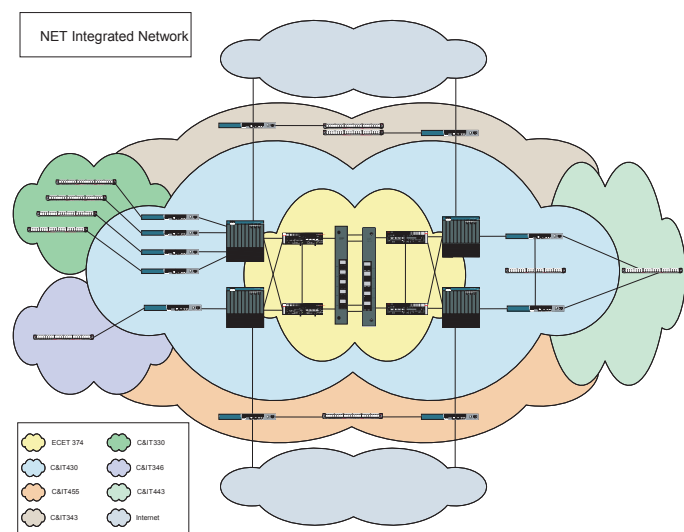


Figure 1. NET network overview



a structured analysis and report using the Top-down model as a reference. This laboratory gives students exposure to a wide array of administration tools and software packages that will be found in industry.

#### C&IT 346: Wireless Networking

C&IT 346 introduces wireless and cellular technologies and their impact upon the telecommunications world. In lecture, students learn about wireless-specific protocols and modulation techniques, as well as the architecture needed to support this communication. In laboratory, students implement wireless solutions and integrate them into wired LAN environments.

#### ECET 374: Digital Telecommunications

ECET 374 provides a broad overview of digital communication methods and systems emphasizing telecommunication fundamentals. Students explore the

Public Switched Telephone System (PSTN) backbone and local loop transmission infrastructure, including physical layer concepts such as analog and digital signals, noise, power, errors and modulation. Telecommunication concepts such as T and E carrier transmission and framing are examined and further developed through higher order multiplexing schemes including SONET/SDH. Additional telecommunication technologies such as ISDN, Frame Relay, and ATM are also discussed.

#### C&IT 430 – Internetwork Design and Implementation

Students design and construct a routed IP-based wide area network capable of simultaneously transporting packet-switched voice, multi-protocol data, and video. Emphasis will be placed on the design and internetworking of diverse telecommunications systems, while considering the effect of engineering decisions on business performance. Organization and management of large scale telecommunications projects are investigated.

#### C&IT 443: Enterprise Network Management

C&IT 443 explores various aspects of enterprise network management with an emphasis on managing faults and optimizing performance to ensure high service availability. Concepts introduced include basic management functions, standards-based management technologies, and the business impact of network management.

#### C&IT 455: Network Security

C&IT 455 covers conceptual and technological aspects of network security for voice and data networks. The course deals with the analysis, design, implementation, and management issues surrounding effective network security. Students must research a variety of solutions to current security issues, and implement their findings in the laboratory environment.

#### REFERENCES

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## Tutorial

# Connecting Requirements and Object-Oriented Modeling

Instructor: Hermann Kaindl, Vienna University of Technology, Institute of Computer Technology, Vienna, Austria;  
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**Prof. Hermann Kaindl** joined the Institute of Computer Technology at the Vienna University of Technology in Vienna, Austria, in early 2003. Prior to moving to academia, he was a senior consultant with the division of program and systems engineering at Siemens AG Austria. There he has gained more than 24 years of industrial experience in software development. His current research interests include software engineering with a focus on requirements engineering, and human-computer interaction as it relates to scenario-based design. He has published four books and more than ninety papers in refereed journals, books and

conference proceedings. He is a senior member of the IEEE, a member of the ACM, the INCOSE and the IRMA, and is on the executive board of the Austrian Society for Artificial Intelligence.

#### OBJECTIVES

The participants will understand several key problems with current OO methods and how they can be resolved by "clean" OO thinking. In particular, they will

be able to distinguish between domain objects and software objects. They will experience UML as a language for representing OO models, but also the need to be clear about what kind of objects are represented. In addition, participants will see how scenarios and use cases can be utilized for requirements engineering. But they will also see the additional need to specify the functional requirements for the system to be built.

The purpose of this proposed tutorial is to connect requirements engineering with object-oriented modeling, so that practitioners can apply the best from both “worlds” together.

#### SUMMARY OF MATERIAL TO BE COVERED

- How do scenarios / use cases fit together with functional requirements?
- How can OO (object-oriented) principles like classification help organizing a huge number of requirements?
- How can the application domain be better understood using OO modeling?

This tutorial addresses these questions because they are relevant for industrial software development but too many misunderstandings still exist with regard to OO processes and methods as related to requirements engineering. It shows how each requirement given in natural language can be modeled as an object, which facilitates a clean organization and association. While scenarios / use cases can somehow illustrate the overall functionality, additionally functional requirements for the system to be built should be formulated and related to them appropriately. In order to better understand scenarios, the goals to be achieved by them should be explicitly defined and linked to them as well. All kinds of requirements typically make statements about the application domain, which should be represented in an OO Domain Model of conceptual classes, in order to make the requirements better understandable.

#### PRESENTATION FORMAT

This tutorial will consist of lectures and group discussions. The technical points made will be illustrated with a running example throughout.

For the lectures, the instructor will use a computer screen projector connected with his laptop computer.

#### Assumed Background of Attendees

The assumed attendee background is some familiarity with scenarios / use cases and basic object-oriented concepts, as well as interest in requirements.

The target audience is requirements engineers, software engineers, project managers, anyone supposed to work on the requirements in the context of object-oriented development.

#### HISTORY, PREVIOUS EXPERIENCE OF THE TUTORIAL PROPOSER AND ADDITIONAL REMARKS

A half-day version of this tutorial was presented at INCOSE 2004 (26 attendees

in a conference of about 850). It received very positive feedback (on tutorial evaluation sheets filled in by attendees) and I will embrace the ideas suggested for improvement. Other versions:

- “Modeling Business and Requirements Using UML” at HICSS’38 (35 attendees in a conference of about 600)
- “Reconciling Requirements, Use Cases and Object-Oriented Modeling” at RE’02 (17 attendees in a conference of about 200)
- “Reconciling Business Modeling and Requirements with Object-Oriented Software Development” at HICSS’36 (38 attendees in a conference of about 600)
- “Reconciling Requirements, Use Cases and Object-Oriented Modeling for Systems Engineering” at INCOSE 2003 (37 attendees in a conference of about 1000).

In addition, this proposer has previously held tutorials on the reuse of requirements at CAiSE’00, RE’01, RE’03, INCOSE 2004, RE’04 and INCOSE 2005.

Among other things, this tutorial proposes solutions to issues discussed in a panel organized by this proposer at OOPSLA 2001 “How do Requirements Relate to Objects?” and another panel with the same title at INCOSE 2004. It includes also material on real-world experience from the approach developed by this proposer as presented in an invited State-of-the-Practice Talk at RE’01:

H. Kaindl, Adoption of Requirements Engineering: Conditions for Success, *Fifth IEEE International Symposium on Requirements Engineering (RE’01)*, Toronto, Canada, August 2001.

The proposed tutorial is also based on an in-house course at Siemens, a teaching course at the Vienna University of Technology, research and consulting experience of its proposer and, e.g., on the following selection of articles and papers:

Kaindl, H., Object-Oriented Approaches in Software Engineering and Artificial Intelligence, *Journal of Object-Oriented Programming* 6, 8, 1994, pp. 38–45.

Kaindl, H. A Practical Approach to Combining Requirements Definition and Object-Oriented Analysis, *Annals of Software Engineering*, Vol. 3, 1997, pp. 319–343.

Kaindl, H., Kramer, S., and Kacsich, R., A Case Study of Decomposing Functional Requirements, in *Proc. Third International Conference on Requirements Engineering (ICRE ’98)*, Colorado Springs, Colorado, April 1998, pp. 156–163, IEEE.

Kaindl, H., Difficulties in the transition from OO analysis to design, *IEEE Software*, Sept./Oct. 1999, pp. 94–102.

Kaindl, H., A Design Process Based on a Model Combining Scenarios with Goals and Functions, *IEEE Transactions on Systems, Man, and Cybernetics (SMC)* Part A 30(5), 2000, pp. 537–551.

Kaindl, H., Is object-oriented requirements engineering of interest?, *Requirements Engineering*, Vol. 10, 2005, pp. 81–84.

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