TDT4252 / DT8802
Enterprise Modelling and Enterprise Architecture

Sobah Abbas Petersen

Adjunct Associate Professor
sap@idi.ntnu.no

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Overview of lecture today

- Actor-role oriented modeling, **introduction to i*, GRL, UCM**
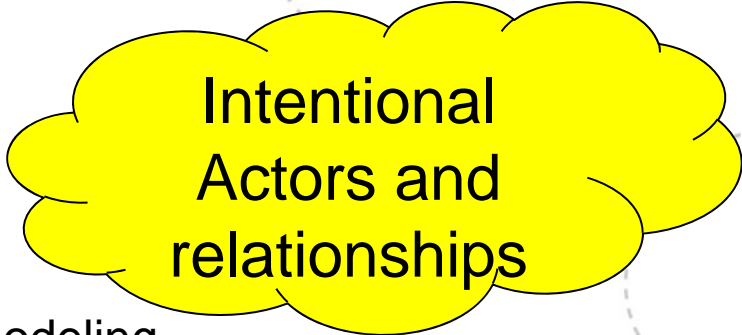
Based on the following articles:

- A01: Yu: "Towards Modeling and Reasoning Support for Early-Phase Requirements Engineering"(Proc. RE'97)

- A02:Liu and Yu: "Designing Information Systems in Social Context: A Goal and Scenario Modeling Approach" Information Systems 29(2):187-203

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From lecture on perspectives to conceptual modelling

- Structural
- Functional
- Behavioral
- Rule-oriented
- Object-oriented
- Social communication
- Actor/role-oriented

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Actor-oriented analysis

- Actors (persons, departments, organizations, …)
    - Focus on who and why
    - Improve understanding of needs
    - Improve structure of requirements

- Example *i* , *GRL*
    - Both actor-oriented and goal-oriented modeling

- Why i*?
    - Broad set of usage experiences by many people
    - Several large examples of usage of the technique for industrial applications.
    - Standardized as part or Requirements engineering -technique together with use case maps

Intentional Actors and relationships

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Short discussion

- Who and what do you as a student depend upon to get a good grade in a course ?

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A01: Introduction to i*: motivation

- Requirements engineering (RE) traditionally: WHAT, not why ,

- But there are problems in the analyses before the requirements are established:
  - **WHY** is the system built?
  - **WHO** needs it?

- i.e.
  - Understand the problem domain
  - Give users support to think about the requirements
  - Enable changes in the business process
  - Improve traceability

- **i* for early-phase RE**

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A01: motivational example

- Meeting scheduling system
  - Best time for a meeting for all participants

- To make a good system, you need to understand the needs of the organization that will use it

- Includes answering questions such as:
  - Why is it necessary to schedule meetings ahead of time ?
  - Why do the meeting initiator need to ask participants for exclusion dates and preferred dates ?
  - Why is a computer-based meeting scheduler desired? And whose interest does it serve ?
  - Is confirmation via the computer-based scheduler sufficient. If not, why not?
  - Are important participants treated differently? If so, why ?

- Most traditional modeling languages are not suitable for modeling these kind of aspects.

A01: central concepts in i*

- **Actor**
  - Perform task with a purpose (intentional)
  - Have goals, skills, responsibilities
  - Is dependent on other actors to achieve own goals

- **Dependency in relation** to
  - Resource (must get from another actor)
  - Task (that another actor must perform)
  - Goal (that another actor must achieve)
  - Soft-goal (that another actor must achieve)

- The above concepts are modelled in a Strategic Dependency Model (SD)
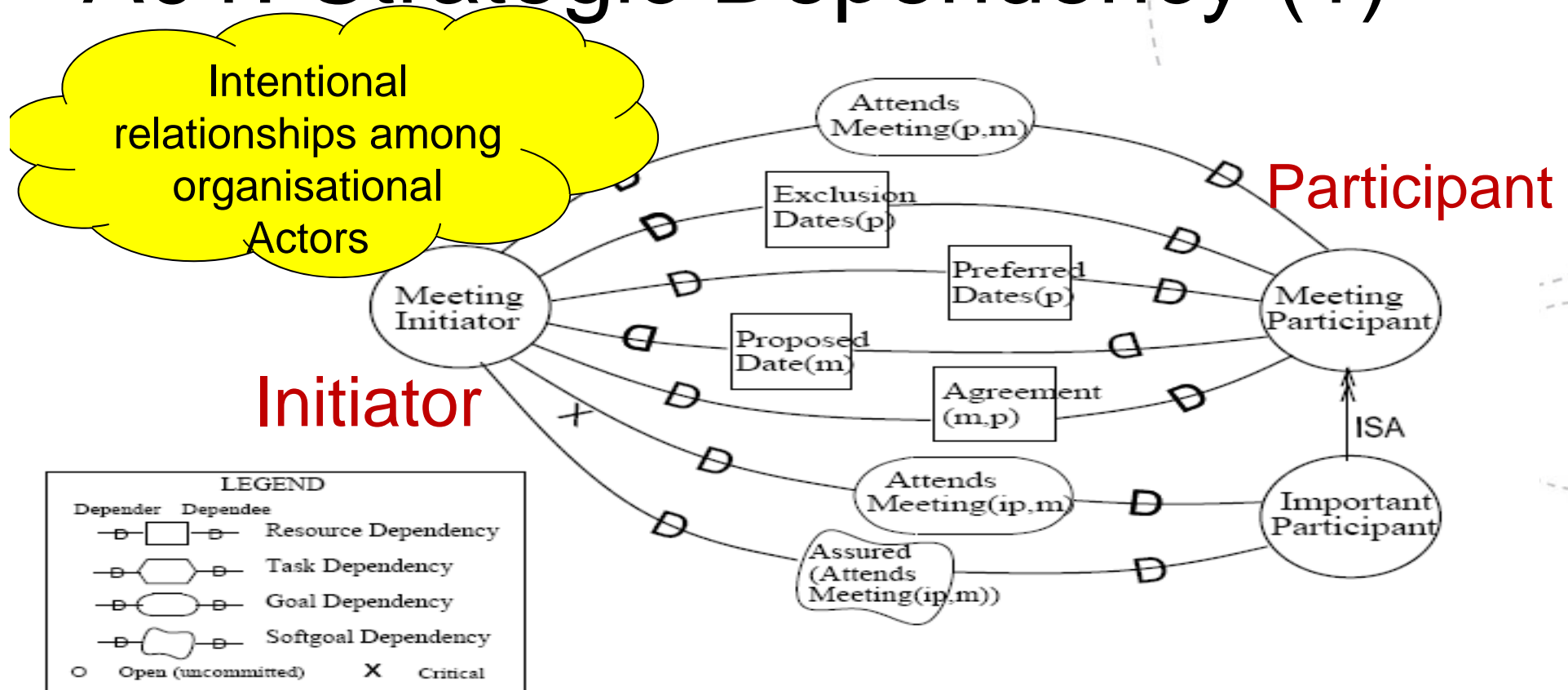
A01: Strategic Dependency (1)

Intentional relationships among organisational Actors

Participant

Initiator

Figure 1: Strategic Dependency model for meeting scheduling, without computer-based scheduler

A01: Strategic Dependency (2)

Initiator

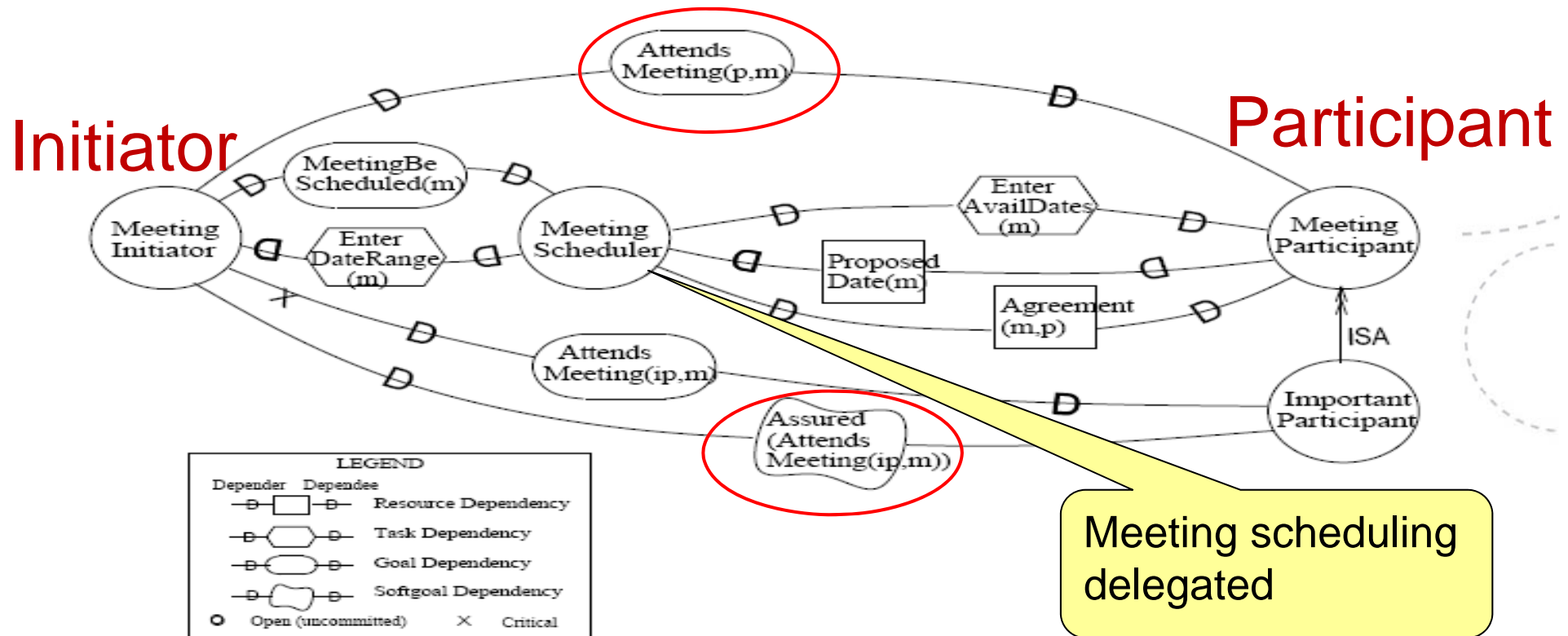**Participant**

Meeting scheduling delegated

Figure 2: Strategic Dependency model for meeting scheduling with computer-based scheduler

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A01: Strategic Dependency (3)

- **Strategic Dependency Model (SD):**

    – Models intentional relationships among agents, not the flow of entities among them.

    – Hide the internal intentions of each actor.

- **SD allows the analysis of opportunity and vulnerability**

    – The ability of the computer-based scheduler to achieve the goal – an opportunity for the meeting initiator not to have to achieve the goal.

    – The meeting initiator is vulnerable to the failure of the computer-based scheduler.

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A01: Strategic Relationship Model (1)

- **Strategic Rationale Model (SR)**

  – "Blowing up" the actor or looking "inside" the actor, to model internal intentional relationships.

  – Allows modelling of stakeholder interests and rationales.

  – Show different goals of each actor.

  – Different relationships between goals

    - Contribution (+, -), means-goal hierarchy, decomposition

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A01: Strategic Rationale Model

Initiator

Participant

Means-end links: **why** an actor will engage in a task

Contribution to goals

Task decomposition

Meeting scheduling can be delegated

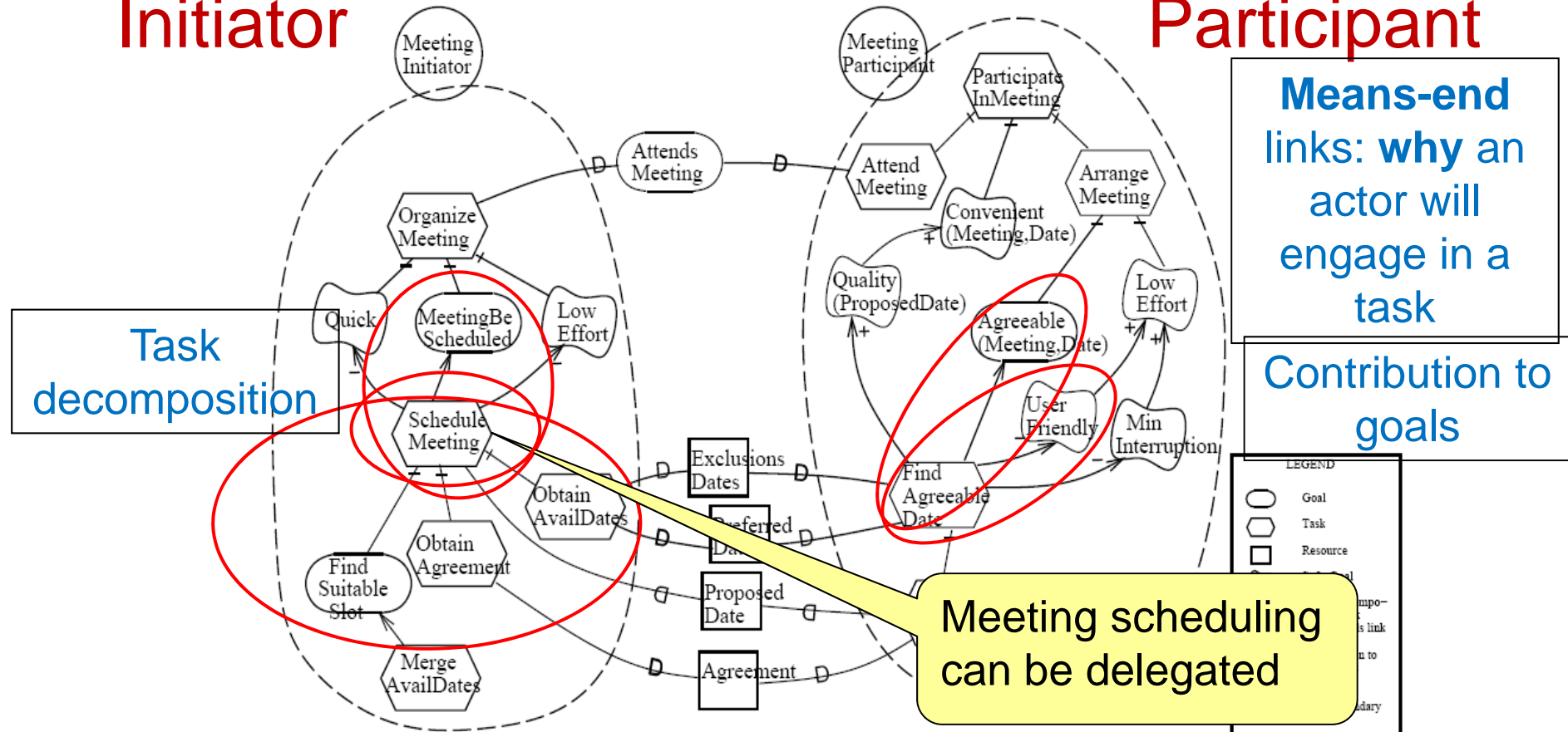Figure 3: A Strategic Rationale model for meeting scheduling, before considering computer-based meeting scheduler

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Analysis

- **Ability**: e.g. when the meeting initiator has a routine to organise a meeting.

- **Workability**: if there is a workable routine for organising the meeting.

- **Viability**: When the soft goals are not satisfied.

- **Believability**: for assessment of workability and viability, based on beliefs and assumptions.

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An example i* model

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How would you use i* in this situation?

You have been hired by a company to specify a social networking app for the elderly, where you are required to conduct a stakeholder analysis and obtain the requirements from the users. Your goal is to understand the users' needs and requirements and the users' goal is to obtain an app that is easy for them to use, which can be achieved by providing the relevant information to you. Consider the early phases of requirements engineering where you both require some input from one another to reach your goals.

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Connection from i* to other techniques: motivation revisited

- **i* GRL (Goal-oriented requirements language)** represents actors and goal, and their dependencies and interrelationships.

- A02. Connection to use case maps (UCM)

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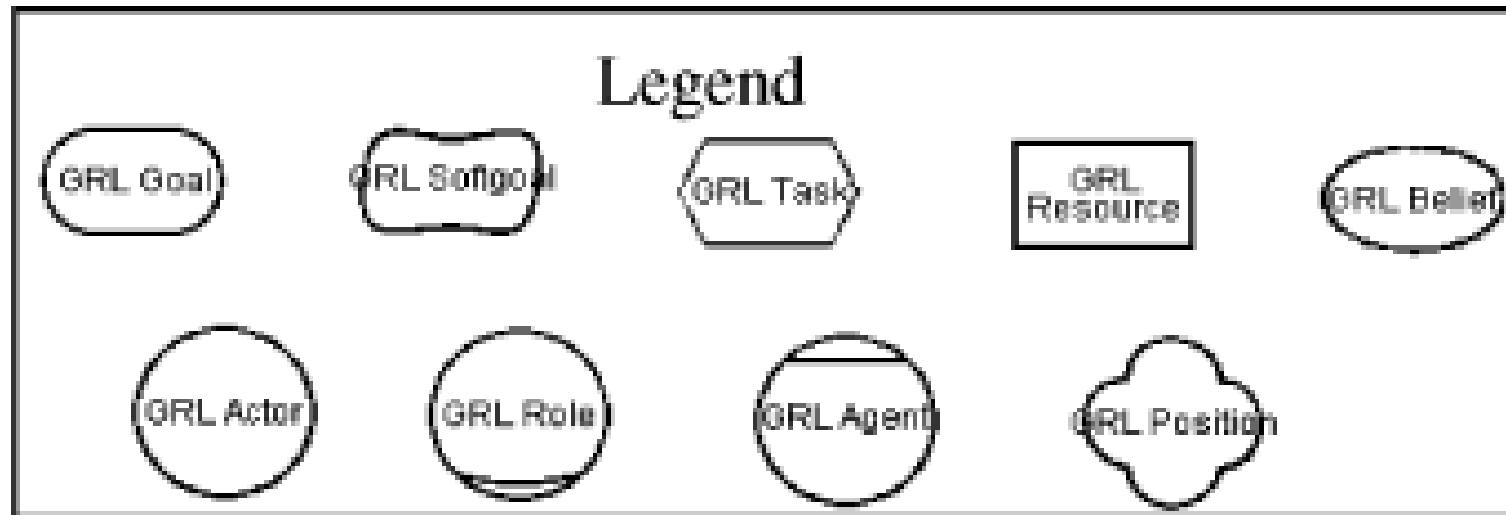
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A02: Main Concepts in GRL

- **Goal**: to depict business objectives and system requirements (functional and non-functional).

- **Tasks**: to represent different ways to achieve goals.

- **Means-end reasoning**: to explore alternative solutions.

- **Social context**: modelled in terms of dependency relationships among the agents.

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Additional aspects of i*/ GRL (1)

- **Actor**: an active entity that carries out actions to achieve its goals.

- **Agent**: an actor with concrete, physical manifestations, such as a human, or a machine.

- **Role**: an abstract characterisation of the behaviour of a social actor within a domain.

- **Postion**: set of roles played by an agent. Agents can **occupy** positions.

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Additional aspects of i*/ GRL (2)

- **Contribution** links: impact one element has on another.

  – Help, make, hurt, break, some+, some-

- **Corrolation** links: side effects of the existence of one element to others.

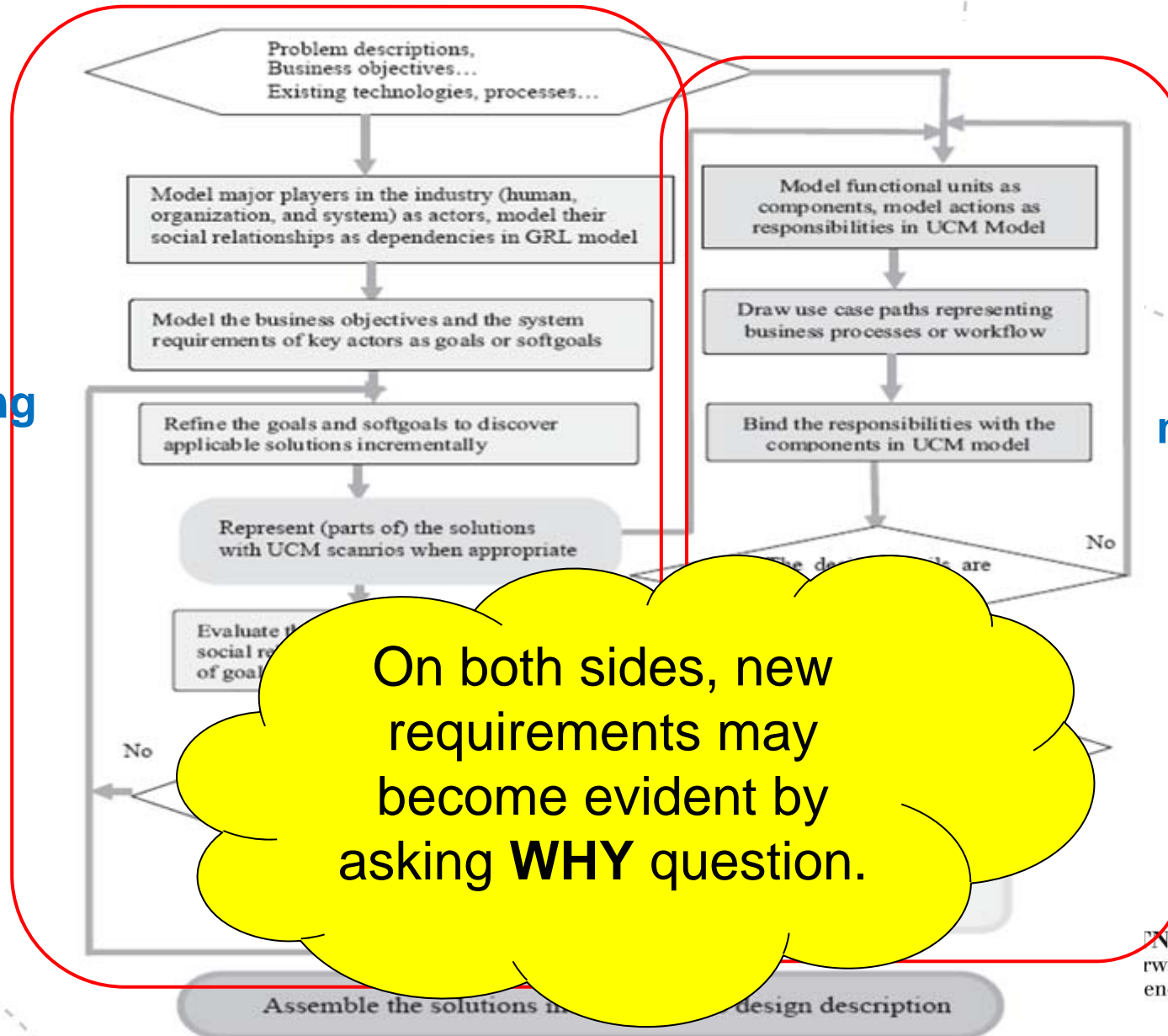- **Dependency** links: inter-agent dependencies.

Legend: GRL Goal, GRL Softgoal, GRL Task, GRL Resource, GRL Belief, GRL Actor, GRL Role, GRL Agent, GRL Position

A02: i* & UCM

- Goal and scenario modelling can be done in parallel:

  – **Goal-modeling** – identification of alternatives and trade-offs in requirements engineering.

  – **Scenario-modeling** – snapshots of possible design solutions or fragments of a solution (partial and incomplete).

- Interaction between the modelling processes:

  – Design-alternatives in the goal modeling is explored in scenarios in UCM.

  – New goals might be elicited with "why"-questions in relation to UCM.

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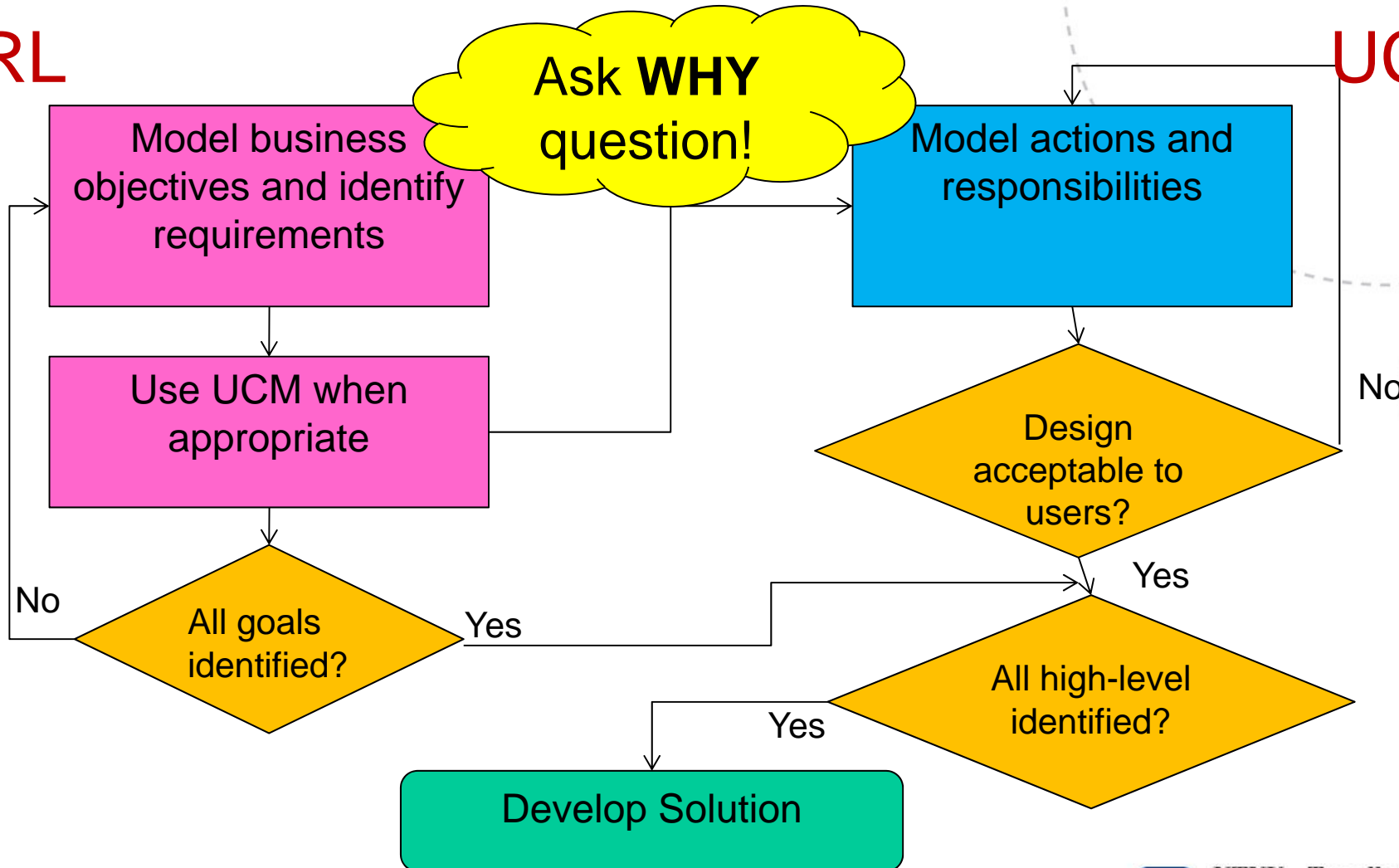Norwegian University of
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A02: Process

GRL modelling

Scenario modelling (UCM)

Problem descriptions, Business objectives… Existing technologies, processes…

Model major players in the industry (human, organization, and system) as actors, model their social relationships as dependencies in GRL model

Model the business objectives and the system requirements of key actors as goals or softgoals

Refine the goals and softgoals to discover applicable solutions incrementally

Represent (parts of) the solutions with UCM scanrios when appropriate

Evaluate the social of goal

Model functional units as components, model actions as responsibilities in UCM Model

Draw use case paths representing business processes or workflow

Bind the responsibilities with the components in UCM model

No

No

No

Assemble the solutions in design description

On both sides, new requirements may become evident by asking **WHY** question.

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GRL and UCM: Parallel & Interactions

GRL

UCM

Ask **WHY** question!

Model business objectives and identify requirements

Model actions and responsibilities

Use UCM when appropriate

Design acceptable to users?

No

No

All goals identified?

Yes

Yes

All high-level identified?

Yes

Develop Solution

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A02: Process Steps

- Step 1: Create Strategic Dependency-model (Fig 2)

- Step 2: Model business objectives (Fig 3)

- Step 3: Explore possible designs for the future system on a high level (Fig 4)

- Step 4: Compare alternative designs (Tab 1, Fig 5)

- Step 5: Evaluate candidate design's advantages and disadvantages (Fig 6)

  - Install mitigation measures (Fig 7)

- Step 6: Make a more detailed solution (refinement)

  - Repeat 3-5 for sub-components

- Step 7: Evaluate impact of dependencies

  - Fig 8-11: two alternatives (e.g. "Teacher-Led", "Instructor-Led")

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Step 1 : Create Strategic Dependency model

Who are the major players?

Knowledge Provider

Course Provider

Technology Provider

Learner

Instructor

Pedagogical Knowledge Provider

What are the relationships between the players?
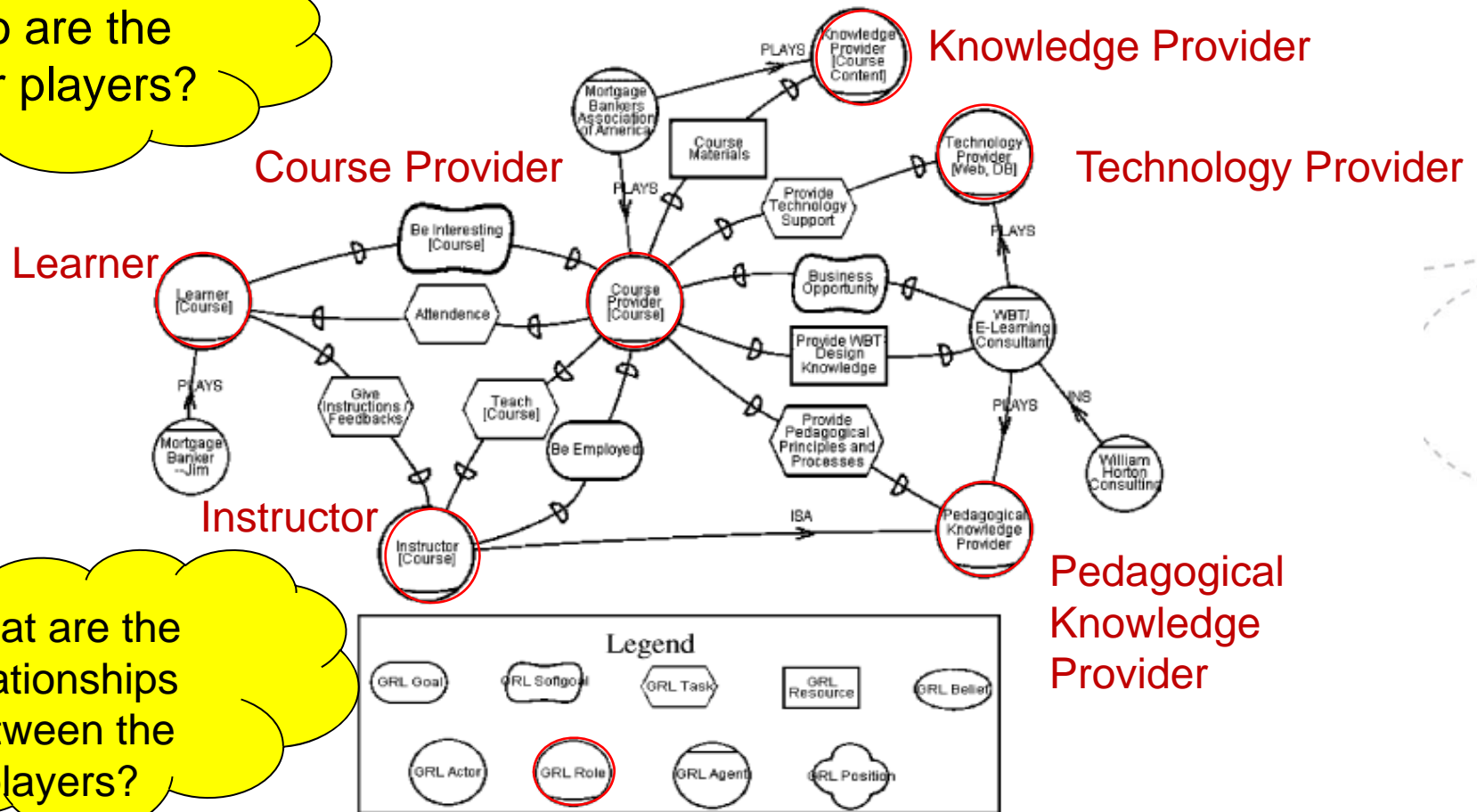
Fig. 2. Major players in E-Learning domain, agent dependency relationships, role-playing relationships and agent classification.
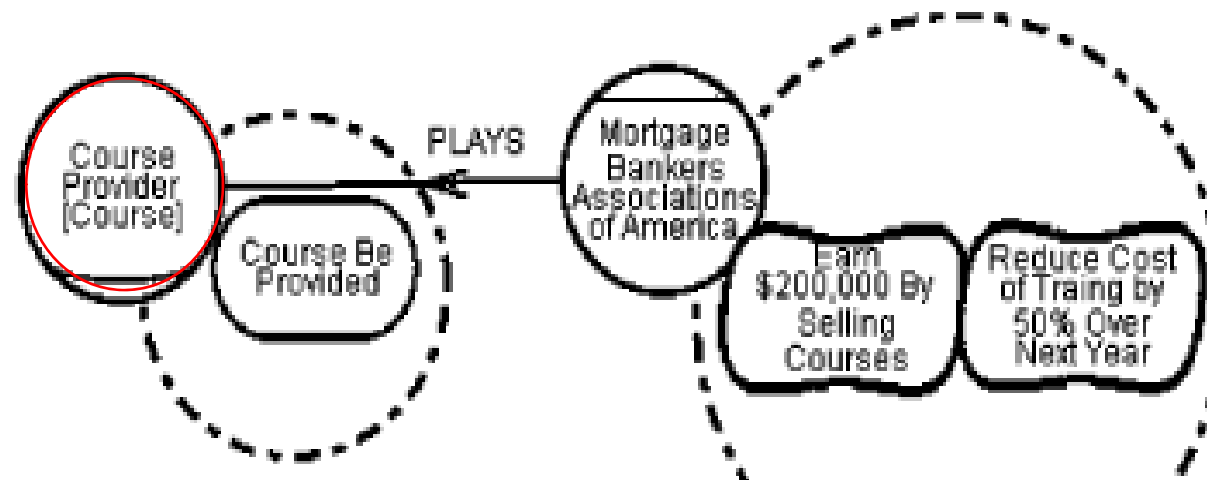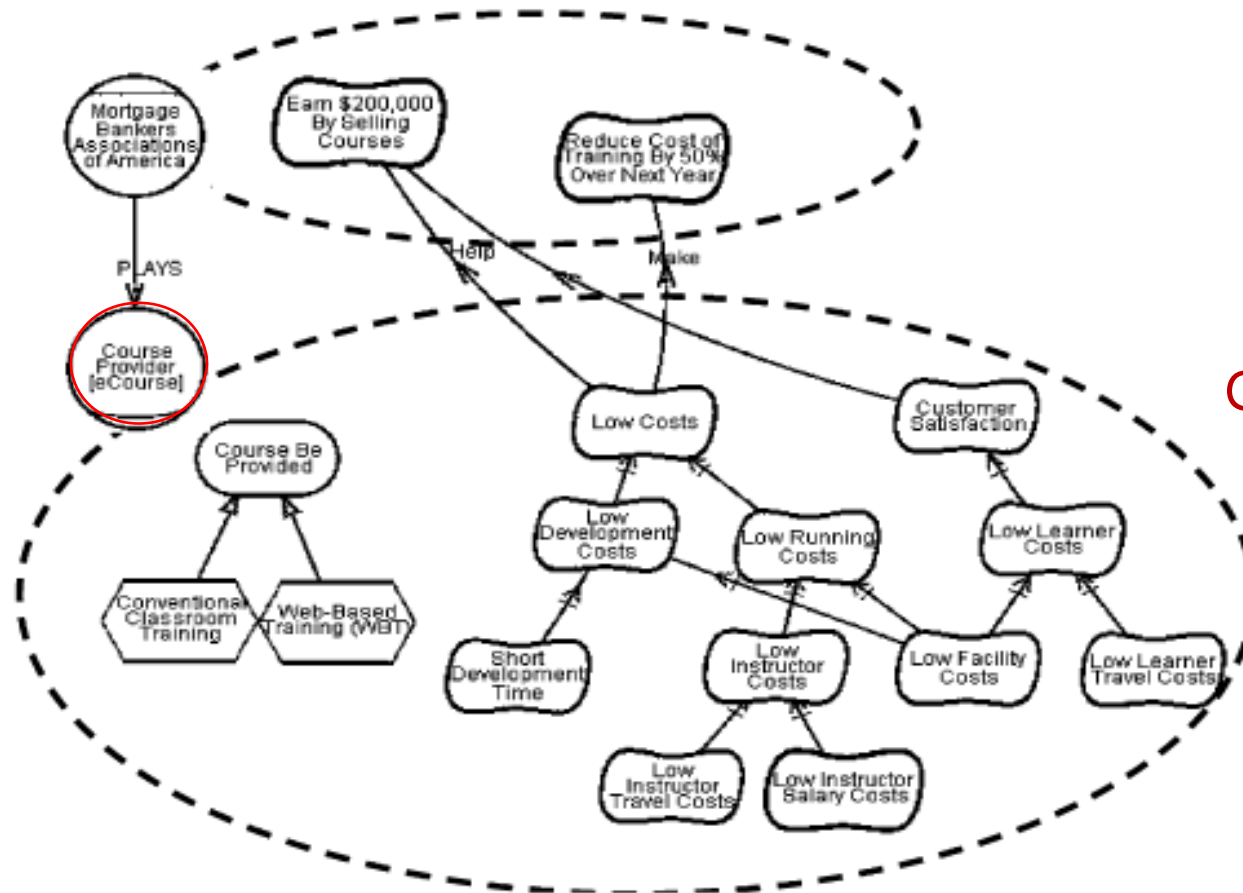
Step 2: Model business objectives

Fig. 3. Business objectives represented as softgoals in original goal model.

Step 3: Explore possible designs for the future system on a high level

Goal hierarchy

Fig. 4. Explore possible designs for the future system (high level).

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Step 4: Compare alternative designs

Table 1
Cost estimation on the two kinds of training

	Develop time (h)	Develop cost ($/h)	Instructor travel cost ($)	Instructor salary cost ($/student)	Facility cost ($/student)	Learner travel cost ($)	Total estimate cost ($)
Conventional classroom training	50	50	1500	25	500	1500	513,000
Web-based training	200	100	0	50	50	0	338,500
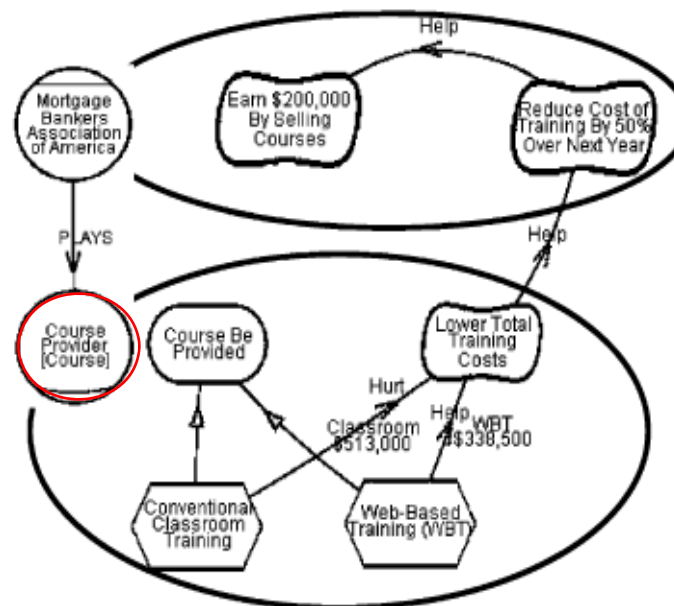
Fig. 5. Compare alternative designs by resource consumption.

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Step 5: Evaluate candidate design
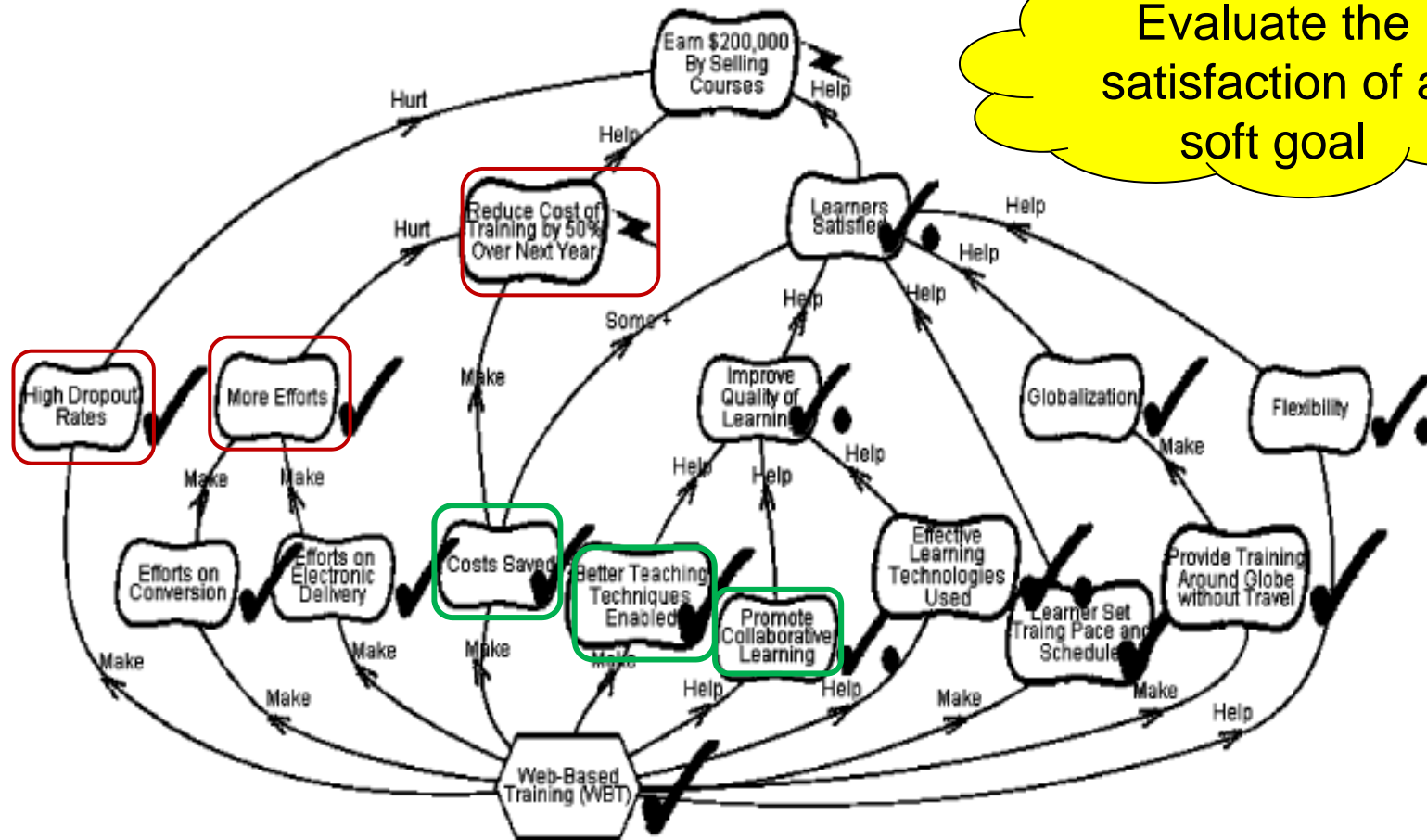
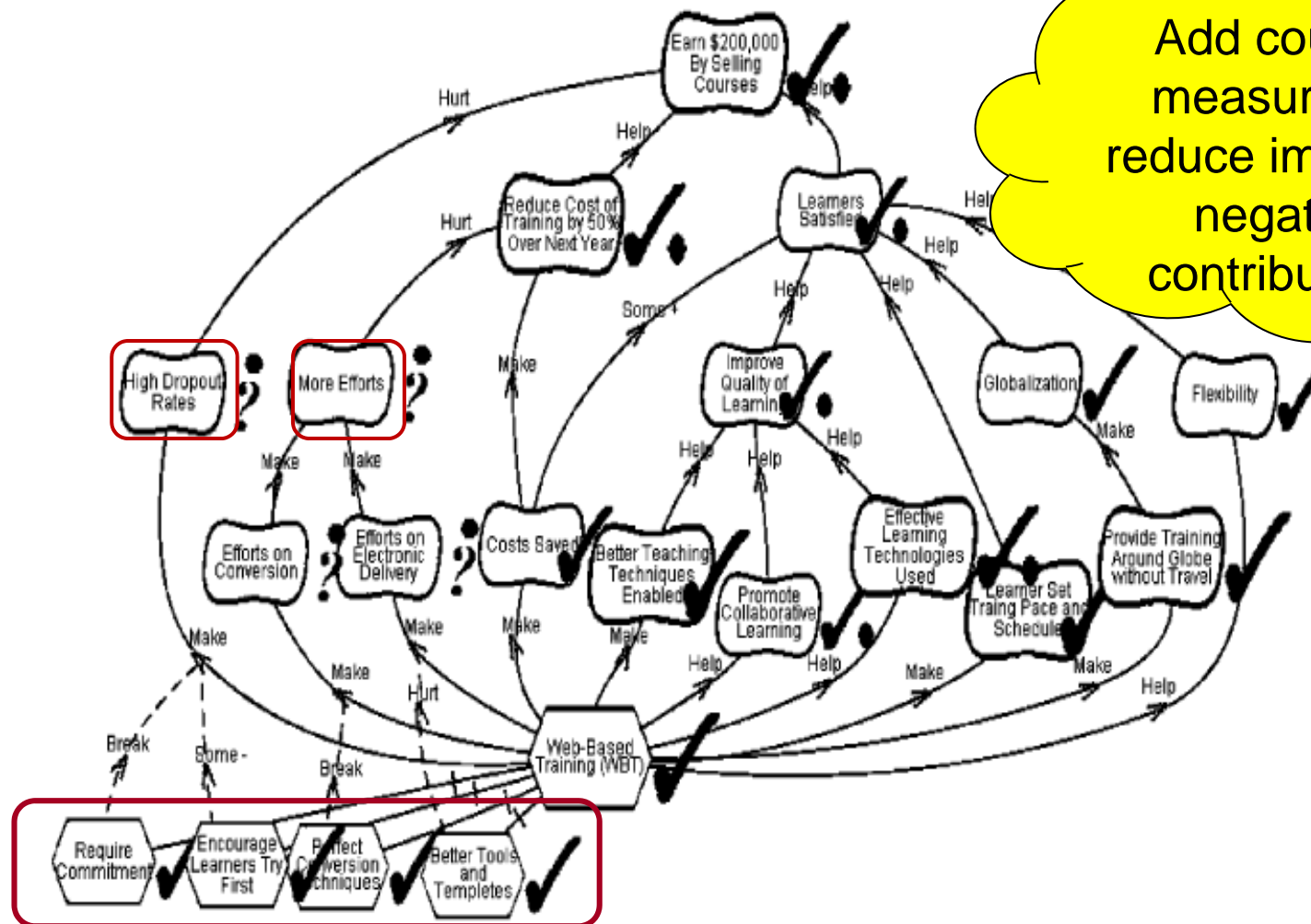Fig. 6. Evaluate candidate design's advantages and disadvantages.

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Install mitigation measures

Add counter measures to reduce impact of negative contributions

Fig. 7. Install mitigation measures to the design.

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Step 6: Refinement

Decision making

2 alternatives
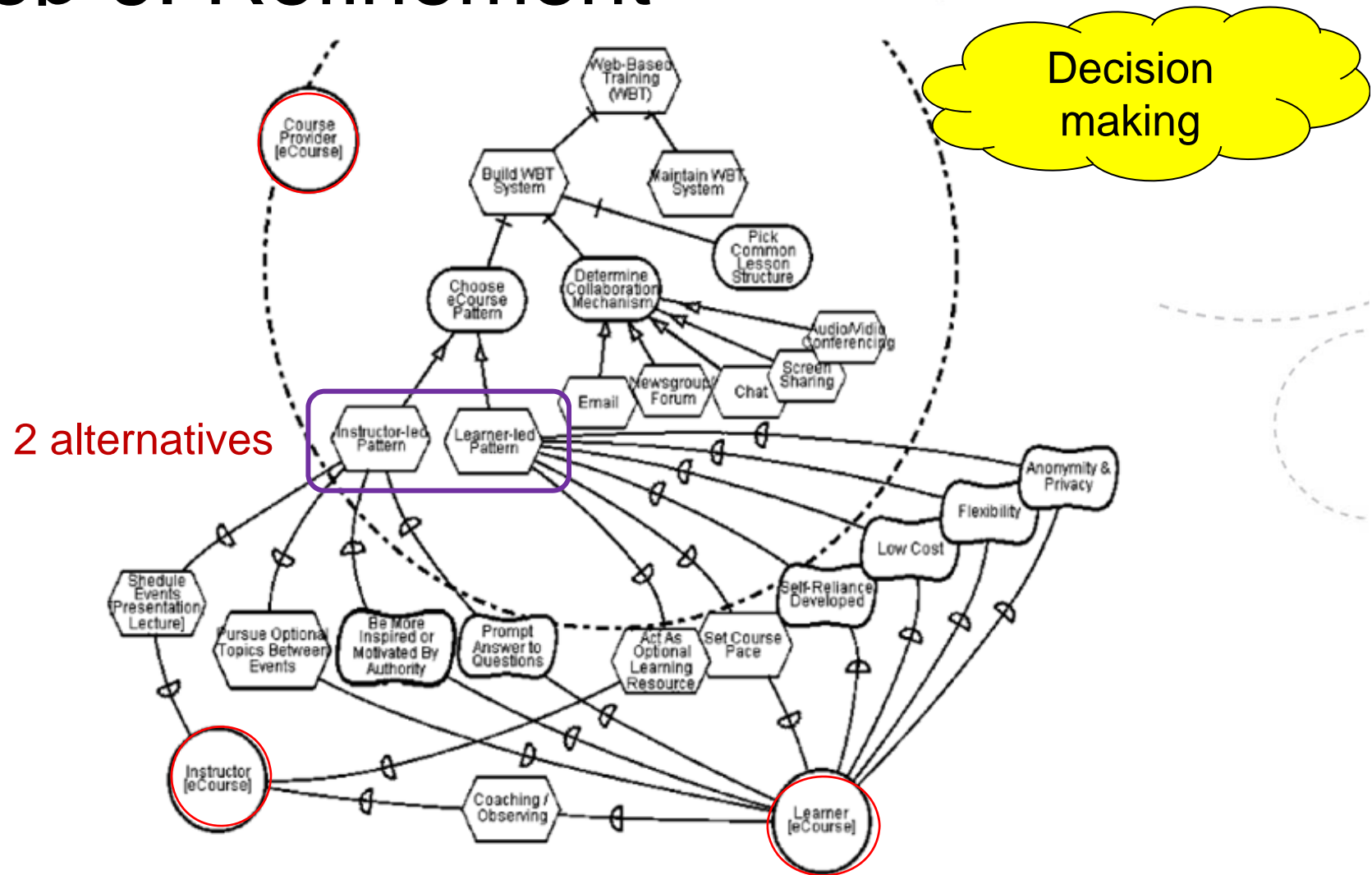
Fig. 8. Refinement of design and decision-making based on social relations.

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GRL and UCM: Parallel & Interactions

GRL

UCM

Ask **WHY** question!

Model business objectives and identify requirements

Model actions and responsibilities

Use UCM when appropriate

Design acceptable to users?

No

No

All goals identified?

Yes

Yes

All high-level identified?

Yes

Develop Solution
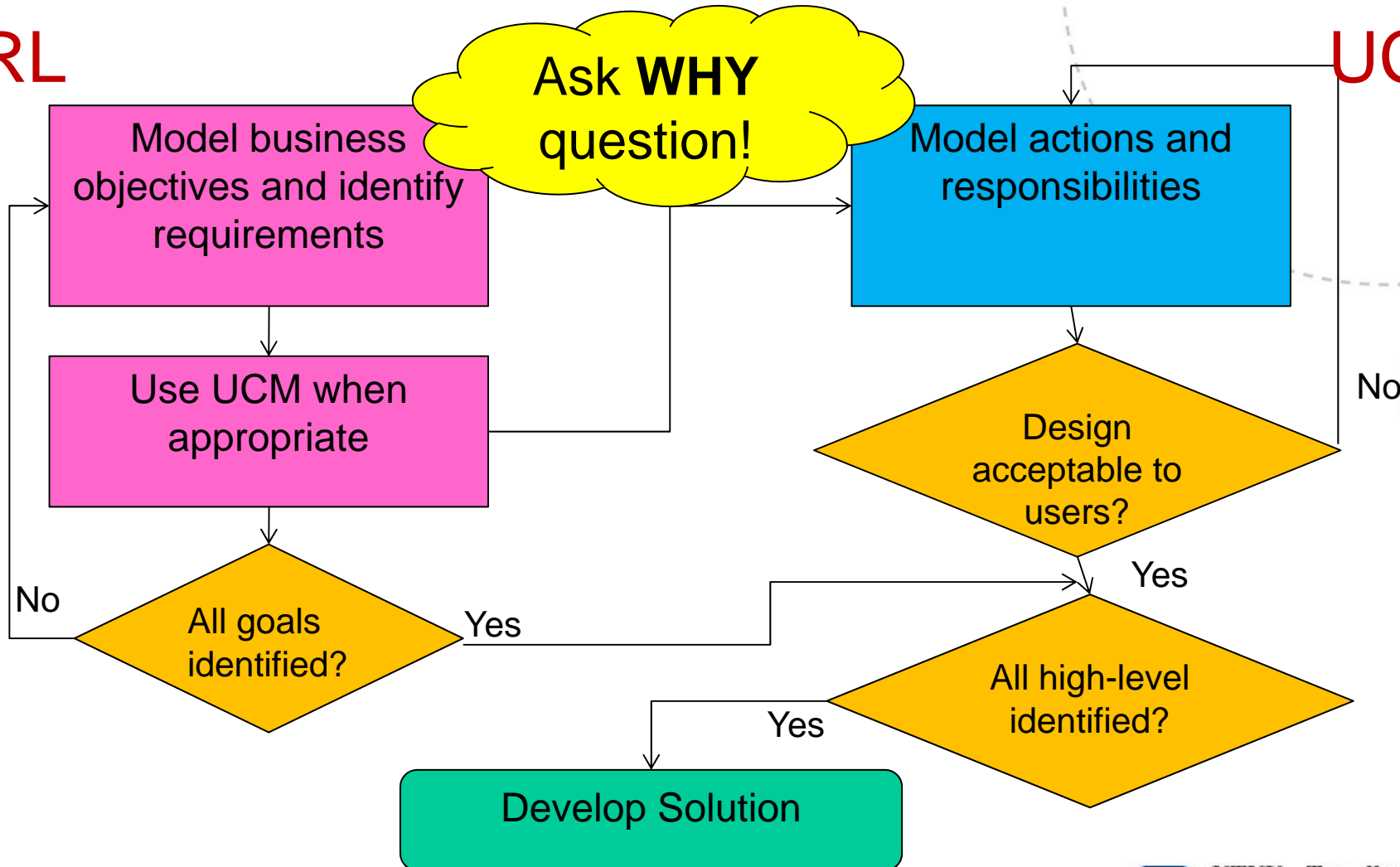
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A02: Use Case Modelling (UCM)

- UCM: visual notation for scenarios

    - Scenario paths to illustrate causal relationships among responsibilities.

    - Describe patterns of behavior

    - Connections between different patterns

    - Connection between behavior and structure

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i* & UCM together

- Fig 9: both diagram types together

  – i* show goal-structure and alternatives

  – UCM shows scenario for task ”Classic Tutorial”

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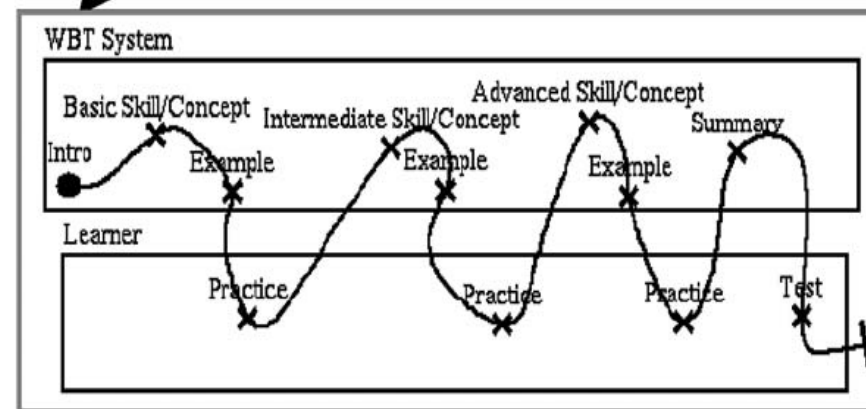# A02: UCM Central Concepts

- Central concepts
  - Start points (preconditions, causes)
  - End points (postconditions, effects)
  - Responsibilities (tasks to be performed)
  - Components (objects in the system)
  - Use case path: connect start points, responsibilities and end points
  - Decomposition
  - Control-flow: OR-join. OR-fork, AND-join, AND-fork, timer, abort, failure points, shared responsibilities

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i* & UCM

i*/GRL:
Goal structure
& alternatives
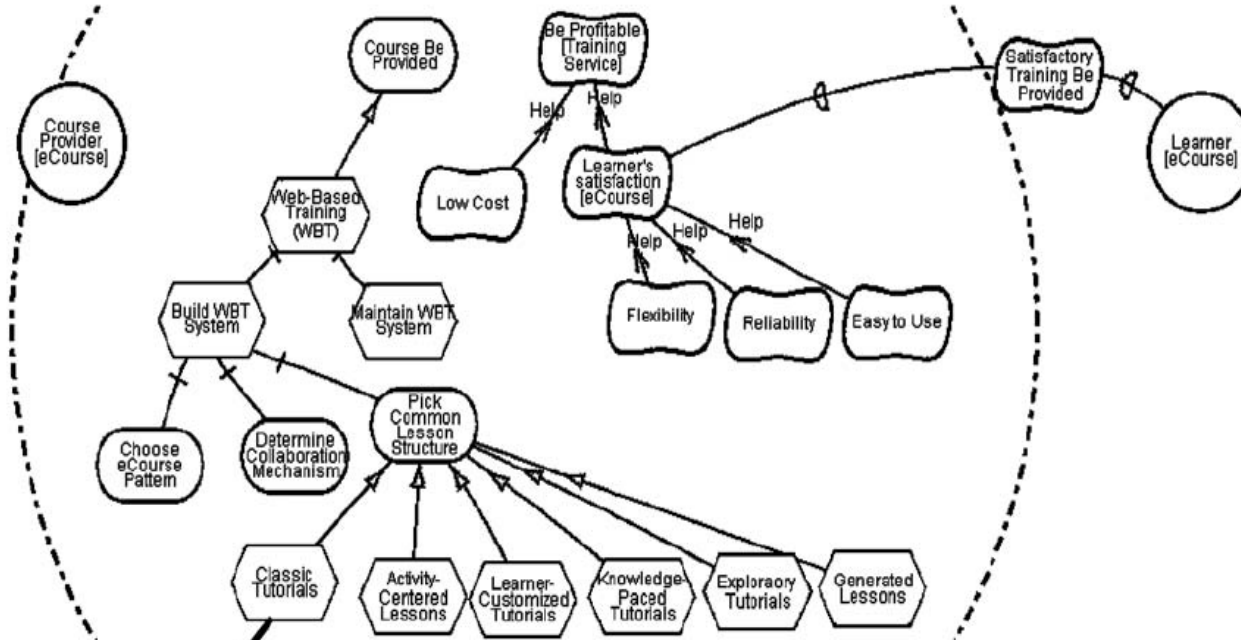
UCM: Scenario

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Fig. 9. Design alternatives and the corresponding scenarios.

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Brief discussion: Compare use case maps with other process modelling notations

- Brief discussion: Compare use case maps with other process modeling notation (e.g. BPMN, UML Activity diagrams)

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Summary

- We have looked at i*, GRL and UCM
- General ideas:
  - Early Phase RE
  - Understanding "WHY?"
  - Modelling stakeholder interests and organisational perspectives
- Basic concepts:
  - Intentional actors and intentional relationships
  - Dependencies among actors
  - Internal goals of actors

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Next Lecture

- i*, GRL and other forms of modelling

    – A03: Maiden et al. Model-Driven Requirements Engineering: Synchronising Models in an Air Traffic Management Case Study. (Proc. CAiSE'04)

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