Supporting tool for student who learns usecase modeling

Teruhisa Ichikawa[†] and Chikage Ohta[‡]

[†]Faculty of Informatics, Shizuoka University, Japan
[‡]Graduate School of Science and Technology, Keio University, Japan

Abstract - Increasing numbers of students of faculties related to information technology are learning UML (Unified Modeling Language). In order to effectively model the object area, it is necessary to understand about business. It is difficult, however, for the student who doesn't know business to call up the tacit function not described in the requirements specification. This paper proposes to use ontology as a way to draw out a tacit function when the student makes the usecase diagram, and is a verification of the effectiveness of the procedure.

Keywords: UML modeling, usecase diagram, ontology

1 INTRODUCTION

Increasing numbers of students of faculties of informatics are learning UML (Unified Modeling Language). In order to effectively model the object area, it is necessary to understand about business. It is difficult, however, for the student who doesn't know the business to call up the tacit function not described in the requirements specification. Moreover, it is necessary to learn the modeling technology in a limited time.

In this paper, we propose the study support tool for the usecase modeling that requires business knowledge.

Usecase modeling is used to extract a necessary function (it is called usecase) from the requirements specification such as RFP (required for proposal), and to make a model. The model refers to the ontology of a limited object domain. The result is described as a usecase diagram. The tacit function, i.e. knowledge not described in the requirements specification, can be discovered by referring to the ontology of the object domain.

To grasp the concept of ontology and to discover tacit knowledge of an object area, and to identify requirements specification, it will be useful for students to model a familiar object area, such as a library or convenience store.

In this paper, we aim to develop educational support for making the usecase diagram by selecting an object domain likely to be familiar to students, enabling them to make a more refined usecase diagram.

2 REVIEW OF CURRENT RESEARCH

Current research that applies ontology to UML includes the following:

Minegishi's "Supporting Software Engineering Processes with Ontologies"[1] is object modeling research aimed to support making the analysis class diagram that is the product in the systems analysis phase. It proposes to solve the following three problems:

(1) Modeling cannot be done due lack of understanding concerning business.

(2) System specific information and common domain information cannot be separated.

(3) Significant differences of interpretation pertinent to the product are generated.

To solve these problems the analysis class diagram making a support technique using ontology is proposed. The process of making the analysis class diagram is supported by the main noun extracted from the usecase description which refers to the domain ontology and general ontology that systematizes the concept in the domain.

Kamiya's "Supporting Analysis Class Modeling with Ontologies"[2] is concerned with object modeling too. If the domain ontology is insufficient, an acceptable class diagram can be derived by applying general ontology, combined with conversation processing with the modeler, etc.

To date no research of support for making the usecase diagram from the requirements specification proposed in this paper is available.

3 OUTLINE OF ONTOLOGY [3], [4]

Recently, ontology research is developing because of knowledge sharing and recycling knowledge. In current practice, ontology is the term used to conceptually systematize the targeted world rigorously and exhaustively, and to create a hierarchical description of relation. Not only objects (noun), but also the process (verb), as well as constraints, are systematized.

The primary meaning of the term ontology is existence. This term is being adapted in the world of informatics to describe a target "real world" to describe algorithmically. That actual domain is a referent more powerful than a dictionary.

Moreover, ontology can identify tacit information that differs from the data of an electronic dictionary, and exists in the background of knowledge. Tacit information might alter the significance of knowledge described by the vocabulary. It is one of the important roles of ontology to clarify such tacit information.

Ontology includes general ontology that describes the concept of specializing, and domain ontology that describes the concept of specializing in the field.

4 USECASE MODELING

UML is a typical modeling language, and 13 kinds of diagrams are defined, among them usecase diagram, which is used to describe a functional side.

What kind of user (It is called actor) uses the system? Moreover, what function (It is called usecase) does each actor use? This relation is described as shown in Fig. 1.

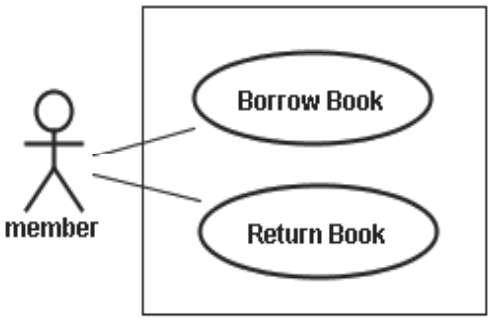

Figure 1: Example of usecase diagram

In this paper, we analyze usecase diagram that students made by the information system design study. We then extracted problems in usecase modeling study.

In this study, the procedure for each theme has been to lecture on knowledge necessary in each theme, studying the theme in groups, who make a presentation the next week. One of the themes is usecase modeling.

It lectures on usecase modeling first. Next, usecase modeling of "Equipment management system of the elementary school" is done. Afterwards, usecase modeling of "Case that each group chose" is done.

Figure 2 is example of usecase diagrams for "Equipment management system of the elementary school" that the student made.

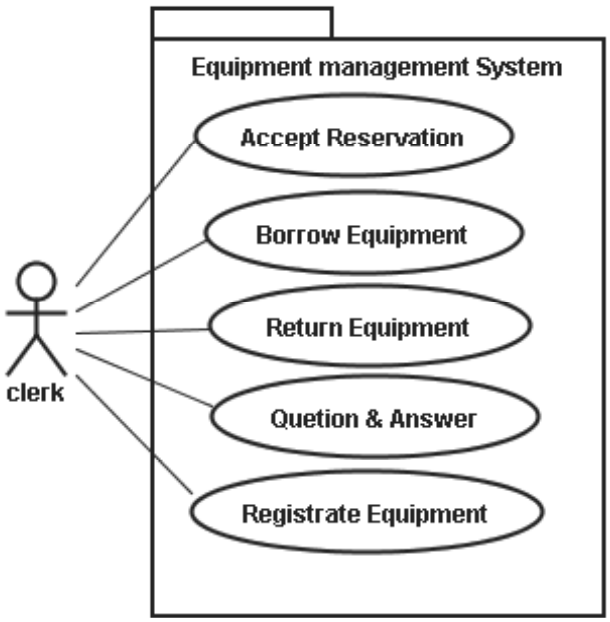

Figure 2: Example of usecase diagram for equipment management system

Most groups are describing five usecase "accept reservation," "borrow equipment," "return equipment," "question & answer," and "register new equipment." These are the descriptions corresponding to the requirement, and it is extracted correctly.

However, the system doesn't work only by these functions.

Figure 3 is usecase diagram by the teacher. Some functions not described in the requirements specification by students are added to this usecase diagram. For example, it is necessary to record what to borrow, and to whom you borrow. Therefore, it is necessary to register the equipment and the user beforehand. Moreover, there is a return if there is a borrowing. A function is necessary if the item is not returned in the time limit. Therefore, the function of press is also necessary. For this the user's name, address and telephone number are required.

Moreover, it is necessary to register information for other schools (where to make contact, and what equipment can be borrowed) beforehand to make equipment available to another school. All functions to retrieve the specification in the lending situation regarding the equipment are noted.

If there is an experienced person of the information system development present, the lack of knowledge in all the others becomes evident. This raises the problem of how to extract required functions accompanying, though not described, in the requirements specification.

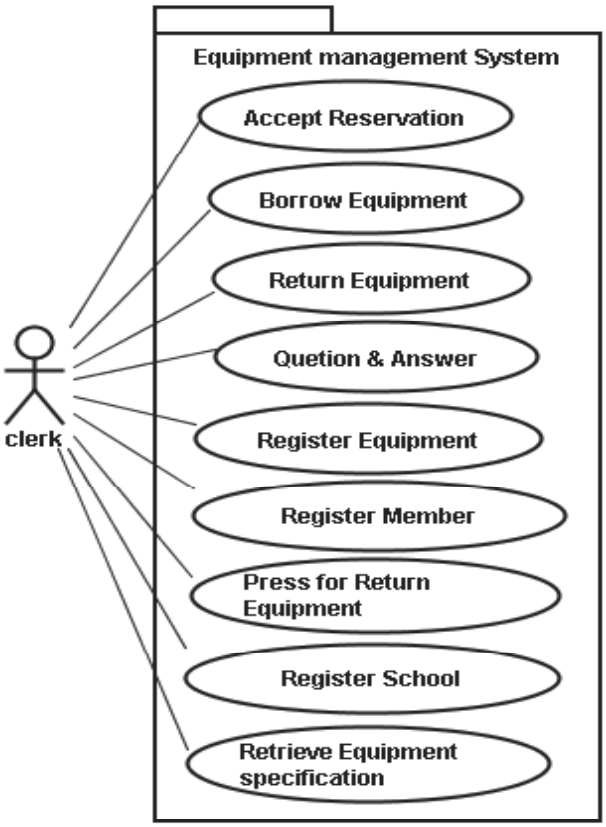

Figure 3: Model answers of usecase diagram for equipment management system

5 PROPOSAL OF USECASE MODELING USING ONTOLOGY

In this proposal, the domain ontology is classified into the object ontology and the task ontology.

The object ontology defines the hierarchical relations between objects. The relation of the noun like the person and the thing, etc. is defined. The relation is described by using the ”is-a” relation as shown in Fig. 4.

The relation of ”equivalence” is described to absorb the difference of the expression.

The task ontology is ontology that defines the attribute of the task (verb concept). It describes it with seven relational operators as shown in Fig. 5.

The feature of the proposed domain ontology was to have prepared “pre-task” and “post-task” in relational operators of the task ontology. The flow of the task can be expressed by adding these relational operators. The before task and the after task are understood by referring to this ontology.

The procedure for refining the usecase diagram that the student made is as follows.

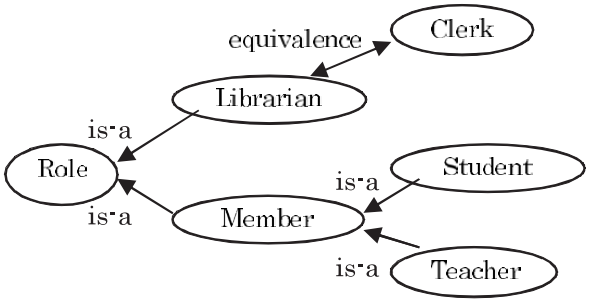

Figure 4: Composition of object ontology

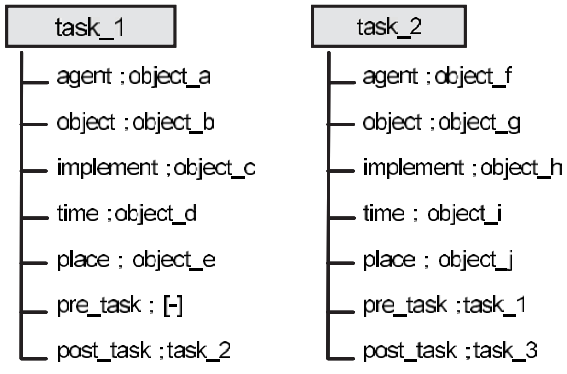

Figure 5: Composition of task ontology

At first, retrieve the task described in the usecase that the student made in the beginning, and refer to the ontology. Then, the student understands what task is necessary before and behind the task.

Moreover, relational operators such as agent and object are described in each task. How the task takes part from these relational operators in the system can be judged. It is a repetitive process to trace the flow from a certain task, and to refer again to the ontology of each task. The function that the system should offer by this operation can be discovered, and the practical oversight of the usecase can be discovered.

6 EXPERIMENT AND CONSIDERATION

6.1 Exercise

To verify the utility of the proposal technique, the case study of the library system was done. The requirements specification and model answers to the library information system were quoted from “Essence of the UML modeling” [5].

[Requirements specification of library information system]
There are insufficient clerical officers in charge of the lending business at the library at A-university. Then, A-university decided to introduce the library information system for the lending business efficiency.

The following three functions are necessary for the system.

- Acceptance processing of lending reservation
- Management of lending and return books
- Record of lending history

“Lending reservation” function is necessary for the user that wants to borrow the book as soon as possible.

The clerical officer at the library places the book in holding area when the book is returned, and reports that the book can be loaned out to the user who reserved it. It is necessary to manage which user has reserved the book to achieve this service.

The collection of books at the library is classified into books and journals. There is only one journal for each title, although there are volumes and numbers. There may be several copies of one book. Therefore, the collection of books is managed by the management indexing number, to distinguish them.

The library users are students and teachers at A-university, and all members are registered. The student and the teacher are divided because there is a restriction “Journals are not lent to the student.”

Student member’s lending limit is 6 books, and teacher member’s lending limit is 12 books. The lending period is up to three weeks.

The object ontology and the task ontology for the library were made based on the proposal technique.

Figures 6 and 7 show the object ontology and the task ontology. Each object and each task has extracted the verb and the noun from business manual [6] at the Shizuoka University library. And, words and phrases that were able to be used in this case were chosen.

6.2 Experiment

The experiment was conducted on the following hypotheses.

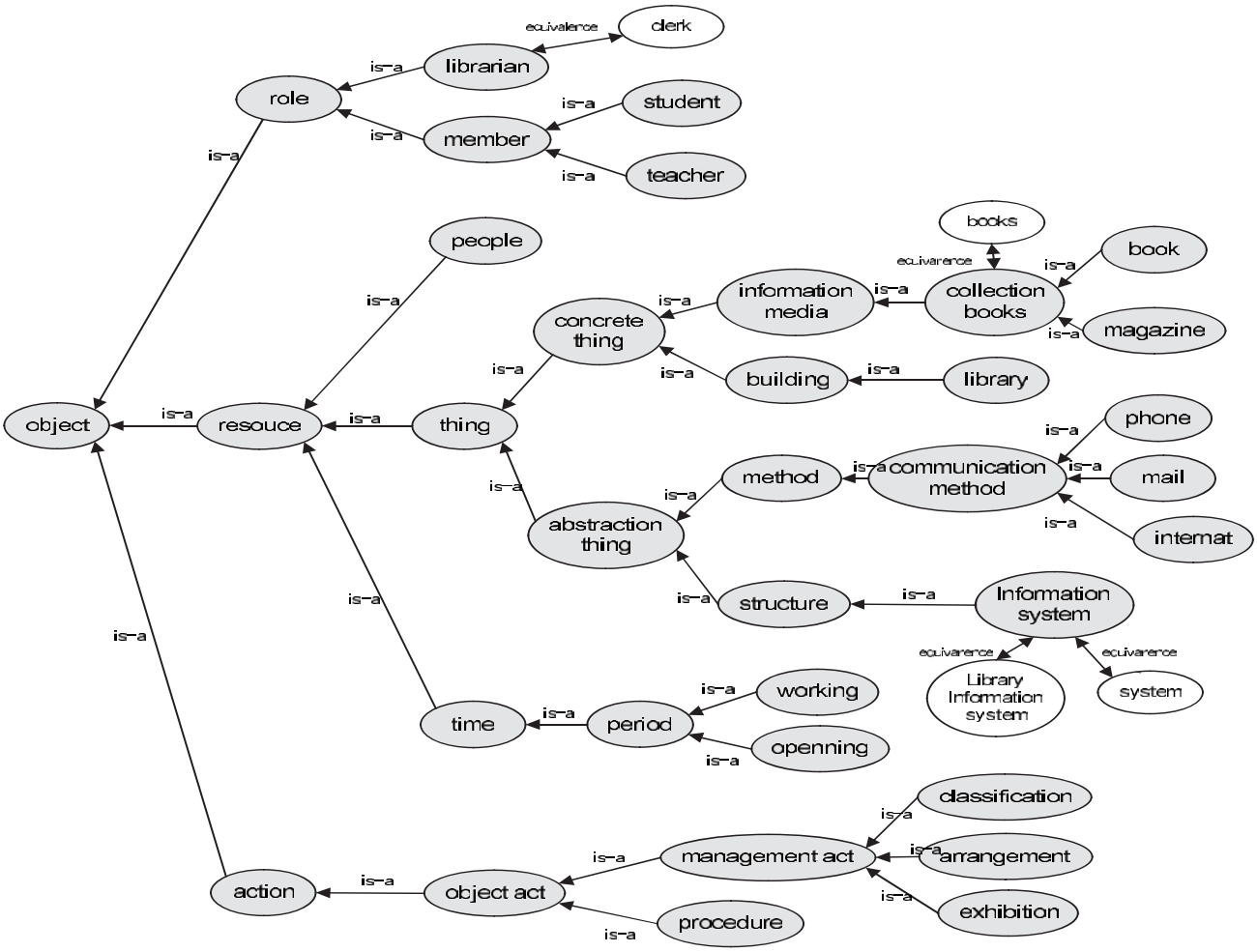

Figure 6: Example of the library object ontology

[Hypothesis 1] Usecase diagram made by using ontology is refined more than usecase diagram made without ontology.

[Hypothesis 2] The refinement result of usecase diagram made by using ontology doesn't depend on a prior lecture environment (teacher's difference, content of the lecture, numbers of students, etc).

Testees are seven beginners of UML. Three students (Hereafter, it is called group-A) have never learned UML. Other four students (Hereafter, it is called group-B) have learned some UML.

We conducted the experiment according to the following procedures.

1) We gave a lecture to the group-A concerning usecase diagram.

2) The requirements specification of the library system is presented, and all testees make usecase diagram (1st edition) from this requirements specification.

3) We explain the conceptual ontology.

Table 1: Procedure of experiment

Step	Group A	Group B
1	Lecture(usecase)	—
2	Trial(1st edition)	Trial(1st edition)
3	Lecture(ontology)	
4	Show(the library ontology)	
5	Revise(2nd edition)	Revise(2nd edition)

4) The library ontology is presented.

5) Usecase diagram (1st edition) is reviewed referring to the library ontology and 2nd edition is made.

6.3 Evaluation

We judged whether extracted usecase was more appropriate than usecase of model answers.

Hypothesis 1 was verified by the comparison usecase diagrams between 1st edition and 2nd edition. Figure 8 shows

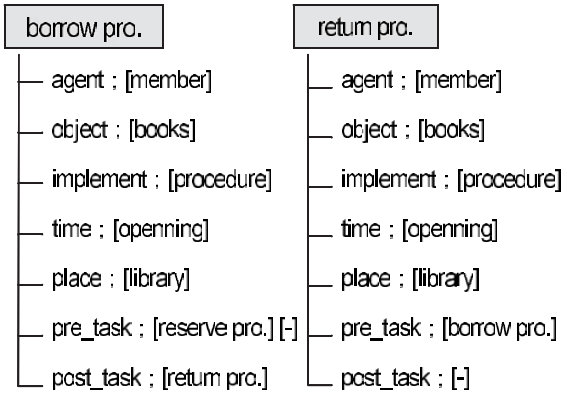

Figure 7: Example of the library task ontology

the result of comparing between usecase of 1st edition and usecase of 2nd edition.

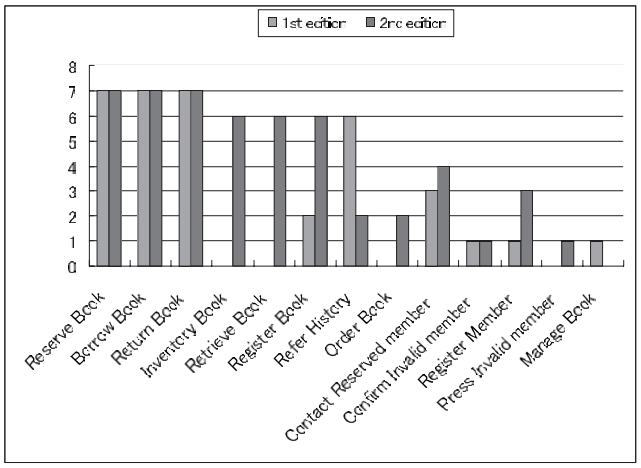

Figure 8: Comparison usecase between 1st edition and 2nd edition

If the term had the same meaning even if the usecase name was different, it counted assuming that it was the same. For instance, “Put back book” and “Return book” have the same meaning, and it counted as “Return book.”

2nd edition after reference to ontology contained more refined distinctions (for example, “inventory book,” “retrieve book,” “register book”) than 1st edition before reference to ontology as shown in Fig. 8, and the effect of ontology was proven. However, after referring to ontology, students who extract usecase (for example, “refer history,” “register member”) are decrease or few. This was caused by the method of describing ontology, and it is necessary to improve the description.

Next, hypothesis 2 was verified by the comparison mutually made the 1st edition and the 2nd editions by group-A and group-B.

The difference of usecase in usecase diagram (1st edition) is 0.5 or less in each usecase as shown in Fig. 9.

The difference of usecase in usecase diagram (2nd edition) is 0.5 or less in usecase other than usecase ”register member”

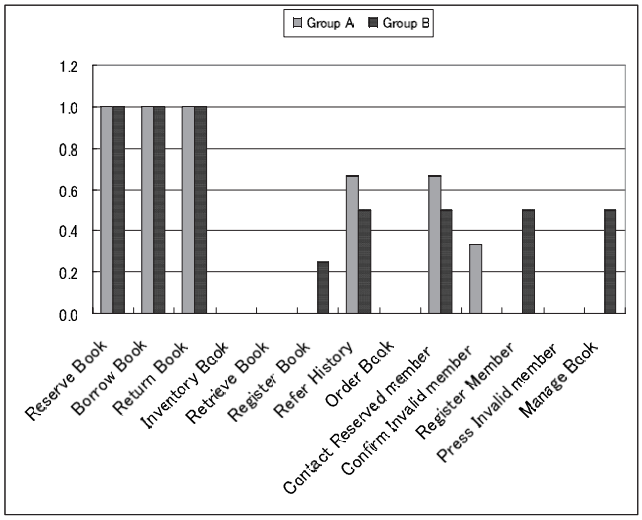

Figure 9: Comparison usecase (1st edition) between group-A and group-B

as shown in Fig. 10.

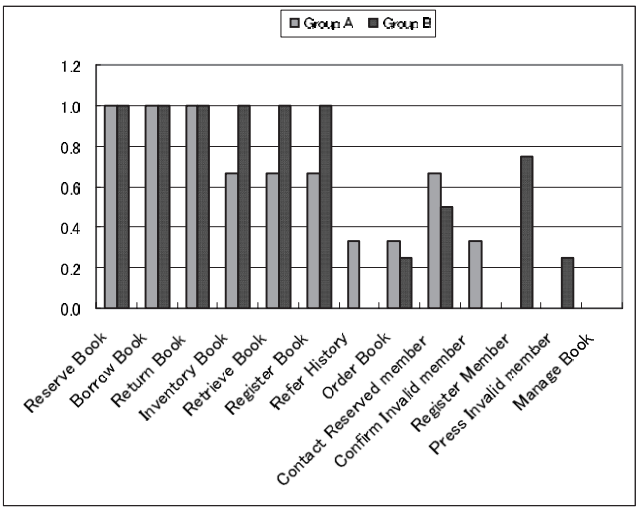

Figure 10: Comparison usecase (2nd edition) between group-A and group-B

It has been shown that the effect of the refinement by the ontology reference is independent of a prior lecture environment.

However, group-B has passed one year since usecase modeling was studied. Group-A studied usecase modeling and experimented at once. Therefore, it is necessary to verify the influence of the difference of the elapsed time after the study of modeling.

7 CONCLUSION

It has been clarified that the refinement technique based on using ontology was useful for making usecase diagram.

Future tasks are as follows.

- Review of domain ontology for making more detailed refinement
- Increase the number of experiment samples, and do a statistical verification of hypothesis 1 and hypothesis 2.
- Systematize the technique for making the proposal.

The systematization of the proposal technique is a system that traces, checks the flow of ontology for making usecase by building ontology into the usecase diagram making tool, and finds the deficiency of usecase.

The refinement level can be expected to reduce the oversight of the relating ontology by systematizing it, to be able to extract appropriate usecase, and to go up.

The constructed ontology is domain ontology that specializes in the library information system. A similar system like various rental systems and reservation systems can use the ontology for enhancing effectiveness.

Future tasks are to ascertain the domain of applicability, and to add ontology smoothly to expand the domain of applicability.

REFERENCES

[1] T. Minegishi, M. Ishibashi, N. Fukuda, T. Ijima, and T. Yamaguchi, Supporting Software Engineering Processes with Ontologies, Proceedings of the 19th Annual Conference of the Japanese Society for Artificial Intelligence (2005).
[2] S. Kamiya, M. Ishibashi, T. Morita, N. Fukuta, T. Ijima, and T. Yamauchi, Supporting Analysis Class Modeling with Ontologies, IEICE Technical Report KBSE2005-15 (2005).
[3] H. Ito, Using Ontology for Knowledge Sharing and Reuse, UNISYS TECHNOLOGY REVIEW, No. 64 (2000).
[4] R. Mizoguchi (Eds.), K. Furusaki, T. Kimura, M. Sasajima, and R. Mizoguchi, Introduction to ontology construction, Ohm press (2006).
[5] K. Kodama, Essence of UML modeling, Nikkei BP (2004).
[6] NALis, operative manual, Library Hamamatsu annex attached to Shizuoka University.

(Received October 28, 2008)
(Revised July 21, 2009)

Teruhisa Ichikawa Professor, Faculty of Informatics, Shizuoka University. Graduated Keio University in 1965, Department of Administration Engineering, Faculty of Engineering, received the Ph.D. in Engineering from Keio University in 2006. He joined Mitsubishi Electric Corporation in 1965. After 33 years of computer industry experience, he was transferred to Niigata International Information University in 1999. After that, he was transferred to Shizuoka University in 2002. His current research interests include modeling of enterprise systems and educational curriculum related to information systems. He is a member of IPSJ, JASMIN, ISSJ and INFSOC.

Chikage Ohta Student, Graduate School of Science for Open and Environmental Systems, Keio University. Graduated Shizuoka University in 2008, Faculty of Informatics. Her current research interests include ontology and service science.