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Title	Ontology - aware Course Management for Curriculum Evolution Process in Higher Education
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Citation	
Issue Date	2009-03-13
Type	Presentation
Text version	publisher
URL	http://hdl.handle.net/10119/8286
Rights	
Description	6th VERITE : JAIST/TRUST-AIST/CVS joint workshop on VERIfication Technologyでの発表資料, 開催：3月12日～13日, 開催場所：JAIST 田町サテライトキャンパス2階多目的室2

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Ontology-aware Course Management for Curriculum Evolution Process in Higher Education

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Outline

- Background and Goal
- Proposed Solution
  - Requirements of multi-stakeholders
  - A Scenario
- Evolutionary Process of Curriculum
  - The Conceptual Model
  - Development of On2C system
  - The Scenario (cont'd)
- Conclusion and Future Works

Background

- Curriculum changes over time. In practice, however, it is not easy to keep curricular system updated and to provide students with trustworthy course services that reflect and correspond to the evolutions of curriculum:

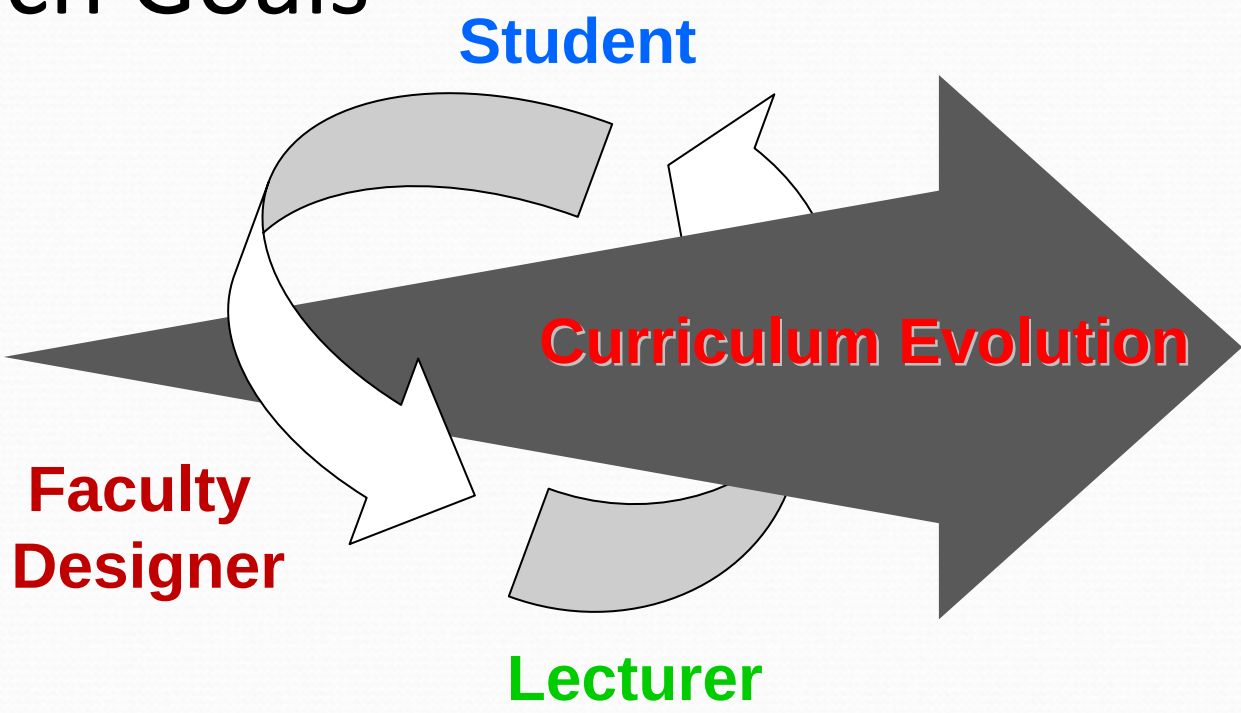
  - The information related to curriculum design and organization may be lost or interpreted in different ways due to the ***distribution of time and space*** in communication among different stakeholders;

Background (cont'd)

- The lack of the shared vocabulary about domain knowledge for different stakeholders to communicate about the curriculum;
- The majority of current strategies need time-consuming and labor-intensive works.

Two Research Goals

It is necessary to balance social needs and different concerns of multi-stakeholders in order to make curriculum evolution smooth.



GOALs

- **To establish a conceptual framework for explicitly and fluently share each concern and understanding among multiple stakeholders, and effectively tracking the history of curriculum change;**

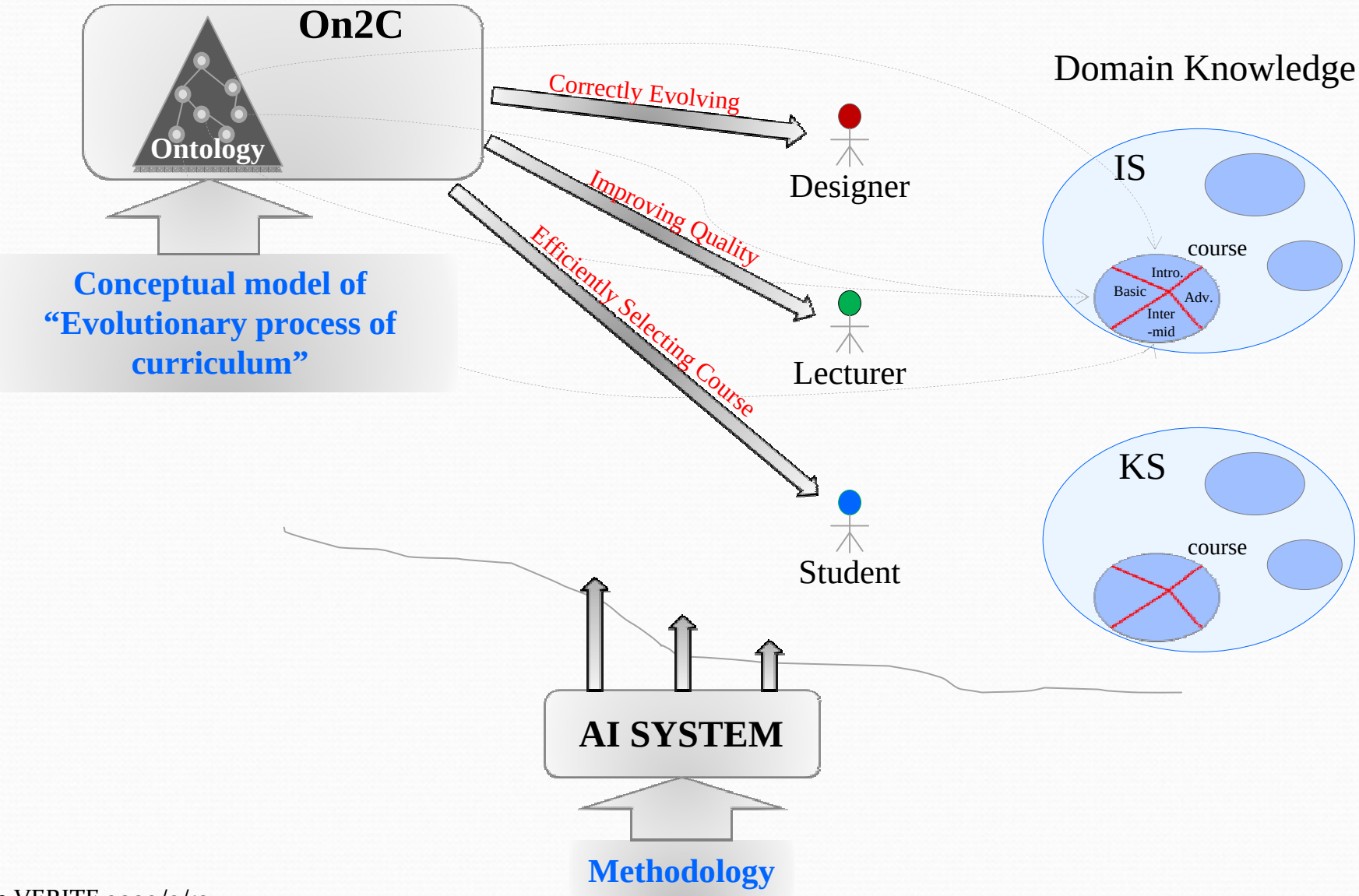
- **To implement an ontology-aware course consulting system to meet the requirements of stakeholders involved in curriculum evolution.**

Proposed Solution

- A conceptual model of evolutionary process reflects essent… comm… with ontolo…
  - Curr…
    - It … ully predict the generic components of curriculum so it can be reused in situation-dependent curriculum system.
  - Ontology-aware Course Consulting system (On2C)

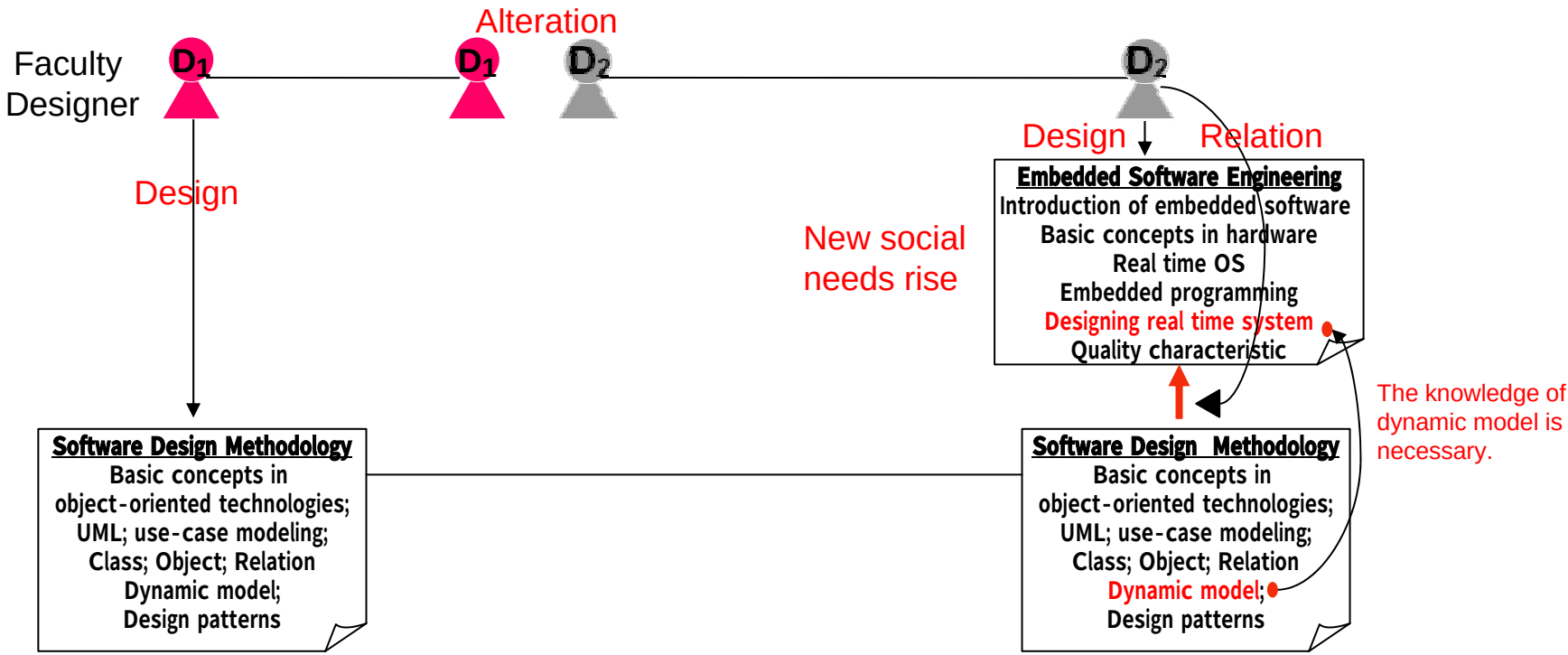
Our research aims to demonstrate a possible solution for smoothness of evolutionary curriculum *step by step* with ontological engineering approach.

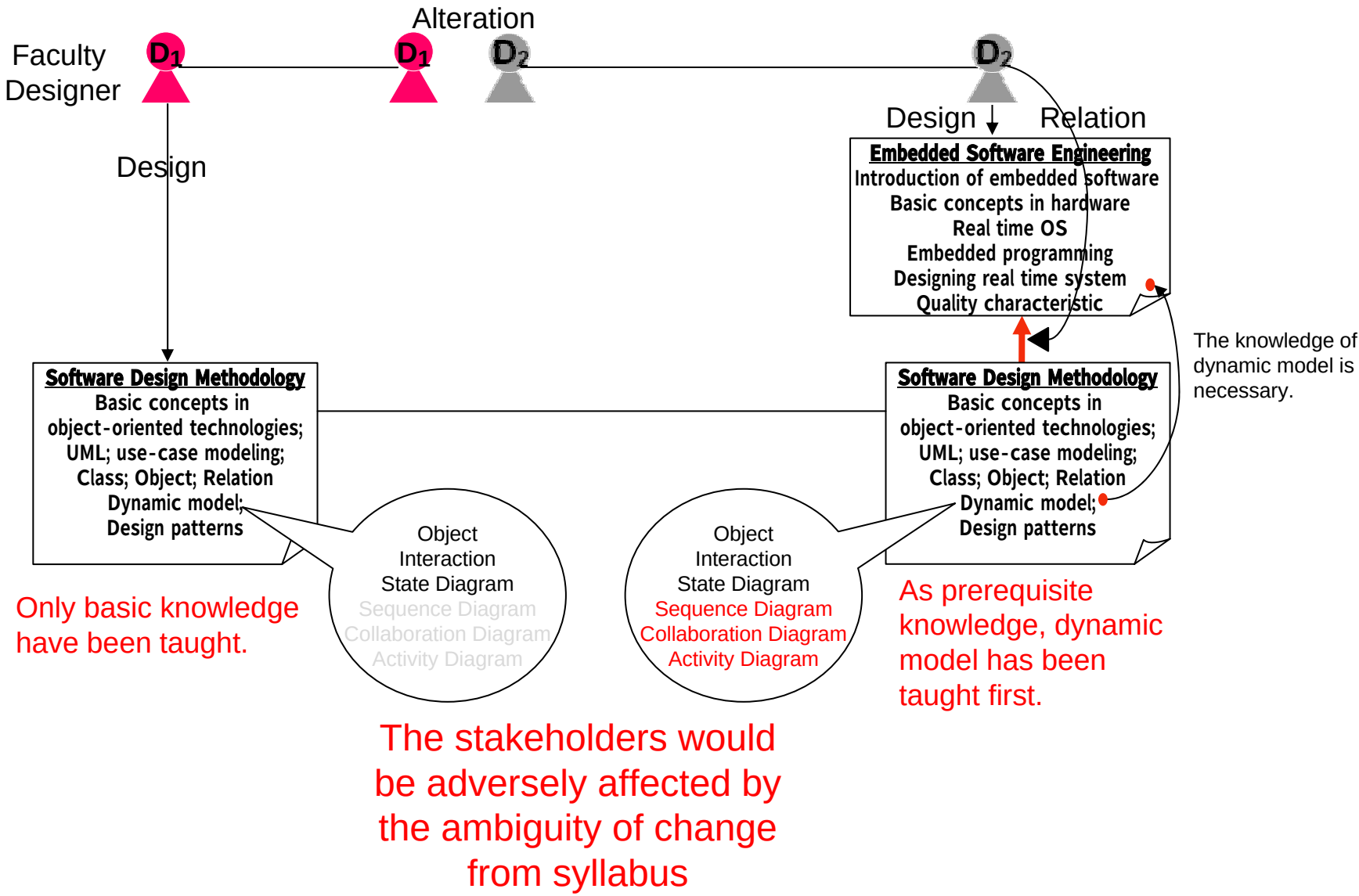
Diagram

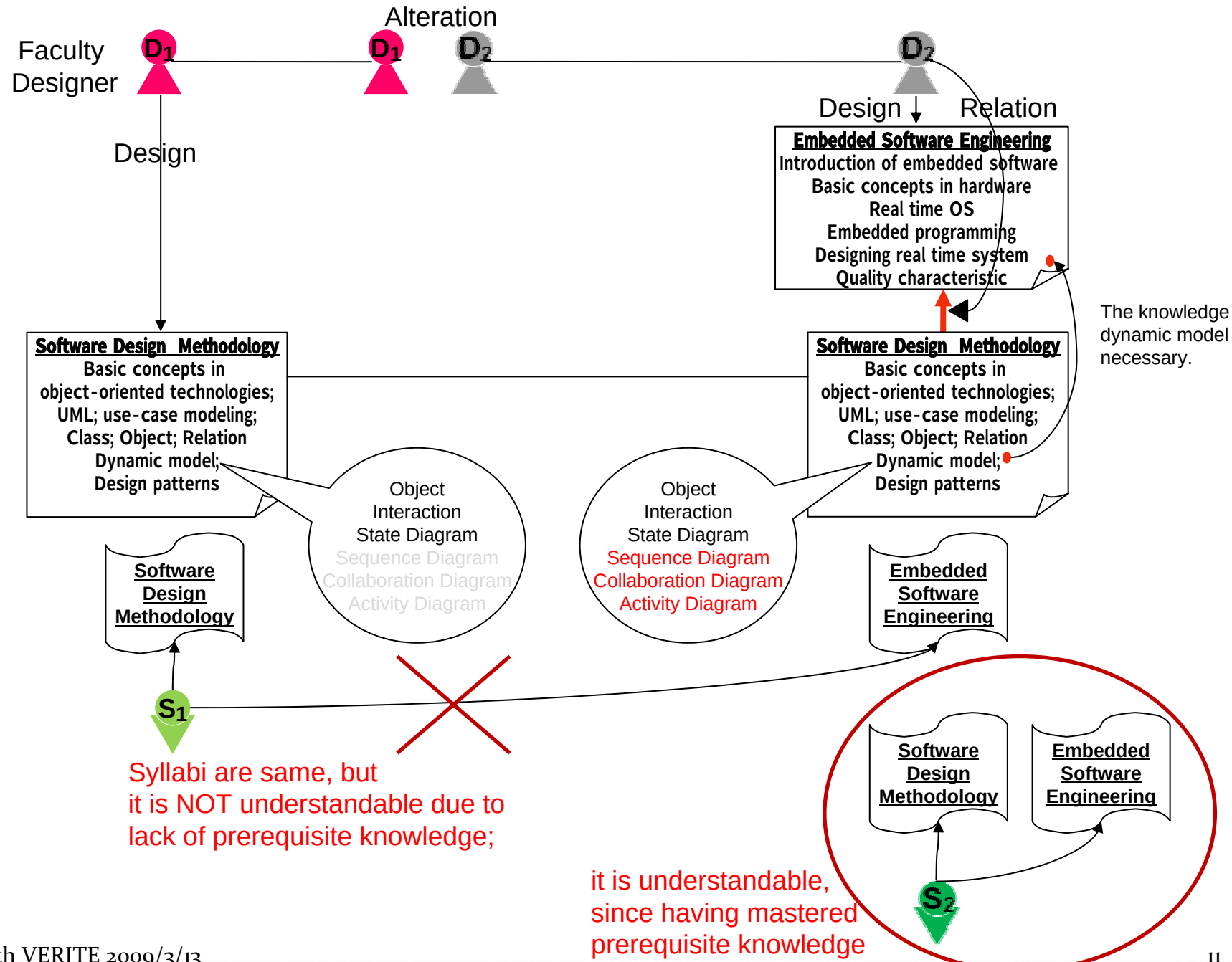

On2C
Ontology
Correctly Evolving
Improving Quality
Efficiently Selecting Course
Designer
Lecturer
Student
Domain Knowledge
IS
course
Intro.
Basic
Adv.
Inter
-mid
KS
course
AI SYSTEM
Conceptual model of "Evolutionary process of curriculum"
Methodology

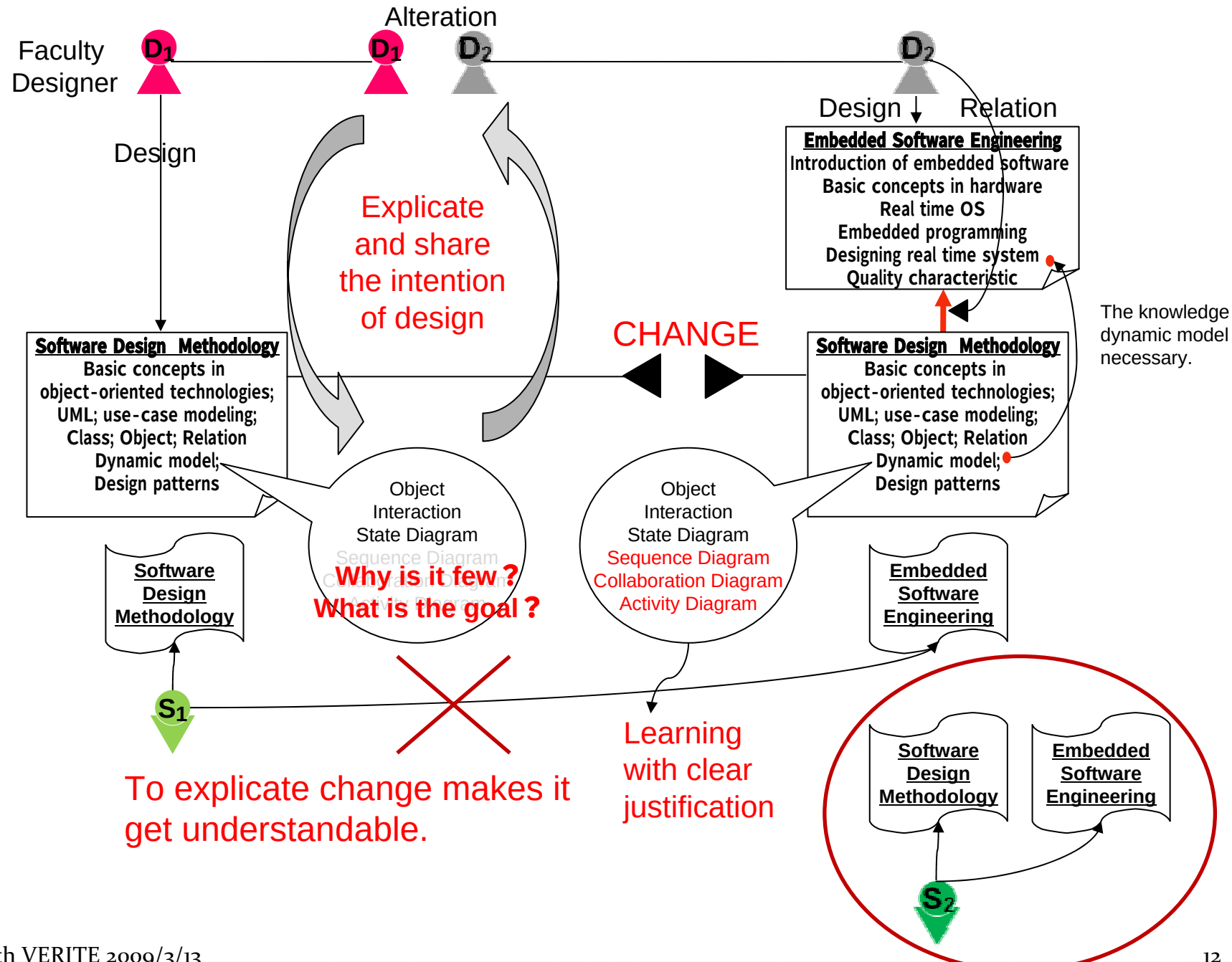
Requirements of multi-stakeholders

- Requirements of faculty designer and lecturer
  - The evolutionary change of curricula should be divided into manageable, more familiar steps. Both faculty designer and lecturer want to familiarize themselves with the changes by taking small steps first.
  - It is necessary to adopt instruction design approach and include one quality circle composing planning and evaluation.
  - Have a clear rationale for change that is grounded in pedagogical practices, which is considered as background knowledge for reflection, such as during practicing evaluation of course process.
- Requirements of student
  - Study plan maintenance


Alteration
Faculty Designer
D1
D1
D2
D2
Design
Design
Relation
New social needs rise
Embedded Software Engineering
Introduction of embedded software
Basic concepts in hardware
Real time OS
Embedded programming
Designing real time system
Quality characteristic
The knowledge of dynamic model is necessary.
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns

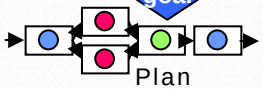

Alteration
Faculty Designer
D1
D1
D2
D2
Design
Design
Relation
Embedded Software Engineering
Introduction of embedded software
Basic concepts in hardware
Real time OS
Embedded programming
Designing real time system
Quality characteristic
The knowledge of dynamic model is necessary.
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Object Interaction State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
Only basic knowledge have been taught.
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Object Interaction State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
As prerequisite knowledge, dynamic model has been taught first.
The stakeholders would be adversely affected by the ambiguity of change from syllabus


Alteration
Faculty Designer
D1
D1
D2
D2
Design
Design
Relation
Embedded Software Engineering
Introduction of embedded software
Basic concepts in hardware
Real time OS
Embedded programming
Designing real time system
Quality characteristic
The knowledge of dynamic model is necessary.
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Object
Interaction
State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
Object
Interaction
State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
Software Design Methodology
Embedded Software Engineering
S1
Syllabi are same, but
it is NOT understandable due to lack of prerequisite knowledge;
Software Design Methodology
Embedded Software Engineering
S2
it is understandable, since having mastered prerequisite knowledge

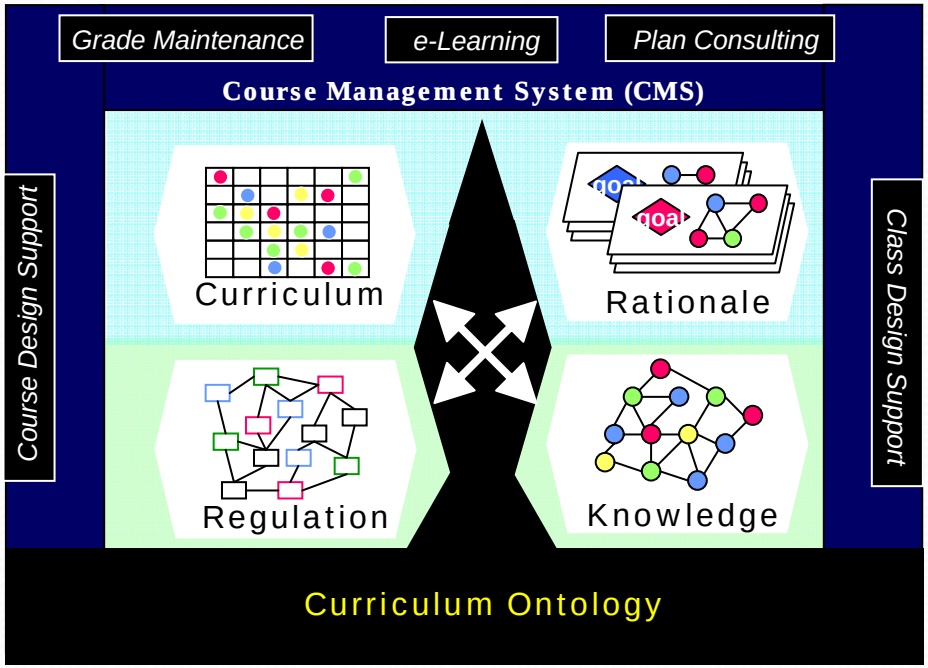

Alteration
Faculty Designer
D1
D1
D2
D2
Design
Design
Relation
Embedded Software Engineering
Introduction of embedded software
Basic concepts in hardware
Real time OS
Embedded programming
Designing real time system
Quality characteristic
Explicate and share the intention of design
CHANGE
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
Software Design Methodology
Basic concepts in object-oriented technologies; UML; use-case modeling; Class; Object; Relation
Dynamic model;
Design patterns
The knowledge of dynamic model is necessary.
Object Interaction State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
Why is it few ?
What is the goal ?
Object Interaction State Diagram
Sequence Diagram
Collaboration Diagram
Activity Diagram
Software Design Methodology
Embedded Software Engineering
S1
To explicate change makes it get understandable.
Learning with clear justification
Software Design Methodology
Embedded Software Engineering
S2

The architecture of On2C system :

STUDENT



Select courses;
Take a course;
Evaluation



FUCULTY DESIGNER

Organize knowledge of learning contents
Design regulation and curriculum
Record rationale

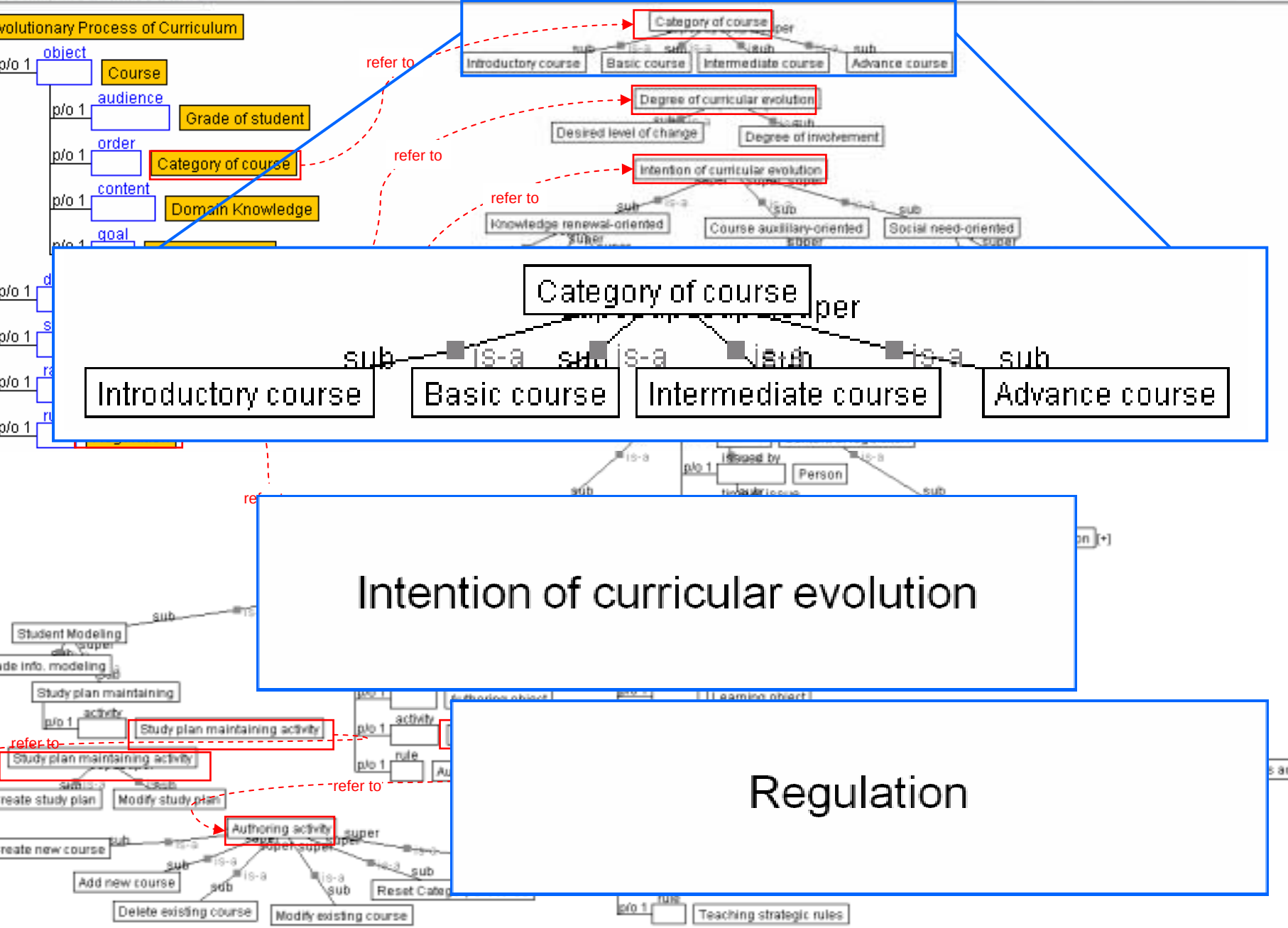
LECTURER

Make course plan
Design teaching strategy
Select examples
Assessment

On2C includes *CMS* and *Curriculum Ontology*
for coping with the requirements from different stakeholders

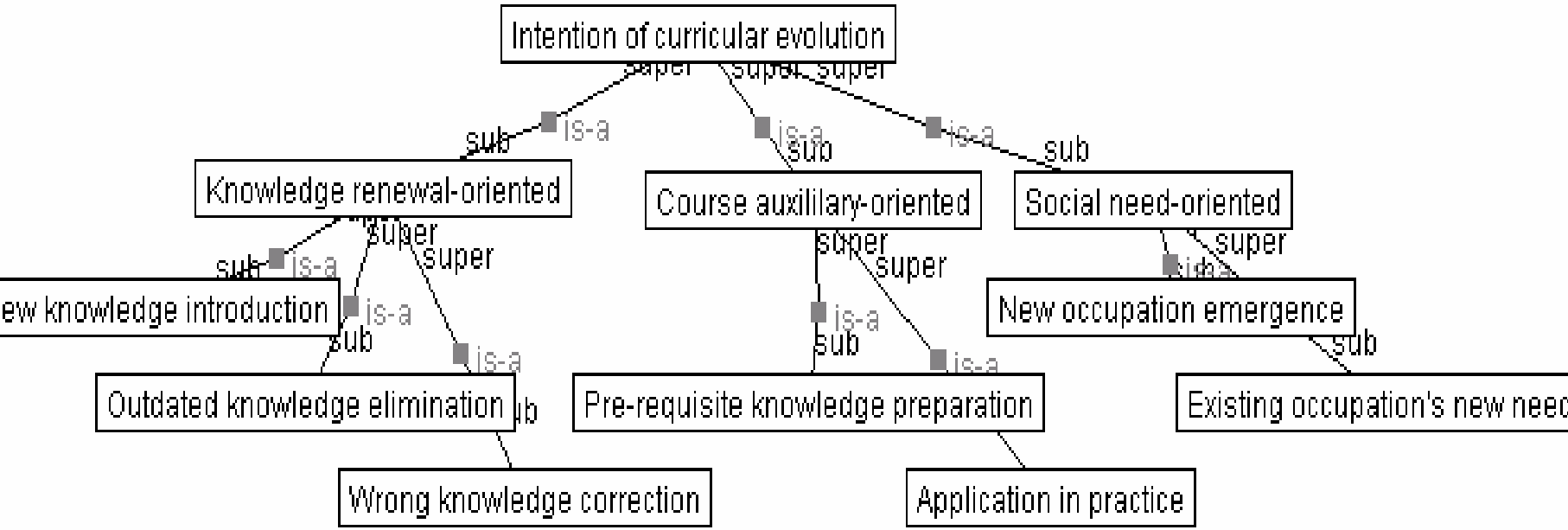
Description of Evolutionary Process of Curriculum-- Curriculum Ontology

- “Evolutionary process of curriculum” indicates two aspects of curriculum in higher education:
  - (1) a designed sequence of changes and development of properties or attributes of curriculum;
  - (2) intention behind the designing, which initiate a series of intentional behaviors of people involved in such process.



A hierarchical conceptualization of "Evolutionary Process of Curriculum"

Intention of curricular evolution



“Regulation” in Curriculum Evolutionary Process

- *Regulation* is considered as a sort of social rules, which plays a crucial role in curriculum evolutionary process:
  - it is the rule of curriculum to control
    - the way curriculum is designed, revised, and evaluated *OR*
    - the way stakeholders behave;
  - it should be always INSPIRED by or MEET with “*Intention of curricular evolution*”.

Four Spaces of Relationship during Course Change:

	Single Course	Contextual Courses
Intra-Term	1st **Component Relationship** •Realized by •Goal of •Guaranteed by •Consist with	2nd **Sequence Relationship** •Pre-requisite •Co-requisite
Inter-Terms	3rd **History Relationship** •Extend from •Narrow down •Adapt to •Accessorize with •Facility-equip with	4th **Effect Relationship** •Cause effect •Influence effect •Initialize effect •Finalize effect

On2C system Development

- Interface of On2C system

A) Domain knowledge viewer

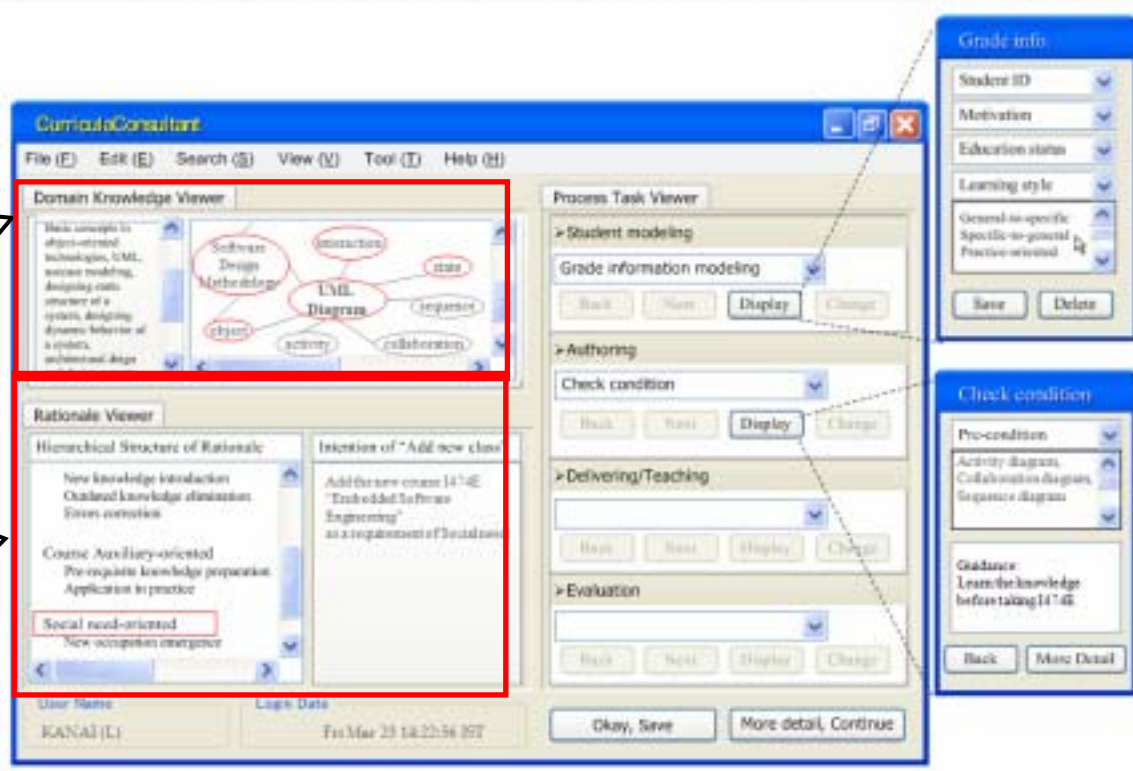
Tree list of domain nowledge in each iscipline

To provide lecturer and tudent with domain ontents and structure

B) Rationale viewer

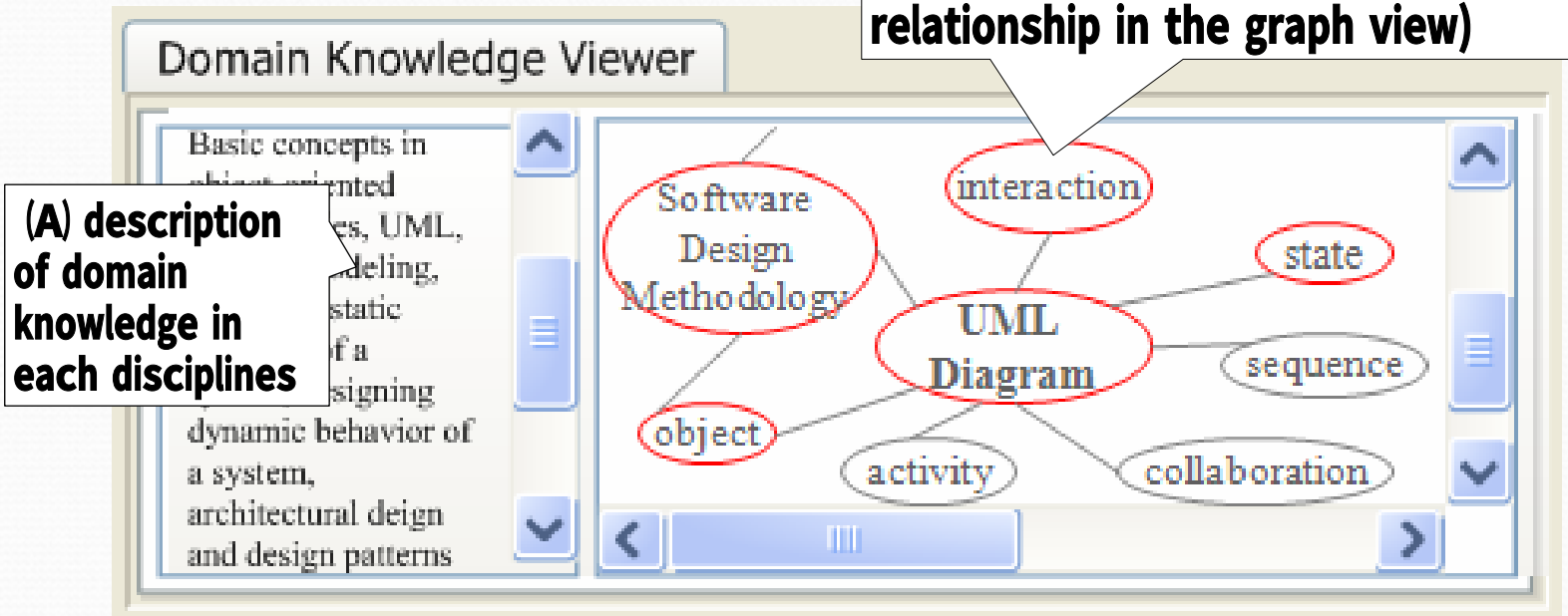
To explicate the basic nformation and intention of urriculum design

Well-structured concepts elated to the intention of urriculum design, and



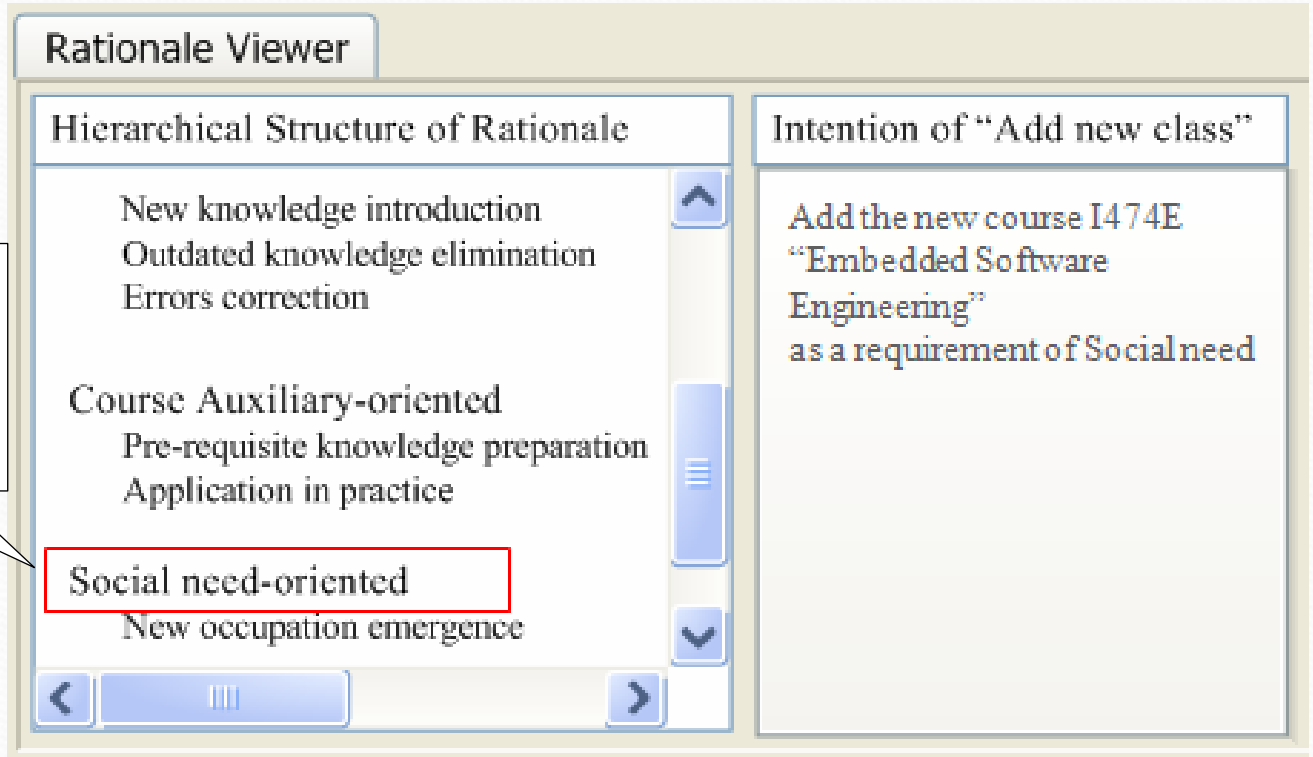
On2C system Development (*cont'd*)

- Domain knowledge viewer
  - (A) the details of the domain knowledge are displayed;
  - (B) the details of the domain knowledge are displayed in the graph view



On2C system Development (*cont'd*)

- Rationale viewer
  - (A) as a part of Curriculum Ontology, it offers the vocabularies to describe the intention of curricular evolution

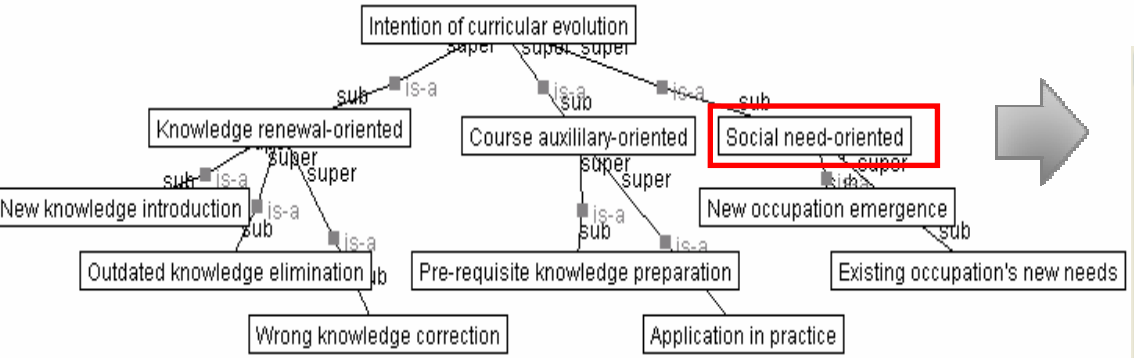


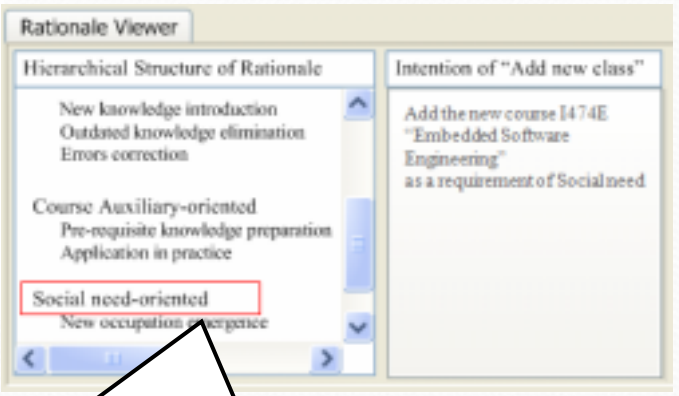
(A) to show the intention of curricular evolution

On2C system Development (cont'd)

- Conceptualized "intention" in Curriculum Ontology

to offer the vocabulary





To explicit that the intention of add the new course of "Embedded Software Engineer" is for the new social need.

Organizing guidance knowledge of design to make evolution smooth

Intention & Activity of Faculty designer

IF (

In order to meet with the change of social needs

Intention

to add new course

Activity

AND

In order to master prerequisite knowledge of the new course

Intention

to add the necessary new learning items in related existing course

Activity

)

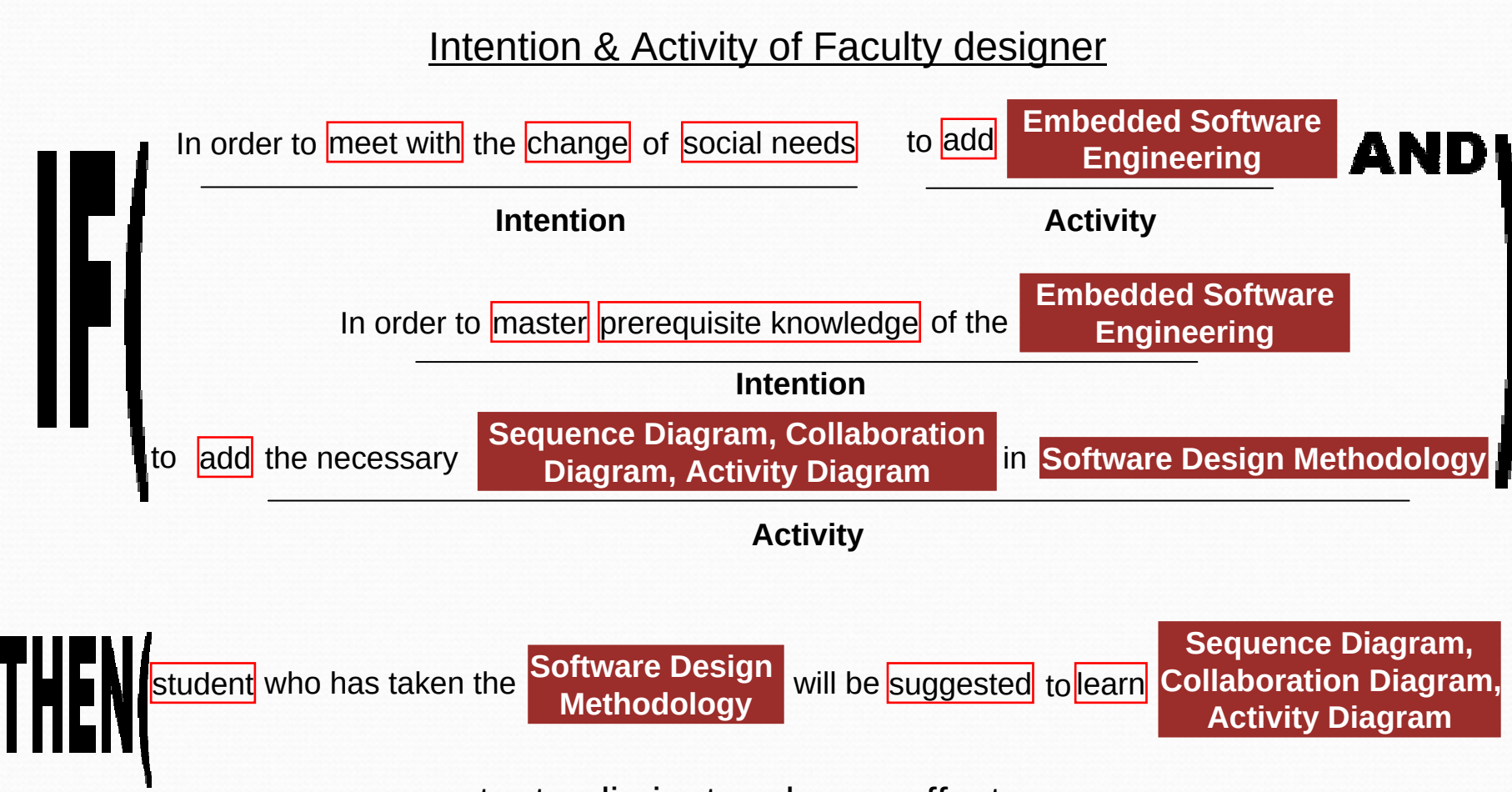
THEN (

student who has taken the related existing course will be suggested to learn new learning items

)

try to eliminate adverse effects

Organizing guidance knowledge of design to make evolution smooth



Conclusion and future work

- In this work we propose the model of evolutionary process which reflects essential structure of curriculum for offering a better ways to tracking the history of curriculum change;

- Curriculum ontology we developed serves as a fixed conceptual system to fully predict the generic components of curriculum so it can be reused in situation-dependent curriculum system.

- Next step is refinements of the evolutionary curricula model for ontology support to intelligent curriculum authoring and consulting. We are mainly interested in exploring which further functionalities are needed and wanted by different stakeholders.