6. Design the learning environment to support and challenge the learner's thinking.
7. Encourage testing ideas against alternative views and alternative contexts.
8. Provide opportunity for and support reflection on both the content learned and the learning process.

The co-developers of the course felt strongly that the incredible speed of change in the two fields under examination required such an approach for many reasons, but, perhaps most importantly, helping learners to master not the facts of technology or international business, but rather, the capacity to continuously learn and update competence in these areas.

WHAT WILL HAPPEN AT THE SYMPOSIUM?

Symposium presenters consist of the co-authors of this seminar who have offered it a total of six times to date. After a brief introduction to the symposium's approach, participants will be invited to generate timely topics and concerns related to the two subject areas. A facilitated discussion will encourage participants to explore existing and potential synergies between the two most powerful forces in business today. Based on their research with business and industry and on their teaching experiences, the co-presenters will offer suggestions for learning challenges that participants will be able to apply in academic or training and development settings. Participants who request them will receive course materials and a summary of the symposium's key points.

This symposium is uniquely suited to IRMA's topic this year. Practical, timely, and appropriate for information managers and academicians as well, its outcomes should help participants to crystallize related issues for their home organizations.

Experiences in Implementing a Network Engineering Technology Curricula

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ABSTRACT

The purpose of this symposium is to share faculty experiences in the successful development of a laboratory-based Network Engineering Technology (NET) program. The symposium will include information on individual courses, the curricula as a whole, facilities required, and experiences in working toward accreditation from CAC/ABET. The symposium will present the individual elements of the lab-based curriculum architected around a network overview diagram that illustrates the infrastructure used to facilitate lab integration amongst the courses.

INTRODUCTION

The focus of the Network Engineering Technology (NET) program is to create highly competent network engineers and administrators. Course materials are reinforced with tightly integrated lecture content and laboratory experiences. Supporting lecture material with laboratory exercises produces an active learning environment where "students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation", which aids in retention and understanding of material (Bonwell 1991). The NET program further reinforces the relationship between lecture and laboratory at the curriculum-level by utilizing course-based laboratory projects as pieces of the overarching network infrastructure. Collectively, these course-based lab projects combine to provide students with an education and hands-on experience in every aspect of network design, implementation, administration, security, and management.

Figure 1 illustrates the network architecture deployed by the students in the NET curriculum each semester. This diagram provides a basis for understanding how the individual course components collectively contribute to a holistic student learning experience. This architecture is critical to enabling cross-course collaboration among students with disparate technologies.

All course materials are designed with actual industry experiences in mind. Designing exercises in this manner ensures that the students gain knowledge of technologies and practices currently utilized in industry, and they will understand the processes for implementing and troubleshooting networks containing these components. As suggested by Qazi and Ishaq (Qazi 1998), students should be offered interdisciplinary projects that provide a seamless connection between the academic sphere and the professional world. This approach to education provides students with the desired learning experience, preparing them for future work in corporate environments as required by CAC/ABET for accreditation.

The NET program is currently undergoing an accreditation review as an IT program by CAC/ABET and should be complete by the date of the symposium. The presenters will also be prepared to share their fresh experiences gained through the accreditation process.

CORE CURRICULUM

NET students will pursue a wide variety of endeavors within the networking and digital telecommunications field upon graduation. The NET program breaks these responsibilities into the logical groups that include network design, administration, security, and management. The following list identifies the courses that compose the core of the NET curriculum:

- C&IT 330 – Local Area Networking and Systems Administration
- C&IT 343 – Advanced Systems Administration
- C&IT 346 – Wireless Networks
- ECET 374 – Digital Telecommunications
- C&IT 430 – Internetwork Design and Implementation
- C&IT 443 – Enterprise Network Management
- C&IT 455 – Network Security

C&IT 330: Local Area Networking and Systems Administration

C&IT 330 introduces students to local area networks, system and network administration. Emphasis is placed on fundamental concepts and best practices. This course also provides students with their first hands-on laboratory experience in the NET curriculum and emphasizes problem-solving and troubleshooting skills through network implementation.

C&IT 343: Advanced Systems Administration

C&IT 343 expands upon the administration concepts learned in C&IT 330 and introduces extended network services. C&IT 343 laboratories focus on solving given business scenarios. Students must research and implement various technologies to address the business cases given, and must support their work with

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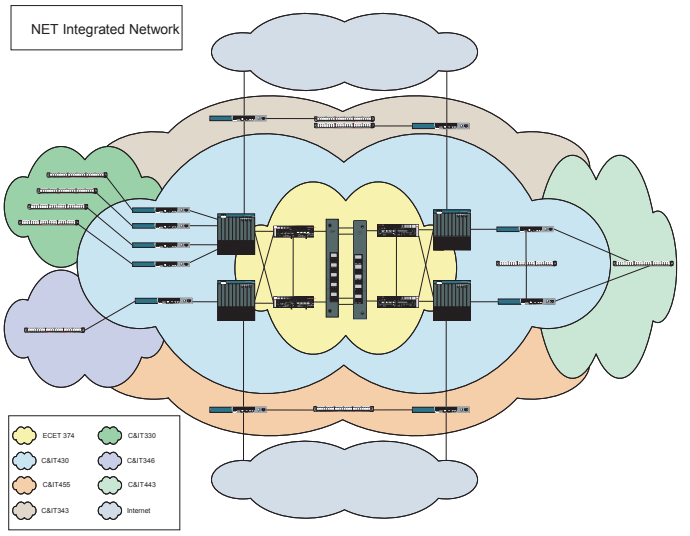
Figure 1. NET network overview



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.

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Tutorial

Connecting Requirements and Object-Oriented Modeling

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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

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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 is 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:

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