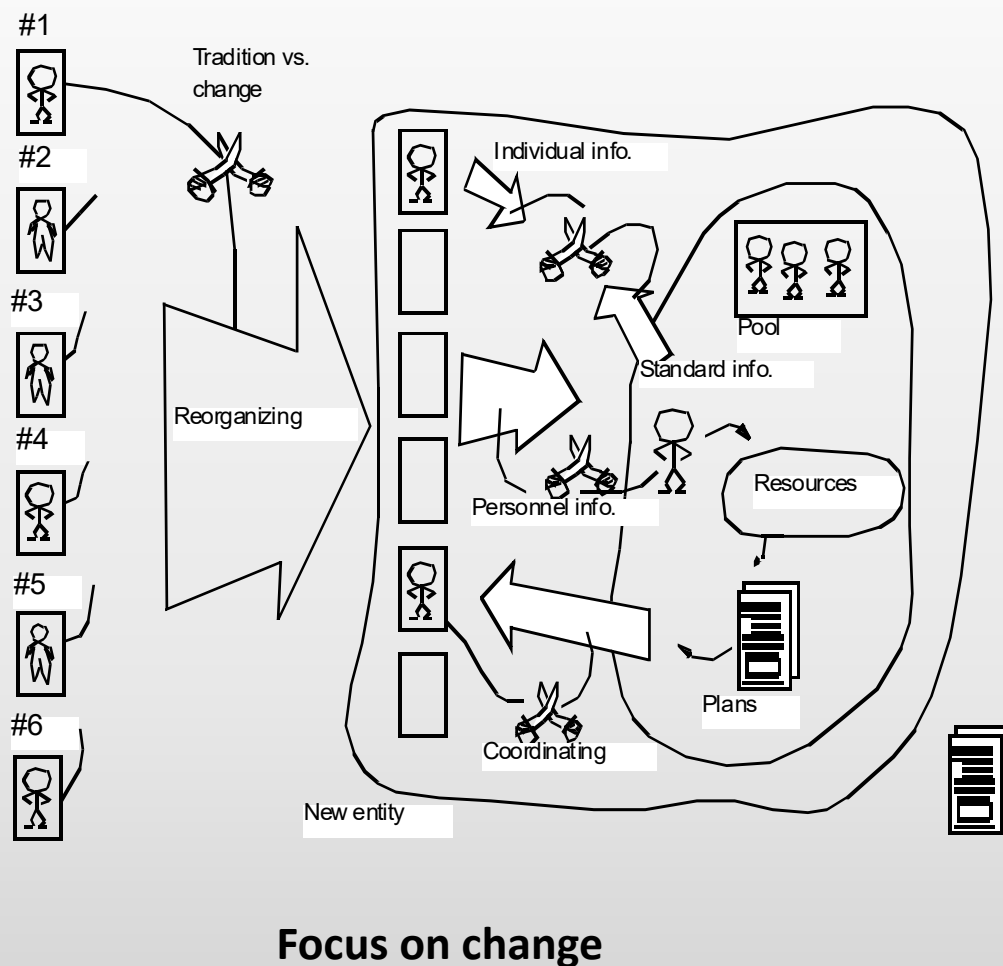


Describe the situation:

- ▶ The system
- ▶ The context of the system
- ▶ The conditions for development of the system

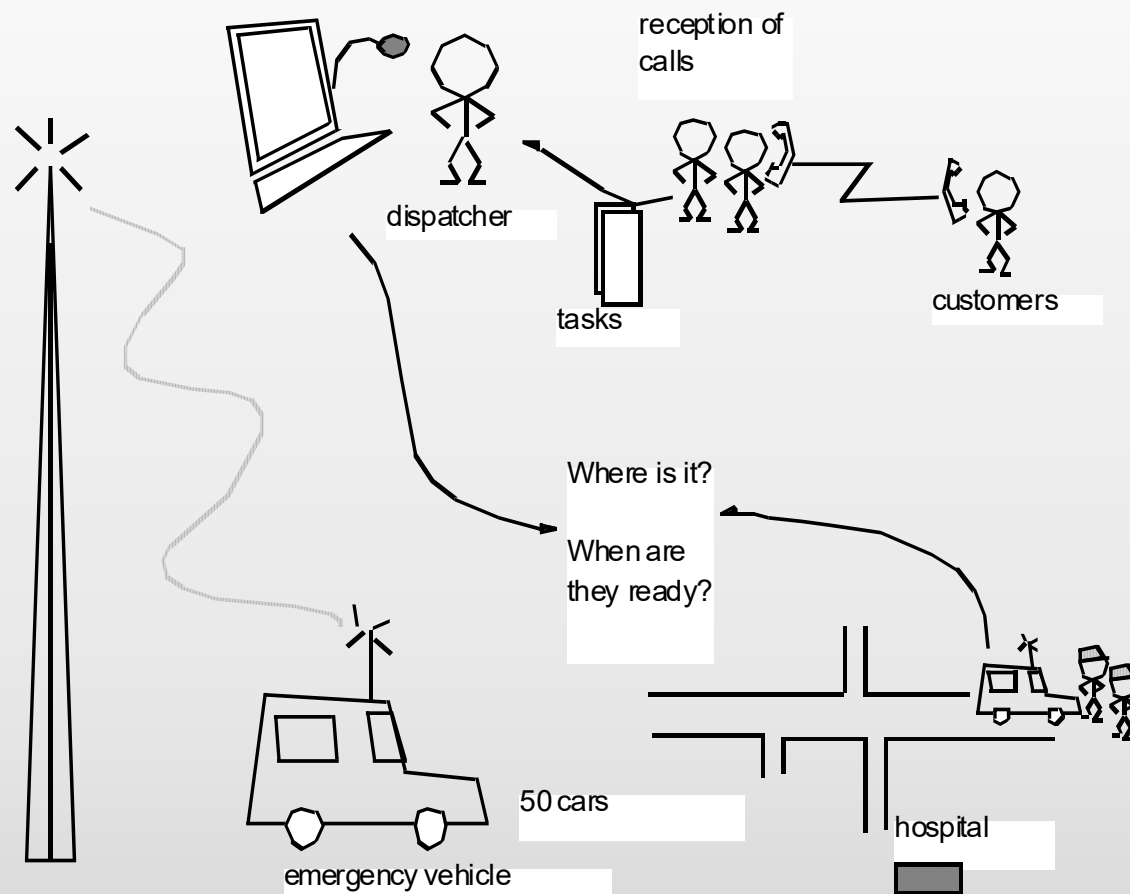
Describe this on an overall level

Use Rich Pictures



- ▶ The situation is described by a rich picture
- ▶ Focus:
 - on change or stability
 - on actors and the role of the system
- ▶ 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
- ▶ Rich pictures
 - but not chaotic

Rich Picture

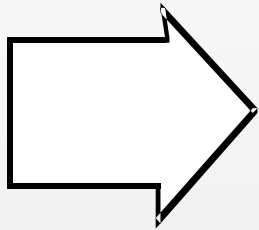


► Entities:

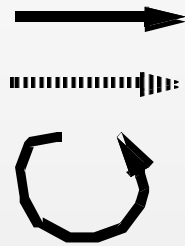
- People
- Roles and tasks
- Locations

Focus on stability

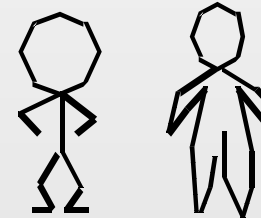
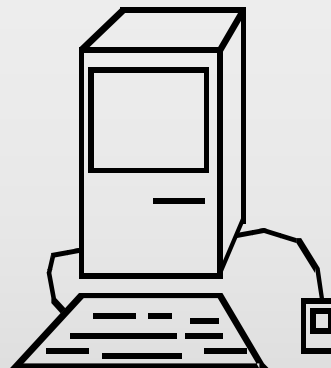
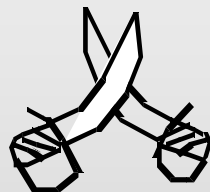
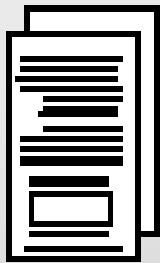
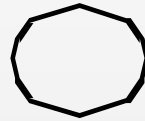
Symbols for Rich Pictures



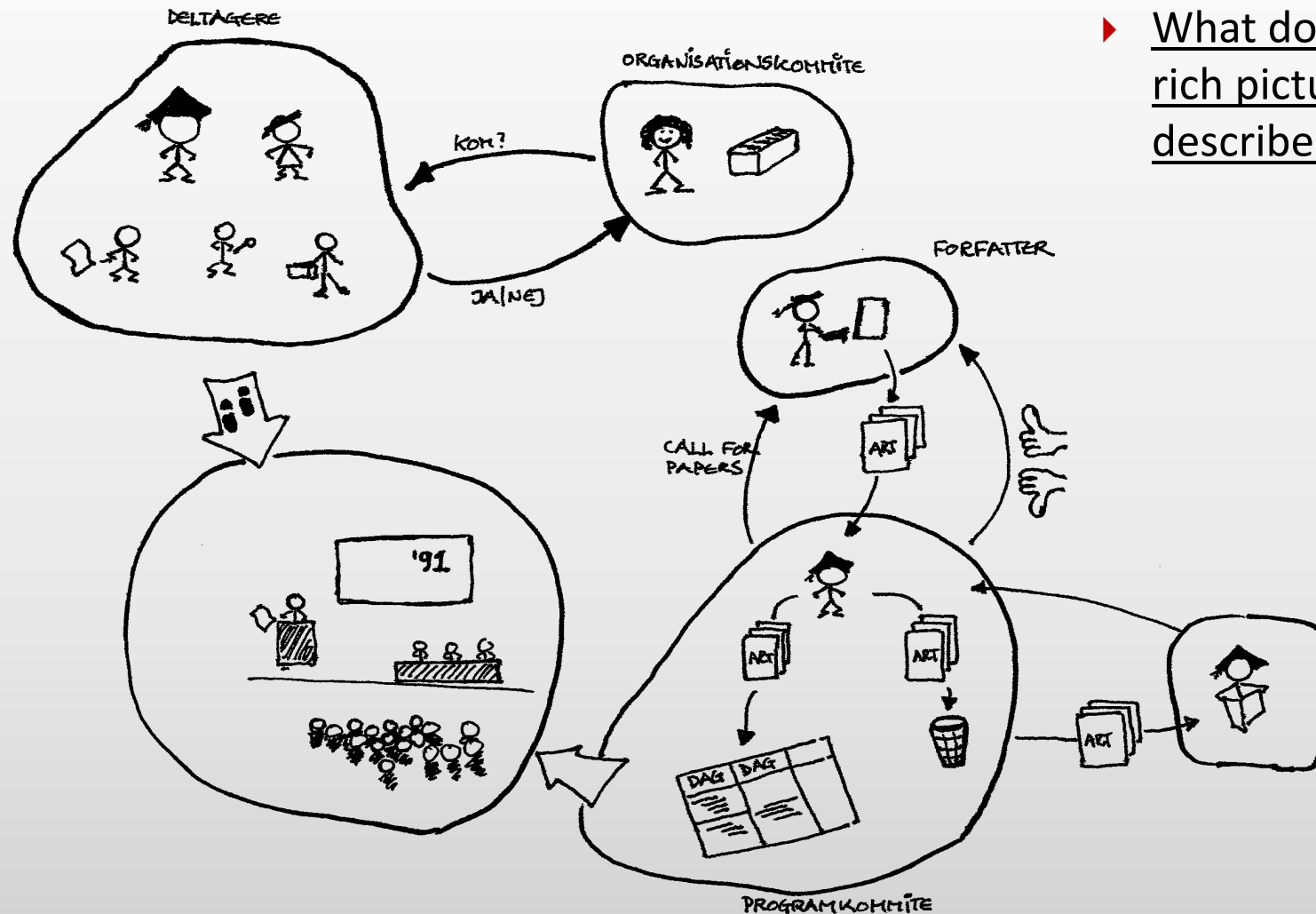
ABC...



123...

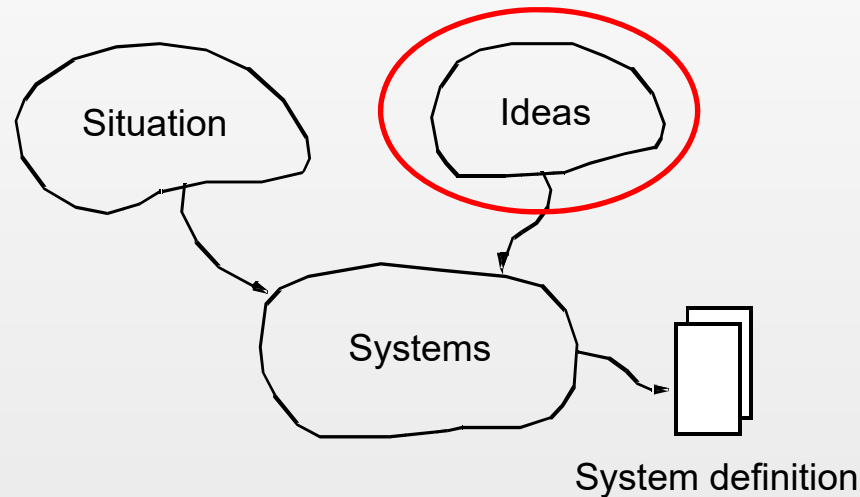


Example of Rich Picture



- What does this rich picture describe?

Ideas

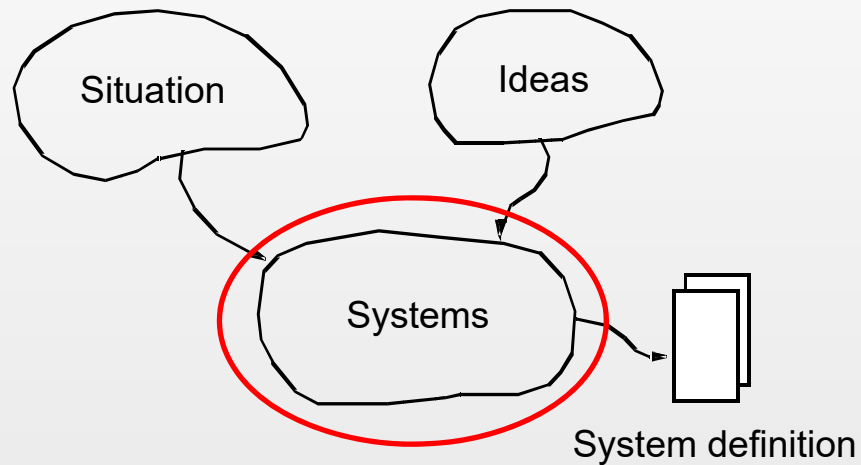


- ▶ Complement the description of the existing situation with new ideas
- ▶ The software developers are often best able to suggest changes

Create Ideas

- ▶ Exemplars (e.g. for a financial system):
 - Study an existing system
 - Look at spreadsheets
 - Examine standard packages
 - Consider SAP
- ▶ Metaphors (e.g. for a library):
 - Storage
 - Supermarket
 - School
- ▶ Experiments with prototypes:
 - Planning
 - Development
 - Preparation
 - Test
 - Summarizing
- ▶ More about prototypes in the DEB course

Systems



► Based on

- The description of the situation
- The new ideas

describe the system to be developed on an overall level

System Definition (FACTOR)

Functionality: The system functions that support the application-domain tasks.

Application domain: Those parts of an organization that administrate, monitor, or control a problem domain; the users and their work tasks.

Conditions: The conditions under which the system will be developed and used.

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

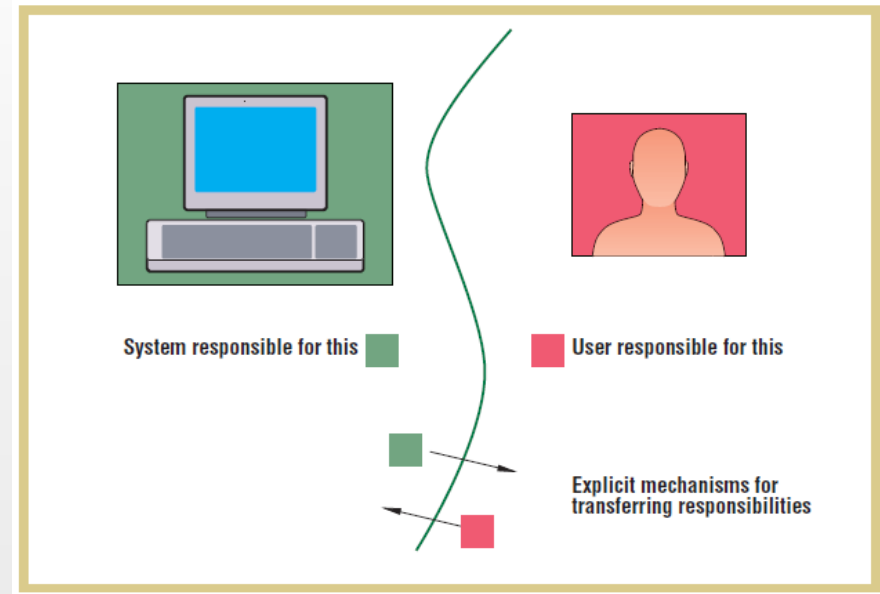
Objects: The main objects in the problem domain.

Responsibility: The system's overall responsibility in relation to its context.

F	Support for program design. Automate participant registration.
A	Administration of speakers and participants. Control of conference papers. Program design. Participant registration.
C	Volunteer labor has widely varying administrative experience. Development to proceed despite contradictory and missing requirements.
T	Cheap PC platform with current tools.
O	Speakers and participants. Conference papers and program.
R	Administrative tool and communication medium.

Understanding Responsibilities

- ▶ Kindberg and Fox (2002)
- ▶ The divide between the responsibilities of the system and the user is a “semantic rubicon”: “[that] demarcates responsibility for decision-making between the system and the user.”
- ▶ For the user to understand the semantic rubicon it requires
 - defining the knowledge the system can have of the physical world and of user(s) behavior – through sensing and user interaction
 - defining the knowledge the user has of the system and how they might influence it
 - defining the mechanisms and permissible interactions for one to influence the other and to transfer responsibilities between them



Explaining Responsibilities

- ▶ Possible division of responsibility:
 - Automatic system
 - Support tool
- ▶ Example systems:
 - Making a schedule for a school
 - Airplane landing system
 - Greenhouse temperature control
- ▶ For each example system: how would different divisions of responsibility work?

Evaluation and Choice

- ▶ Do the system choice activity as early as possible
- ▶ Iterate within the activity and in subsequent activities
- ▶ The purpose is to choose one system
- ▶ The customer/user is responsible for the choice
- ▶ The system developers provide support and organize the process
- ▶ Approach: question overall decisions and evaluate alternatives
 - and do it with the prospective users

System Choice: Summary

Purpose	<ul style="list-style-type: none">• To agree on the overall system characteristics.
Concept	<ul style="list-style-type: none">• System definition: A concise description of a computerized system expressed in natural language.
Principles	<ul style="list-style-type: none">• Appreciate the situation.• Cultivate new ideas.• Define alternative systems.
Results	<ul style="list-style-type: none">• A system definition that fulfills the FACTOR criterion.

Contents

- ▶ Introduction to the course
- ▶ Object-oriented analysis and design
- ▶ System Choice
- ▶ Varying system definition elements
 - Three examples
- ▶ Challenges in this activity

Exploring Alternative System definitions

- ▶ The system developers explore different alternative systems by changing elements of the system definition

Conference Administration

► Functionality 1

- Register information about participants and produce a complete participant list.

► Functionality 2

- Register general participants as well as those with an active role such as author, speaker, or reviewer. Support the administration of finances and invitations. Support development of conference programs, including registration, paper acceptance, and sessions divisions.

► Responsibility 1

- Support program design by producing overviews and allowing users to add components and save different versions. Support conference operations by emphasizing potential problems at regular intervals.

► Responsibility 2

- Automatic conference-planning program. Generate program from suggested sessions and incoming paper reviews.

Bank

- ▶ The classical bank:
 - A bank clerk uses the system to register customer transactions
 - For example withdrawal of money
- ▶ The modern bank:
 - A customer uses the system to make transactions
- ▶ How will the differences be reflected in the system definition, i.e. which element of the system definition is changed (and how)?



*1. november 1979 konverterte to af bankens filialer til IDA — Kongsgård og Vågsbygd.
Billedet er hentet fra sistnevnte.*



Warehouse

- ▶ What would the system definition for a traditional warehouse be?
- ▶ How should we change it with a modern warehouse like IKEA?



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- ▶ Challenges in this activity

Challenges in this Activity

- ▶ Difficulties differentiating:
 - F – A
 - F – R
 - T – C
- ▶ Work in exercises for this activity
 - Write text for each element of the FACTOR criterion
 - Experiment with variations on selected elements
 - If desired, write as a coherent text