# Knowledge Modelling and Management

# Part A (3)

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**http://www.aiai.ed.ac.uk/~jessicac/project/KMM**

# Case Study:
# Social Security Services

# Real-Life Case Study
# Social Security Services
# In Netherlands (SSS)

- Two most important types of social securities:
  - General assistance benefits;
  - End-of-the-line type of benefits.
- 60,000 people supported by general assistance benefits.
- To qualify for benefits, each applicant is screened in detail.
- Screening rules are codified and derivable from volumes of laws and regulations.
- Considerable backlog of applications and growing.
- Results in long queues in office and delay of final decision making from initial client intake.
- Such delay has caused complaints and caught media attention.

Source: chapter 3 of [1]

# Rationale: Problem - Opportunity Formulation

- **The Secretary of the Directorate therefore has suggested to use knowledge systems to reduce backlog.**
- **Rationale:**
  - **The applicable laws and regulations are so complex, it takes too much time for the staff to reach a decision.**
  - **Therefore, if we can provide a knowledge system that stores the needed legal decision-making knowledge, the decision process can be speeded-up.**
  - **As a result, the backlog is reduced !!**

# Organisational Model OM-1

**Organisation Model: Problems and Opportunities Worksheet OM-1**
**Initial contextual and problem analysis**
**Example Worksheet for Housing Application**

| | |
|---|---|
| **Problems and Opportunities** | ***Assessment of individual applications takes too much time, creating back log to be processed.**<br>***There is not sufficient staff for handling urgent cases.** |
| **Organizational Context** | ***Mission: Enable people to take responsibility to find a proper home.**<br><br>***External factors: National regulations.**<br><br>***Strategy: Provide high quality housing at a reasonable price.** |
| **Solutions** | **Solution 1: Develop an automated system to speed up application assessment.**<br>**Solution 2: Set up a training program for application assessment.** |

[Table taken from Chapter 10, p241. ]

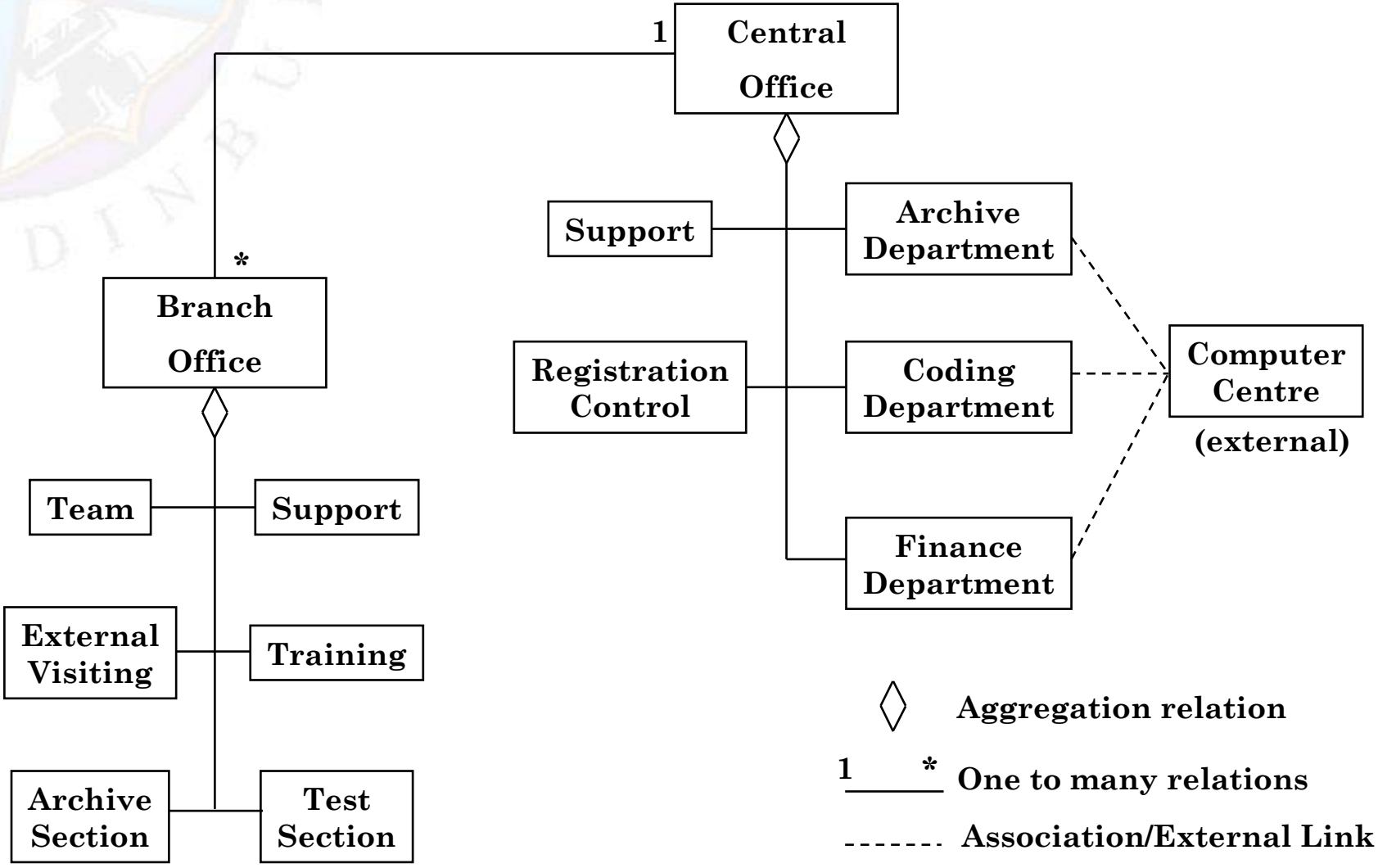
# Initial Assessment of the Case

- **Problem areas clearly identified.**
- **Objectives are clear – reduce backlog.**
- **Have a sense of direction for solution.**
- **Clear benefits for the organisation.**
- **Sufficient information for OM-1 !!**

# Quick Review: Organisation Model Variant Aspects OM-2

- **For each identified problem-opportunity area in OM-1, describe important organisational-related characteristics:**
  - **Organisational structure;**
  - **People involved and their roles;**
  - **Culture and power – organisational practice; social and interpersonal skills; relationships and networks.**
  - **Resources involved – e.g. information systems, equipment and materials, technology/patents and rights;**
  - **Processes – identify of processes, may use e.g. UML activity diagram, or other business process models (more in OM-3);**
  - **Knowledge involved (more in OM-4);**

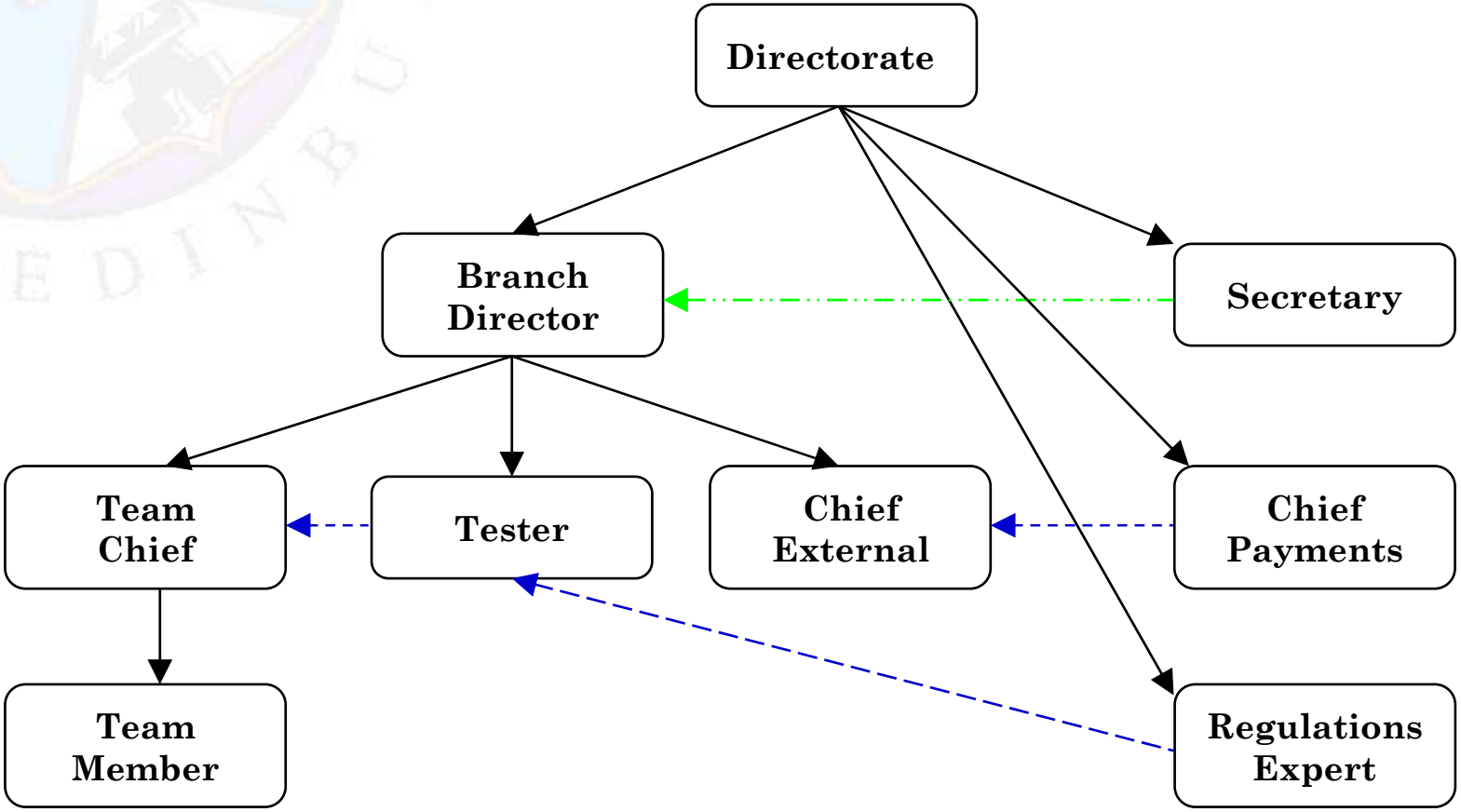
# Organisational Structure (SSS)




p.s. there are 16 branch offices

UML Class Diagram

# Organisational Chart and Power and Influence

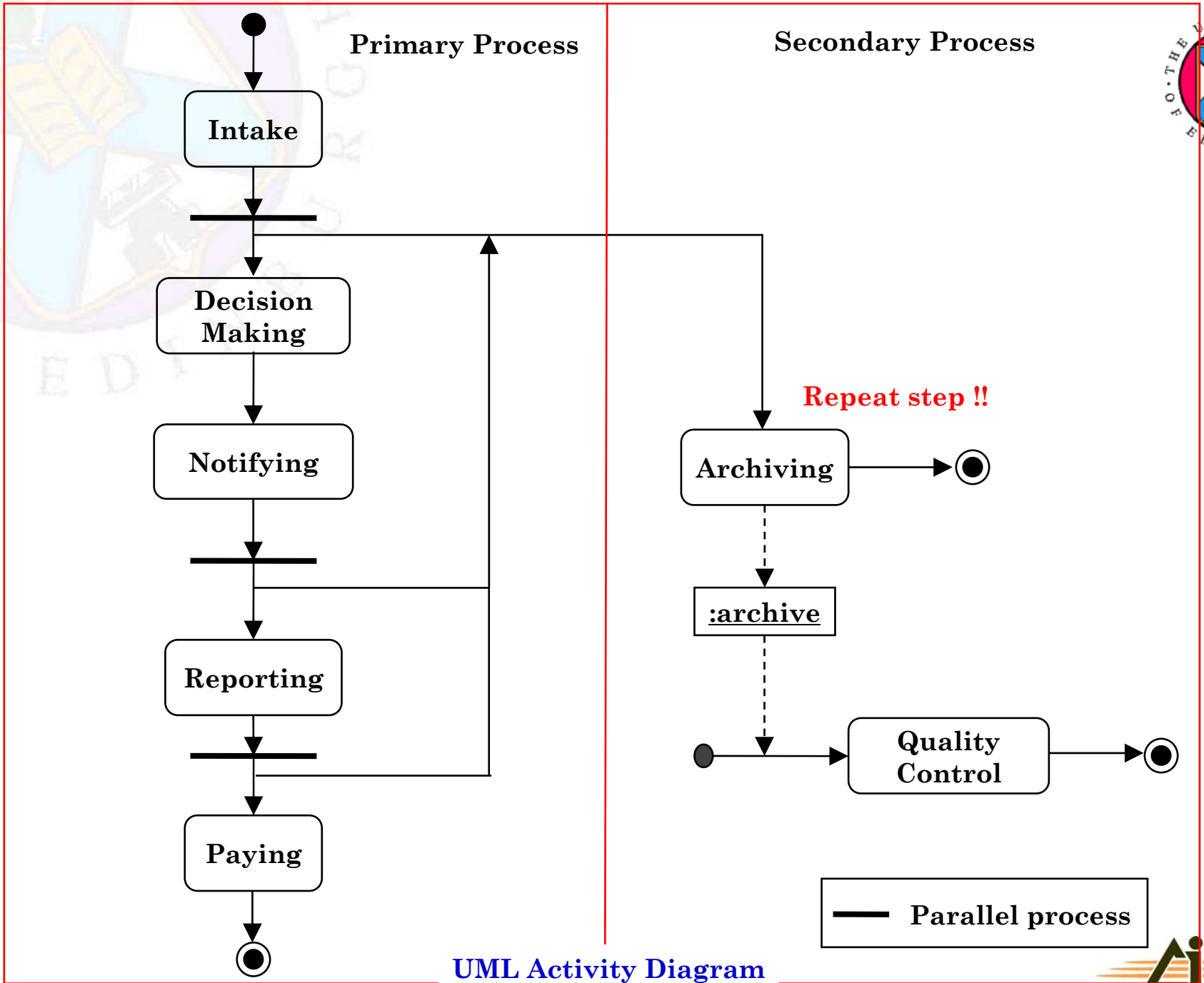


# Resources Analysis

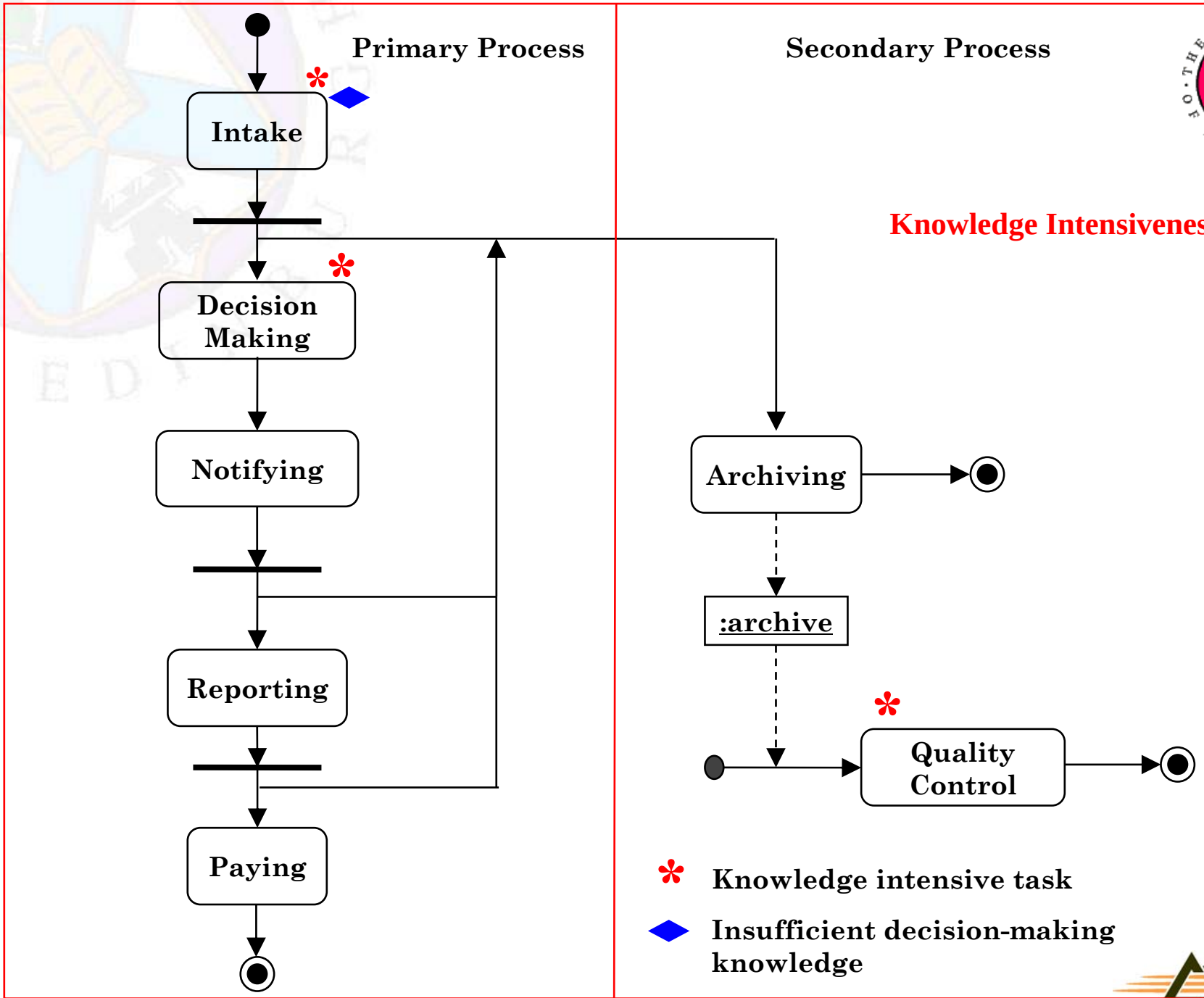
- Limited computers available.
- “Outsourced” computing capacity – use external computer center.
- Only some terminals are connected to the external central computer center.
- Some experiments with the use of PC with limited applications – e.g. producing letters of notification.
- Insufficient office space in some branches for receiving applicant intake.

# Process and Knowledge
# Task Analysis OM-3, OM-4

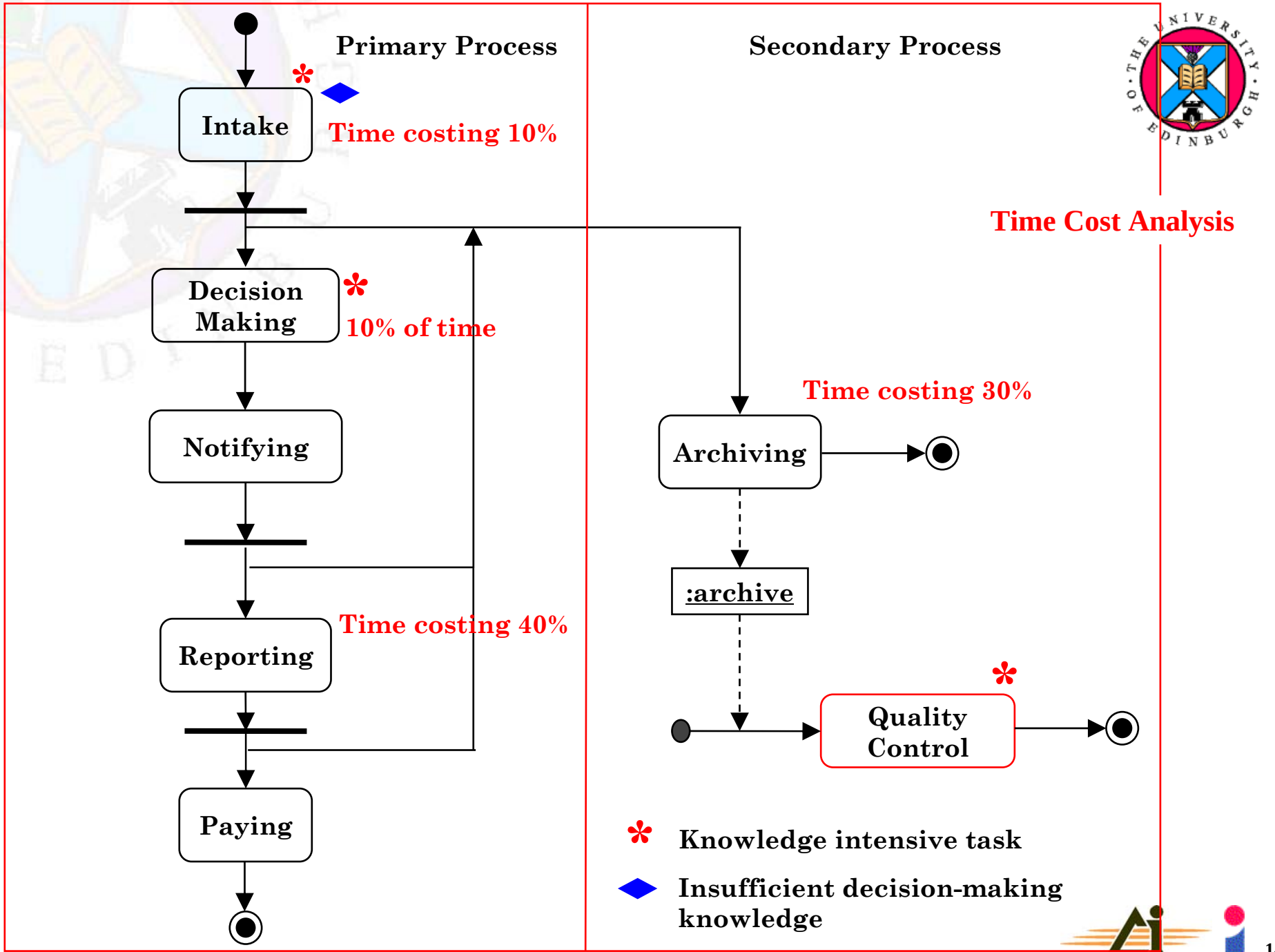
- **Assumed main process need automation: i.e. the decision-making process for approving benefit applications.**
- **Process breakdown:**
  - **Intake,**
  - **Archiving,**
  - **Decision-making,**
  - **Notifying,**
  - **Reporting,**
  - **Paying,**
  - **Quality control.**
- **An UML Activity Diagram is used.**




UML Activity Diagram

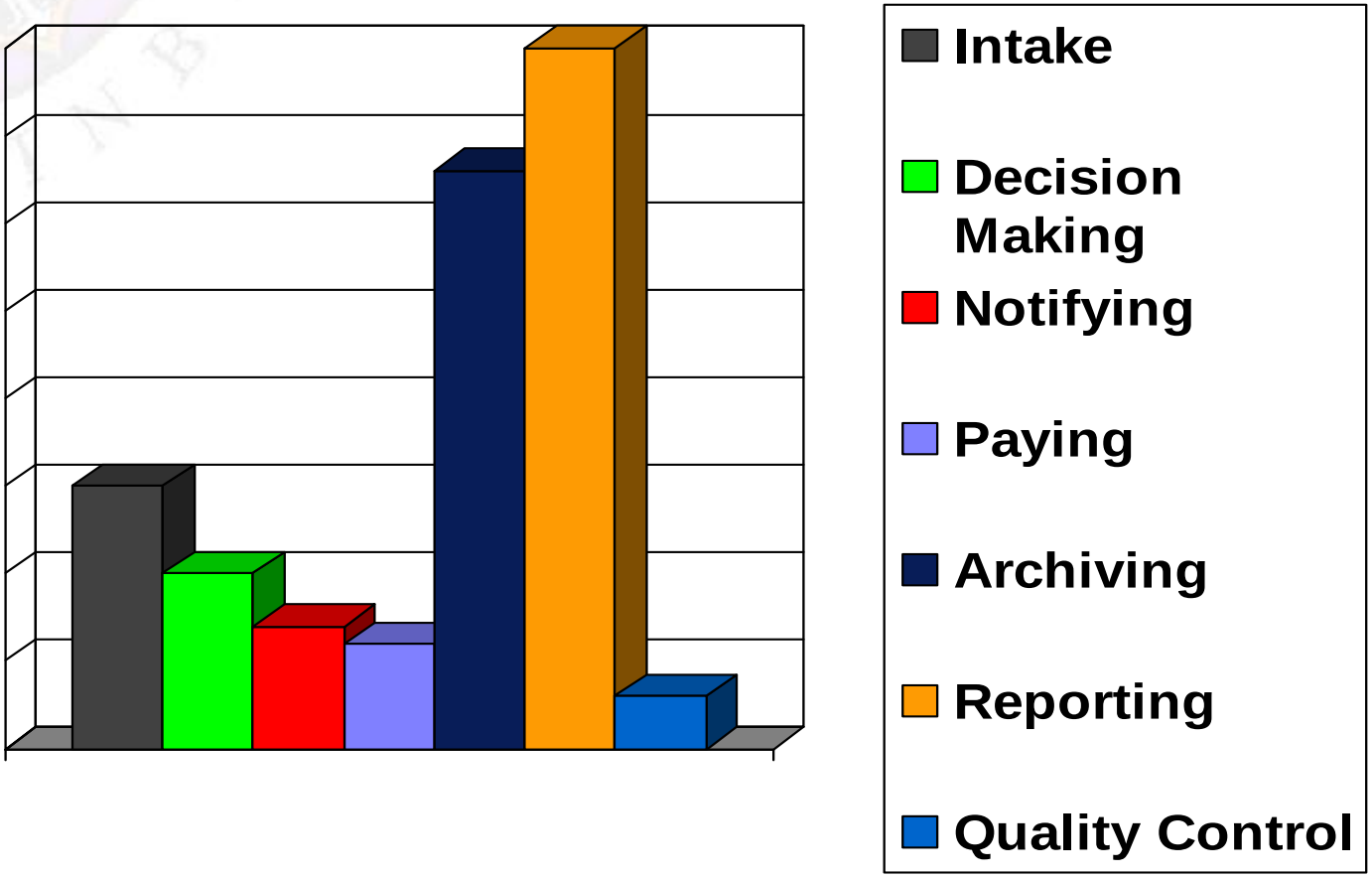



## Knowledge Intensiveness Analysis




Time Cost Analysis

# Relative time spend for activities as cost – cost-effectiveness Analysis



# Two Possible Solutions

- **Knowledge based system solution – original proposal.**

- **Archiving and reporting system solution – proposed after cost-effectiveness analysis.**

# OM-5
# Feasibility Studies

# Feasibility Evaluation
# Business Feasibility

- A knowledge system will not in itself solve the time inefficiency problem.
- Higher benefits in speeding up Archiving and Reporting processes.
- More PCs may be needed
  - Decentralised computing may replace centralised computing:
  - Some branches may have space issues.
- The interactions between different roles may be changed.
  - Remote auditing and query is possible
- The interactions between different organisational units may be changed.
  - Remote reporting and archiving is possible

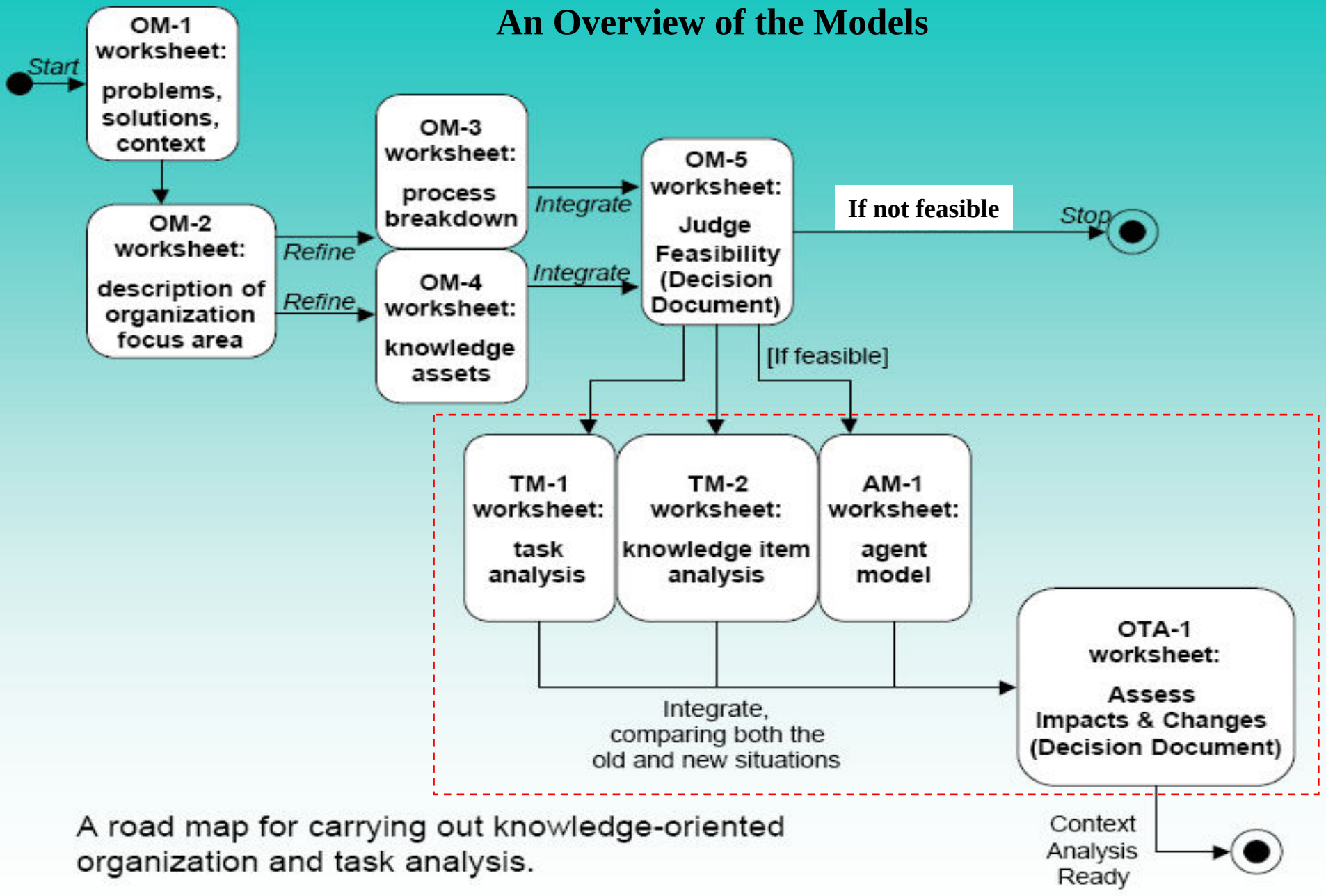
# Technical and Project Feasibility Evaluation and Conclusion

- **Technical Feasibility:** **Grey decision-making process and non-verbal tacit knowledge is used, but hard to formulate.**
- **Project Feasibility:**
  - **knowledge systems vs. efficient reporting and archiving solutions:**
  - **reporting and archiving solution looks favourably.**
- **Proposed actions:**
  - **Not to take the KS solution, but to**
  - **Simplify the workflow for reporting and archiving process, so can**
  - **Resolve the bottleneck problems of reporting and archiving.**

# Discussion: Regarding Actor and In-depth Task Analysis

- In the provided UML activity diagram – when used on its own - it is unclear as who are involved in those tasks. It is therefore unclear as when those tasks are automated how they will affect certain individuals.
- Lack of detailed process, task descriptions and analysis – a task model is needed.
- Lack of in-depth analysis of tasks from the view point of organisational operations.
- Organisational impacts: it is unclear how the organisation may be impacted, although we can guess that external regulations expert may change their interactions with the tester – as machines would provide some of the information – agent and OTA (Organisation-Task-Agent) model is needed.
- We can also image that there may be less dependency and interactions between the branch and the external computer center in the to-be model, as some processing are now done locally in branch offices – OTA model is needed.

# An Overview of the Models




A road map for carrying out knowledge-oriented organization and task analysis.

**OTA: Organisation-Task-Agent Model**

**Source: AIFB [16]**

# Task, Agent and OTA Concluding Statement

**These models are used, if a Knowledge System is decided to be built**

# What is a Task in CommonKADS

- Task is a subpart of a business process that:
  - Represents a goal-oriented activity adding value to the organization;
  - Handles inputs and delivers desired outputs in a structured and controlled way;
  - Consumes resources;
  - Requires (and provides) knowledge and other competences;
  - Is carried out in according to given quality and performance criteria;
  - Is performed by responsible and accountable agents.

# Task Model TM-1

- Task Analysis
- Refinement of OM-3 (process breakdown).
- Analysis from 3 different aspects: the 3-D view:
  - Functional view:
    - » task decomposition, I/Os, I/O flows, data flows
    - » may use UML activity, business process, or data flow diagrams to describe a task model;
  - Static information structure:
    - » information content and structure of objects – may use UML class diagrams;
  - Control or dynamic view:
    - » May use temporal links and control flow over sub-tasks
    - » may use activity and/or state transition diagrams.

# Elements Included in TM-1

- Name of task
- Organisation where the process is carried out
- Dependencies between processes (I/O)
- Objects handled (I/O objects)
- Timing and control (record frequency and duration, pre- and post-conditions)
- Agents involved
- Knowledge and competence involved
- Resources involved (staff time, systems, equipments, materials, financial, budgets)
- Quality and performance measures used

# Task Model 2 (TM-2)
## Process Criticality and Bottleneck Analysis

- **Knowledge item analysis**
- **Refinement from OM-4 (knowledge assets).**
- **Below questions may be asked for each identified task:**
  - **How often do you carry out this task?**
  - **How long does it take?**
  - **Whom do you talk to when carrying out the task? (e.g. to gain necessary knowledge)**
  - **What do you need in order to start with it?**
  - **What happens to the organisation, if it goes wrong?**
  - **What may go wrong, and what do you do then?**
  - **How do you know that the task is successfully concluded ?**

– Other Bottleneck and criticality analysis:

» How many processes need information produced by this process so that they can start/finish their own executions? This information may be derived via control and data flow constraints

» How many processes need to be completed before this process can start/finish its execution?

» What data is required for this process? Is this data difficult/complicated to obtain? What is the accuracy of this data? Is this data important for this process?

» Can some constraints be relaxed, in case this process can not be executed successfully, without compromising overall organisational operations?

- May use task scenarios to gain further understanding.

# Agent Descriptions
# Agent Model (AM-1)

- **Analysis from the view point of an agent involved in a task.**
- **Understanding their roles, involvements, competence, and how they collaborate with other agents in their tasks, inc:**
  - **Organisation position;**
  - **Involvements in tasks;**
  - **Communication with other agents;**
  - **Has/use knowledge in tasks;**
  - **Other competences;**
  - **Responsibilities and constraints.**
- **To show how systems are used by an agent, UML Use-Case diagrams are useful.**

# Organization-Task-Agent Models (OTA-1) Concluding Statement

- **Impacts and changes in organisation (as-is vs. to-be models)**
  - **Inc. aspects of organisational structure, processes, resources, people, knowledge, culture and power.**
- **Impacts and changes on specific task/agent:**
  - **Task layout, resources needed, training needed, performance and quality criteria, staffing, individual positions, responsibilities, authorities, constraints, required knowledge and communication.**
- **Attitudes and commitments (from stakeholders): is it sufficient?**
- **Proposed actions:**
  - **Improvements, supporting facilities, parallel project actions, expected results/cost/benefits, when to re-consider the proposals.**

# Summary: Organisational Context and Task Analysis

- **Organisation Model (OM)**
  - **OM-1: problems-opportunities, goals, solutions;**
  - **OM-2: variant (main) aspects of an organisation;**
  - **OM-3: process breakdown;**
  - **OM-4: knowledge assets and relations with people;**
  - **OM-5: Feasibility study and decision making.**
- **Task Model (TM)**
  - **TM-1: detailed task description – process detail analysis;**
  - **TM-2: task criticality and bottleneck analysis – knowledge item analysis;**
- **Agent Model (AM)**
  - **Agent position, involvements, responsibilities;**
  - **communication patterns, has knowledge, constraints.**
- **Organisation-Task-Agent (OTA) Model**
  - **Evaluation and conclusions: impact and changes in organisation, task/agent impact and changes, attitudes and commitments; proposed actions and prospects.**

# Additional Information

# CommonKADS

- **The CommonKADS (Knowledge Acquisition Data System) methodology for the KBS development is a result of the KADS-II project ("An Advanced and Comprehensive Methodology for Integrated KBS Development"), which was a part of ESPRIT 2 (European Strategic Programme for Research and Development in Information Technology) project. It has been developed over a period of 1990 – 1994;**
- **However some ideas were derived directly from the former KADS project ("A Methodology for the Development of Knowledge-Based Systems"; 1985 - 1990).**
- **At the moment, it is one of the most widely used methodology for KBS development in both research and commercial applications.**
- **It is still the European de facto standard for knowledge analysis and knowledge-intensive system development.**

**Source: [21a]**

# Different Levels of Formality of Models

- **Informal model: explained using natural language with or without graphical or other visualisation aid.**
- **Semi-formal model: explained using well-defined (graphical) notations complimented with informal (textual) descriptions, i.e. in natural language.**
- **Formal model: use well-defined notations only. This form of representation is suitable to use as a basis to provide automation.**

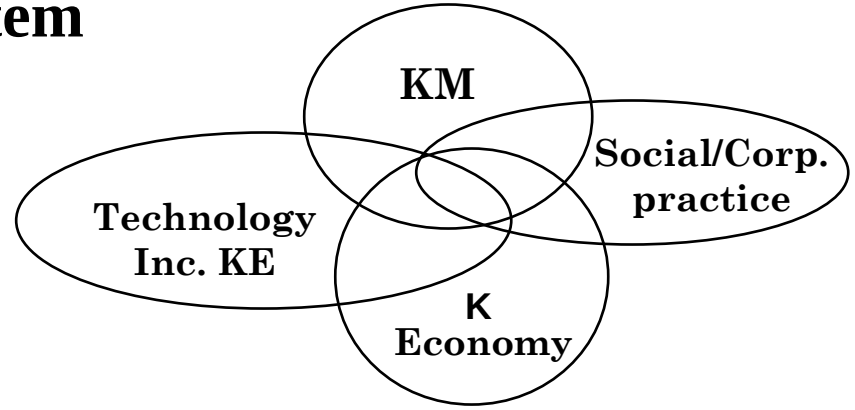
- **Models of different levels of formalities are often chosen to describe different domains to serve different purposes. They are often used together when describing a highly informal domain, which is often the case where CommonKADS method is applied.**

# Roles of KE and KM

- **The role of knowledge engineering and knowledge system in KM:**
  - **Knowledge engineering offers effective methodologies for KM, including KA, high level conceptual modelling, formulisation and automation.**
  - **Knowledge systems offer important options for automation of KM activities.**
- **Areas that KE has contributed to:**
  - **Knowledge-oriented organisation analysis.**
  - **Task and agent analysis.**
  - **Conceptual modelling methods and transition to automation.**
  - **Intuitive graphical visualisation method – suitable for non-technical personnel.**
  - **Support sharing and reuse of knowledge, information and system components (from task models).**
  - **Example applications:**
    - » **May be used in KM (quick scans) workshops, IT strategy scoping and feasibility studies.**
    - » **Support early stages of SE project: requirement engineering, conceptual modelling of knowledge.**
- **Ultimate goal of KM: to deliver knowledge at the right time, right place, right shape, with needed quality and the lowest possible cost.**

# Subject Areas Related to KM

- Business management
- Organisation theory
- Business process re-engineering and improvement
- Information management
- Knowledge system development
- Community based discussion forum
- Corporate Intranet environment
- Document management system
- Email management system
- Knowledge economy
- Knowledge ecology
- Community of practice
- Social network analysis

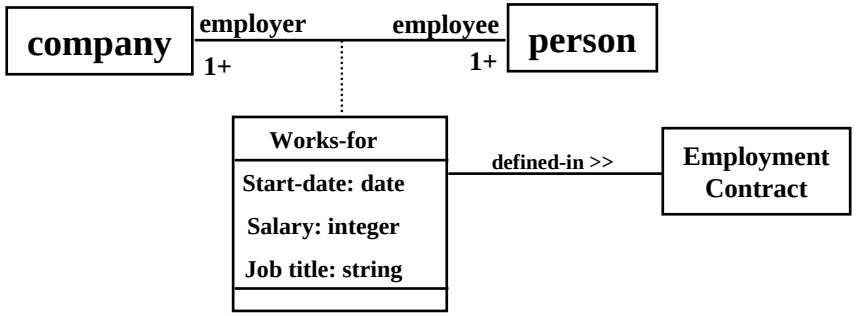


# UML Class Diagram

**Organisational resources, information and data may be described in UML Class Diagrams**

# UML Class Diagram

- A class includes three parts:
  - class name
  - attributes and their types (e.g. string, number, integer, Boolean, date, universal)
  - operations, parameters used and their types.
- Association
  - Relationship: An attribute whose value is not an atomic values, but indicate a relationship with objects (of other classes)
  - May be bi- or uni-directional, e.g. married-to, owned-by
  - Cardinality: e.g. 0-1, 1-0, 1-many, many-1.
  - May indicate the "roles" of objects that are involved in a relationship, e.g. husband and wife, employer and employee.
- Association Class
  - Important associations may be "upgraded" to become a class, as it contains important attributes, e.g. the works-for relationship may be described in a class.




Source: chapter 14 in [1]

# Associations and Object

- **Generalisation: super-class, sub-class**
  - **Agent vs. human and computer-program**
  - **human vs. man and woman**
  - **Arrow-headed link hanging from the super-class**
- **Aggregation: part-whole relation**
  - **Physical and conceptual aggregates**
  - **Audio system vs. CD-player, record-player, tape-deck, speaker, amplifier, head-phones, etc.**
  - **Can specify cardinality, e.g. must have one amplifier, but may have 2-4 speakers and 0-1 CD-player2, etc.**
  - **Empty diamond-head hanging from the "whole" side of the association**
- **Composition: necessary part-whole relation**
  - **E.g. table and table-leg**
  - **Solid diamond-head hanging from the "whole" side of the association**
- **Objects – instances of a class**

# Main Reference


**[1] Knowledge Engineering and Management: The CommonKADS Methodology. Guus Schreiber, Robert de Hoog, Hans Akkermans, Anjo Anjewierden, Nigel Shadbolt, Walter Van de Velde.**

**[16] AIFB: CommonKADS Methodology. http://www.aifb.uni-karlsruhe.de/Lehrangebot/Sommer2001/Wissensmanagement/download/folien/kap2.kads-vCS.pdf**


**[source: http://www.aiai.ed.ac.uk/~jessicac/project/KMM]**

# Additional References (not examable)



- **[21a] CommonKADS home page at http://www.commonkads.uva.nl/, 2003.**