Can Ethics Be Taught as a Core Competence of the Engineer?: Engineering Ethics across the Curriculum at the Kanazawa Institute of Technology

International Conference on Cultivating Citizens' Core Competence
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Kanazawa Institute of Technology

Outline

1. Introduction
2. Ethics in the Formation of Engineers
3. Ethics across the curriculum at KIT
4. The required "Science and Engineering Ethics" course for junior-standing students
5. The "Agora" e-learning system
6. Characteristics of the ethics across the curriculum at KIT

KIT?

Kanazawa
Institute of
Technology

Kanazawa
- 300 km west of Tokyo (50 minutes by plane)
- On the coast facing the Sea of Japan

Location of Kanazwa and KIT

KIT Ohgigaoka Campus

KIT?

One of the largest technical universities in Japan

- Founded in 1965
- Private, independent, no religious affiliation
- Single-college until 2004 (in 2004, added two colleges; in 2008 four colleges)
- About 7,000 students, 340 faculty and 150 FT staff
- Strong ties with industry (more than 50% of technical faculty members are from industry)

KIT's Three Founding Principles

- 「人間形成」:To create well-rounded citizens with good character
- 「技術革新」:To be innovative
- 「産学連携」:To promote industry-university collaboration

KIT Colleges (14 Departments)

- College of Engineering
- College of Environmental Engineering and Architecture
- College of Information Science and Human Communication
- College of Bioscience and Chemistry

(Most of the programs are accredited by the Japanese Accreditation Board for Engineering Education)

Newsweek, September 15, 2003

"In Japan, a once obscure regional technical institute has emerged as role model. The Kanazawa Institute of Technology doesn't yet have the prestige of Tokyo or Waseda Universities, but it does boast that 99 percent of its students have jobs before graduation—a remarkable statistic in a slow economy. The transformation began more than a decade ago, when KIT officials began sending groups of professors and staffers to major U.S. universities to study how things were done. By the mid-1990s KIT launched a reform plan that emphasized hands-on experiences. At the Factory for Dreams and Ideas, students build projects like a robot that shoots basketballs or a solar-powered car. There are also close ties with Japanese industry, an important source of additional funding. The school has launched its own company to commercialize its research and development."

University Rankings in Japan (2013)

by The *Asahi Shimbun* (Newspaper)

- Ranking 754 universities and colleges in Japan in various categories

- KIT was voted by university and college presidents as the most distinguished institution
  - In Education 1^{st} (8 years in a row)
  - In Research 25^{th}
  - Total 2nd

Who?

金沢工業大学 科学技術応用倫理研究所
Kanazawa Institute of Technology
Applied Ethics Center for Engineering and Science

- ACES (Applied Ethics Center for Engineering and Science)
  - Established in 1997
  - 14 members
  - Visiting Research Fellows from various countries
  - Characteristics: industry-university cooperation, trans-disciplinary, international, education-oriented

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The importance of ethics is widely recognized in engineering education

- CDIO Syllabus V. 2.0

  2.5 ETHICS, EQUITY AND OTHER RESPONSIBILITIES

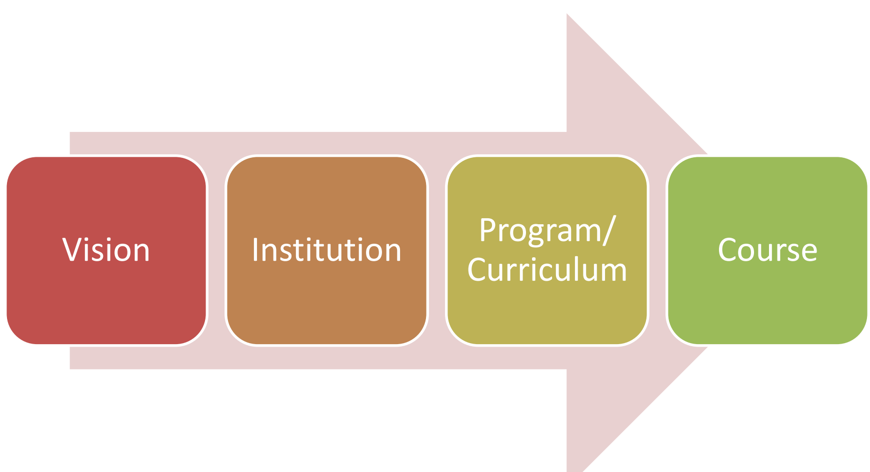
  2.5.1 Ethics, Integrity and Social Responsibility
  2.5.2 Professional Behavior
  2.5.3 Proactive Vision and Intention in Life
  2.5.4 Staying Current on the World of Engineering
  2.5.5 Equity and Diversity
  2.5.6 Trust and Loyalty

  - And many other areas

The OECD DeSeCo Project's Framework and Engineering Education

- The key competencies of the DeSeCo Projects are reflected in the recent objectives of engineering education.
- Competency Categories 2 & 3 are included in a broader sense
  - Category 2: Interacting in Heterogeneous Groups
  - Category 3: Acting Autonomously

Four Levels of Educational Objectives



Competency Categories 2 & 3

- Category 2: Interacting in Heterogeneous Groups
  - 2-A The ability to relate well to others
  - 2-B The ability to cooperate
  - 2-C The ability to manage and resolve conflicts
- Category 3: Acting Autonomously
  - 3-A The ability to act within the big picture
  - 3-B The ability to form and conduct life plans and personal projects
  - 3-C The ability to assert rights, interests, limits and needs

Source: OECD, *THE DEFINITION AND SELECTION OF KEY COMPETENCIES Executive Summary* (2005)

Examples that the competency requires 1

- The capacity to make decisions that allow for different shades of opinion (2-A)
- Analyse the issues and interests at stake, the origins of the conflict and the reasoning of all sides, recognising that there are different possible positions (2-C)
- Identify the direct and indirect consequences of their actions (3-A)
- Choose between different courses of action by reflecting on their potential consequences in relation to individual and shared norms and goals (3-A)

Source: OECD, *THE DEFINITION AND SELECTION OF KEY COMPETENCIES Executive Summary* (2005)

Examples that the competency requires 2

- Balance the resources needed to meet multiple goals (3-B)
- Learn from past actions, projecting future outcomes (3-B)
- Know written rules and principles on which to base a case (3-C)
- Construct arguments in order to have needs and rights recognised (3-C)
- Suggest arrangements or alternative solutions (3-C)

Source: OECD, *THE DEFINITION AND SELECTION OF KEY COMPETENCIES Executive Summary* (2005)

"Going beyond the either-or: An illustration of reflectiveness"

"The ability to deal with differences and contradictions is found on many lists of key competencies within the economic and educational sector. Today's diverse and complex world demands that we do not necessarily rush to a single answer, to an either-or solution, but rather handle tensions … by integrating seemingly contradictory or incompatible goals as aspects of the same reality. Thus, individuals have to learn to think and act in a more integrated way, taking into account the manifold interconnections and interrelations between positions or ideas that may appear contradictory, but that may sometimes only superficially be so."

Source: OECD, *THE DEFINITION AND SELECTION OF KEY COMPETENCIES Executive Summary* (2005)

"Vision Level" examples for Engineering Education

- The UNESCO Four Pillars of Learning (1996)
- Engineering Criteria 2000 (1999) <ABET>
- *The Engineers of 2020* (2004) <NAE>
- The European Qualification Framework Standards for Lifelong Learning (EQF) (2008)
- EUR-ACE Framework Standards for the Accreditation of Engineering Programmes (2008)
- Graduate Attributes and Professional Competencies (2009) <International Engineering Alliance>
- Accreditation Criteria and Procedures (2010) <Canadian Engineering Accreditation Board>
- JABEE Accreditation Criteria for 2012 (2011)
- The CDIO Syllabus version 2.0 (2011)

The UNESCO Four Pillars of Learning

Learning to Know	Learning to Do	Learning to Live Together	Learning to Be

Source: UNESCO, *Learning: The treasure within* (1996) <or the Report of the Delors Commission on Education for the 21st Century>

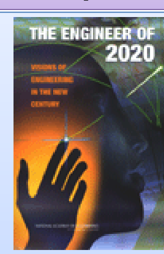
Learning to be

"At its very first meeting, the Commission powerfully re-asserted a fundamental principle: education should contribute to every person's complete development - mind and body, intelligence, sensitivity, aesthetic appreciation and spirituality. All people should receive in their childhood and youth an education that equips them to develop their own independent, critical way of thinking and judgement so that they can make up their own minds on the best courses of action in the different circumstances in their lives."

Source: http://www.unesco.org/delors/ltobe.htm

The Engineer of 2020

(National Academy of Engineering, 2004)



- Attributes of the engineer of 2020
  - Analytical skills
  - Practical ingenuity
  - Creativity
  - Communication skills
  - Mastery of the principles of business and management
  - Leadership
  - High ethical standards and a strong sense of professionalism
  - Dynamism, agility, resilience, and flexibility
  - Lifelong learning

The Engineer of 2020
(National Academy of Engineering, 2004)

- What attributes will the engineer of 2020 have?

  "He or she will aspire to have the ingenuity of Lillian Gilbreth, the problem-solving capabilities of Gordon Moore, the scientific insight of Albert Einstein, the creativity of Pablo Picasso, the determination of the Wright brothers, the leadership abilities of Bill Gates, the conscience of Eleanor Roosevelt, the vision of Martin Luther King, and the curiosity and wonder of our grandchildren." (p. 57)

ABET Engineering Criteria 2010-2012

Engineering programs must demonstrate that their graduates have

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

ABET Engineering Criteria 2010-2012

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, societal and environmental context

(i) a recognition of the need for, and an ability to engage in, life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Canadian Engineering Accreditation Board's Criteria

3.1.1. Knowledge Base for Engineering

3.1.2. Problem Analysis

3.1.3. Investigation

3.1.4. Design

3.1.5. Use of Engineering Tools

3.1.6. Individual and Team Work

3.1.7. Communication Skills

3.1.8. Professionalism

3.1.9. Impact of Engineering on Society and the Environment

3.1.10. Ethics and Equity

3.1.11. Economics and Project Management

3.1.12. Life-Long Learning

JABEE Accreditation Criteria （2011）

(a) An ability of multidimensional thinking with knowledge from global perspective

(b) An ability of understanding of effects and impact of professional activities on society and nature, and of professionals' social responsibility

(c) Knowledge of and ability to apply mathematics and natural sciences

(d) Knowledge of the related professional fields, and ability to apply

(e) Design ability to respond to requirements of the society by utilizing various sciences, technologies and information

(f) Communication skills including logical writing, presentation and debating

(g) An ability of independent and life-long learning

(h) An ability to manage and accomplish tasks systematically under given constraints

(i) An ability to work in a team

「認定基準」の解説（2011）

(a) 地球的視点から多面的に物事を考える能力とその素養

この項目は、物質中心の社会から精神的価値を重視した社会への変革や持続可能な社会の構築を担い、国際的にも活躍できる自立した人材に必要な教養と思考力を示している。個別基準に定める次の内容も参考にして、具体的な学習・教育到達目標が設定されていることが求められる。

・人類のさまざまな文化、社会と自然に関する知識

・それに基づいて、適切に行動する能力

「認定基準」の解説(2011)

(b) 技術が社会や自然に及ぼす影響や効果、及び技術者が社会に対して負っている責任に関する理解

この項目は、技術者倫理、すなわち、技術と自然や社会などとの係わり合いと技術者の社会的な責任の理解を示している。技術史についての理解を含めるのもよい。また、技術と自然や社会との係わり合いを特定分野について理解させるのでも差し支えない。自立した技術者として必要な責任ある判断と行動の準備をさせることが重要であり、多くの機会を捉えて学生に自ら考えさせることによって得られる実践的な倫理についての理解が求められる。個別基準に定める次の内容も参考にして、具体的な学習・教育到達目標が設定されていることが求められる。

・当該分野の技術が公共の福祉に与える影響の理解

・当該分野の技術が、環境保全と社会の持続ある発展にどのように関与するかの理解

・技術者が持つべき倫理の理解

・上記の理解に基づいて行動する能力

International Engineering Alliance

"Engineering is an activity that is essential to meeting the needs of people, economic development and the provision of services to society. Engineering involves the purposeful application of mathematical and natural sciences and a body of engineering knowledge, technology and techniques. Engineering seeks to produce solutions whose effects are predicted to the greatest degree possible in often uncertain contexts. While bringing benefits, engineering activity has potential adverse consequences. Engineering therefore must be carried out responsibly and ethically, use available resources efficiently, be economic, safeguard health and safety, be environmentally sound and sustainable and generally manage risks throughout the entire lifecycle of a system."

Source: International Engineering Alliance, "Graduate Attributes and Professional Competencies Version 2, "18 June 2009

International Engineering Alliance

- Knowledge Profile (8)

  "comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability"
- Graduate Attribute Profiles (12)
- Professional Competency Profile (13)

Source: International Engineering Alliance, "Graduate Attributes and Professional Competencies Version 2, "18 June 2009

International Engineering Alliance Graduate Attribute Profile

1. Engineering Knowledge
2. Problem Analysis
3. Design/development of solution
4. Investigation
5. Modern Tool Usage
6. The Engineer and Society
7. Environment and Sustainability
8. Ethics
9. Individual and Team Work
10. Communication
11. Project Management and Finance
12. Life long Learning

Source: International Engineering Alliance, "Graduate Attributes and Professional Competencies Version 2, "18 June 2009

International Engineering Alliance Graduate Attribute Profile (Ethics related)

6. The Engineer and Society

Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

7. Environment and Sustainability

Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

8. Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

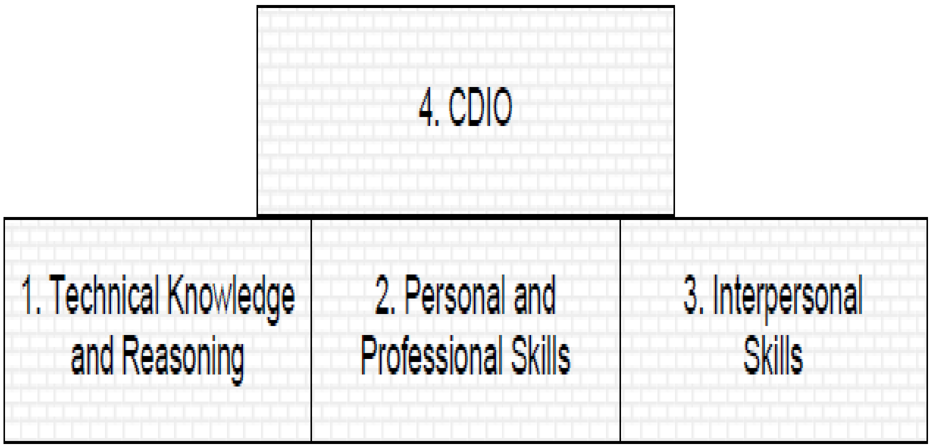
Source: International Engineering Alliance, "Graduate Attributes and Professional Competencies Version 2, "18 June 2009

CDIO Premise

"Graduating engineers should be able to conceive-design-implement-operate complex value-added engineering systems in a modern team-based environment."

Source: E. Crawley, et al., "The CDIO Syllabus Ver. 2.0," <http://www.cdio.org/framework-benefits/cdio-syllabus>

CDIO Building Brocks



Source: E. Crawley, et al., “The CDIO Syllabus Ver. 2.0,” <http://www.cdio.org/framework-benefits/cdio-syllabus>

CDIO Syllabus ver. 2.0 at the Second Level of Detail (Underlined Text is Updated from v1.0)

1 DISCIPLINARY KNOWLEDGE AND REASONING
- 1.1 KNOWLEDGE OF UNDERLYING MATHEMATICS AND SCIENCE
- 1.2 CORE FUNDAMENTAL KNOWLEDGE OF ENGINEERING
- 1.3 ADVANCED ENGINEERING FUNDAMENTAL KNOWLEDGE, METHODS AND TOOLS

2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES
- 2.1 ANALYTICAL REASONING AND PROBLEM SOLVING
- 2.2 EXPERIMENTATION, INVESTIGATION AND KNOWLEDGE DISCOVERY
- 2.3 SYSTEM THINKING
- 2.4 ATTITUDES, THOUGH AND LEARNING
- 2.5 ETHICS, EQUITY AND OTHER RESPONSIBILITIES

3 INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION
- 3.1 TEAMWORK
- 3.2 COMMUNICATIONS
- 3.3 COMMUNICATIONS IN FOREIGN LANGUAGES

4 CONCEIVING, DESIGNING, IMPLEMENTING, AND OPERATING SYSTEMS IN THE ENTERPRISE, SOCIETAL AND ENVIRONMENTAL CONTEXT
- 4.1 EXTERNAL, SOCIETAL AND ENVIRONMENTAL CONTEXT
- 4.2 ENTERPRISE AND BUSINESS CONTEXT
- 4.3 CONCEIVING, SYSTEMS ENGINEERING AND MANAGEMENT
- 4.4 DESIGNING
- 4.5 IMPLEMENTING
- 4.6 OPERATING

Source: E. Crawley, et al., “The CDIO Syllabus Ver. 2.0,” <http://www.cdio.org/framework-benefits/cdio-syllabus>

CDIO Syllabus ver. 2.0
Correlated with ABET EC 2010 Criterion 3

CDIO Syllabus	ABET EC2010 Criterion 3										
	a	b	c	d	e	f	g	h	i	j	k
1.1 Knowledge of Underlying Mathematics, Science	■										
1.2 Core Engineering Fundamental Knowledge	■										
1.3 Adv. Engr. Fund. Knowledge, Methods, Tools	▒										■
2.1 Analytical Reasoning and Problem Solving					■						▒
2.2 Exper., Investigation and Knowledge Discovery		■									
2.3 System Thinking			▒								
2.4 Attitudes, Thought and Learning									■		
2.5 Ethics, Equity and Other Responsibilities						■					▒
3.1 Teamwork				■							
3.2 Communications							■				
3.3 Communication in Foreign Languages											
4.1 External, Societal and Environmental Context			▒					■		■	
4.2 Enterprise and Business Context			▒					■			
4.3 Conceiving, Systems Engr. and Management			■								
4.4 Designing			■								
4.5 Implementing			▒								
4.6 Operating			▒								

■ Strong Correlation ▒ Good Correlation

Source: E. Crawley, et al., "The CDIO Syllabus Ver. 2.0," <http://www.cdio.org/framework-benefits/cdio-syllabus>

CDIO Syllabus ver. 2.0
at the Third Level of Detail
(Broadly Ethics Related)

2.4 ATTITUDES, THOUGHT AND LEARNING
- 2.4.1 Initiative and the Willingness to Make Decisions in the Face of Uncertainty
- 2.4.2 Perseverance, Urgency and Will to Deliver, Resourcefulness and Flexibility
- 2.4.3 Creative Thinking
- 2.4.4 Critical Thinking
- 2.4.5 Self-awareness, Metacognition and Knowledge Integration
- 2.4.6 Lifelong Learning and Educating
- 2.4.7 Time and Resource Management

2.5 ETHICS, EQUITY AND OTHER RESPONSIBILITIES
- 2.5.1 Ethics, Integrity and Social Responsibility
- 2.5.2 Professional Behavior
- 2.5.3 Proactive Vision and Intention in Life
- 2.5.4 Staying Current on the World of Engineering
- 2.5.5 Equity and Diversity
- 2.5.6 Trust and Loyalty

4.1 EXTERNAL, SOCIETAL, AND ENVIRONMENTAL CONTEXT
- 4.1.1 Roles and Responsibility of Engineers
- 4.1.2 The Impact of Engineering on Society and the Environment
- 4.1.3 Society's Regulation of Engineering
- 4.1.4 The Historical and Cultural Context
- 4.1.5 Contemporary Issues and Values
- 4.1.6 Developing a Global Perspective
- 4.1.7 Sustainability and the Need for Sustainable Development

4.2 ENTERPRISE AND BUSINESS CONTEXT
- 4.2.1 Appreciating Different Enterprise Cultures
- 4.2.2 Enterprise Stakeholders, Strategy and Goals
- 4.2.3 Technical Entrepreneurship
- 4.2.4 Working in Organizations
- 4.2.5 Working in International Organizations
- 4.2.6 New Technology Development and Assessment

Source: E. Crawley, et al., "The CDIO Syllabus Ver. 2.0," <http://www.cdio.org/framework-benefits/cdio-syllabus>

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Obstacles Seen by Japanese Engineering Educators in Implementing Engineering Ethics Education

- Lack of time
- Lack of human resources
- Lack of teaching materials
- Lack of interest (administration/colleagues/students)
- Constraints in curricula

KIT's Founding Principles

- To create well-rounded citizens with good character
- To be innovative
- To promote industry-university collaboration

KIT's Institutional Objective

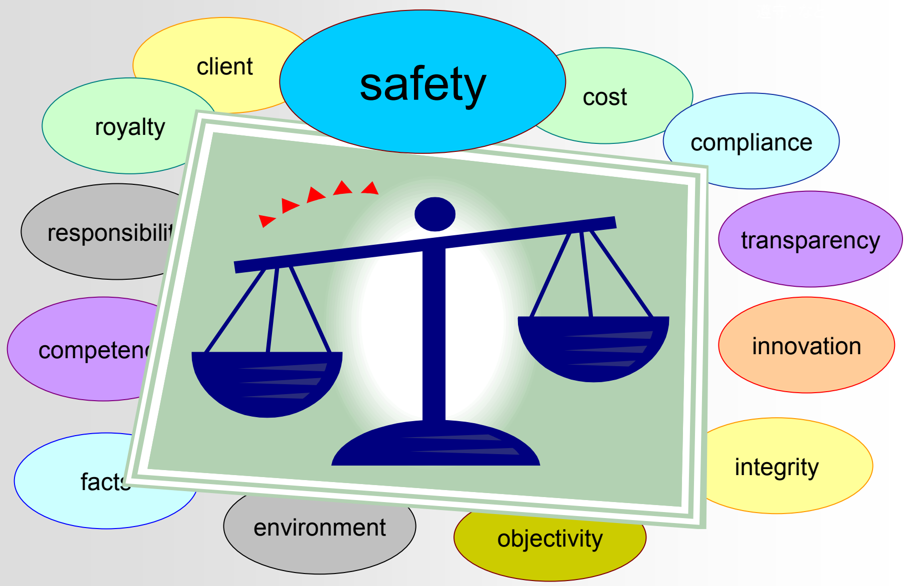
To Foster Engineers Who Can
Think for Themselves,
Make Wise Decisions, and
Act on Them
(for the Benefit of Mankind)

What kind of action?

- “Ethics is the science of conduct.” (Oliver A. Johnson)

- Engineering ethics education is to make students share values which are considered important for engineering practice, such as safety, health, and well-being of the public.

Engineering Ethics is to Balance Values



Value Statement: KIT IDEALS

K Kindness of Heart (思いやりの心)
私たちは［素直、感謝、謙虚］の心を持つことに努め、明るく公正な学びの場を実現します。

I Intellectual Curiosity (知的好奇心)
私たちは［情熱、自信、信念］を持つことに努め、精気に満ちた学びの場を実現します。

T Team Spirit (共同と共創の精神)
私たちは［主体性、独創性、柔軟性］を持つことに努め、共同と共創による絶えざる改革を進め、前進します。

I Integrity (誠実)
私たちは、誠実であることを大切にし、共に学ぶ喜びを実現します。

D Diligence (勤勉)
私たちは、勤勉であることを大切にし、自らの向上に努力する人を応援します。

E Energy (活力)
私たちは、活動的であることを大切にし、達成や発見の喜びを実現します。

A Autonomy (自律)
私たちは、自律することを大切にし、1人ひとりを信頼し、尊敬します。

L Leadership (リーダーシップ)
私たちは、チームワークを大切にし、自分の役割における自覚と責任を持ちます。

S Self-Realization (自己実現)
私たちは、自らが目標を持つことを大切にし、失敗に臆することなくさらに高い目標に挑戦することに努めます。

Ethics across the Curriculum?

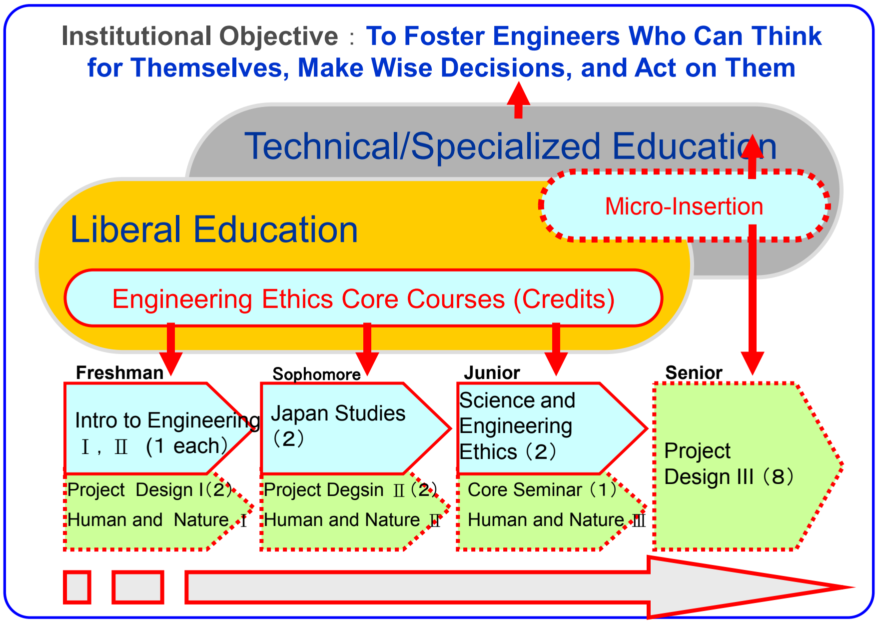
A pedagogical approach to provide opportunities to learn and contemplate ethical issues throughout students' learning experiences (including technical courses) at a particular institution.

What needed to implement an EAC program?

- Institution-wide educational objectives
- Institutional support
- Faculty Buy-in
- Faculty Development
- "Micro-insertion" (Michael Davis)

EAC at KIT Started with the Class of 2008

- Three core courses
  - "Introduction to Engineering I/II/III" (3 1-credit courses)
  - "Japan Studies" (2 credits)
  - "Science and Engineering Ethics" (2 credits)
- Engineering Design Courses
  - "Project Design I/II"
  - "Core Seminar"
  - "Project Design III"
- "Human and Nature I/II/III"
- Plus micro-insertion in technical courses



Engineering Ethics Education at KIT

49

Outline

1. Introduction
2. Ethics across the curriculum
3. **The required "SCIENCE AND ENGINEERING ETHICS" course for junior-standing students**
4. The "Agora" e-learning system
5. Characteristics of the ethics across the curriculum at KIT and how it can be of assistance to the CDIO collaborators

Basics of the core course

- Required for all junior-standing students (about 1,500 students per year/750 per semester/50 per class)
- Six full-time faculty members
- Using the same syllabus and educational materials (including exams)
- The same assessment and evaluation methods

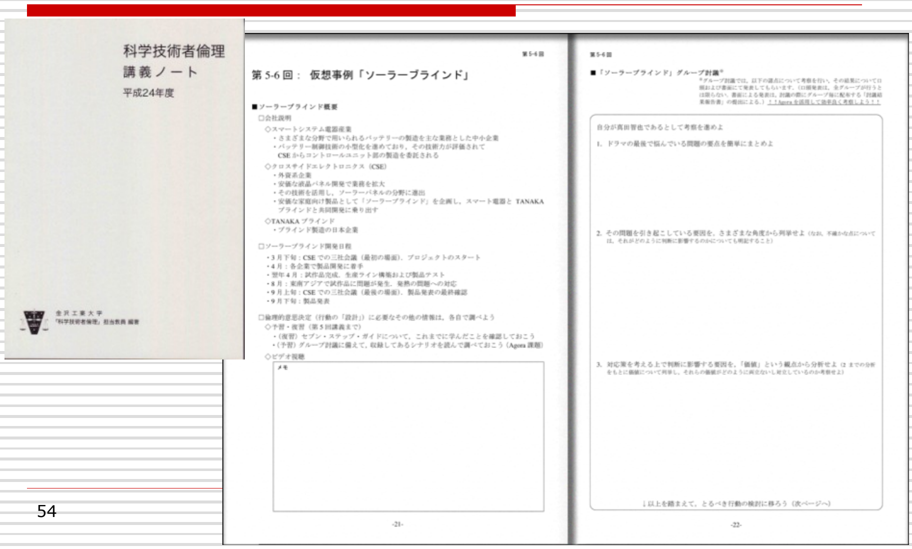
Basics of the Core Course

- Class meets twice a week for 45 minutes each for 16 weeks
- 31-32 class meetings in a semester including a final exam and a "self-assessment session"
- Textbook and Supplements: Jun Fudano et al., *Engineering Ethics*; Caroline Whitbeck, *Ethics in Engineering Practice and Research* (First four chapters translated into Japanese) and printed "Lecture Notes" based on class presentation materials

Textbook written by Fudano et al. for a course of the Open University of Japan

53

Lecture Note (revised every year)



54

Performance Criteria

1. To be able to identify ethical issues which might be encountered in engineering practice and research and to explain their types with some concrete examples
2. To be able to convince others that engineers must have ethical imagination, skills in identifying and analyzing ethical issues, and willingness to improve sense of responsibility
3. To be able to demonstrate sound knowledge on the codes of ethics of relevant engineering societies and to explain "values," such as safety, in those codes

Performance Criteria

4 To virtually experience ethical dilemmas in class and to be able to explain what he/she learns in solving the dilemma, relating it to his/her own experience and thoughts, in a reflective essay

5 To understand how to use various methods to solve ethical problems such as ethics tests and the seven-step guide and to be able to apply those methods in concrete cases

6 To understand and evaluate educational objectives of this course and relate them to the mission, goals, and educational objectives of his/her program, department, college, and KIT as a whole

Educational Methods in the Course

1. Lectures
2. Case studies and analysis and discussion using the case method
3. Assignments (a lot by the Japanese standard)
4. A hybrid-style e-learning using the "Agora"

Ethics cases addressed in the course

1. The "Hyakumangoku Road Race" (a hypothetical mini case)
2. The Space Shuttle Challenger case
3. The "Solar Blind" (a hypothetical case written by KIT students and filmed by a professional movie maker)
4. The "Gilbane Gold" (by the National Society of Professional Engineers)
5. Contemporary and field-specific cases

Assessment and Evaluation of Learning Outcomes in the Course

Comprehensive evaluation with many types of assignment tools

1. Individual case analysis reports with the Agora e-learning program (3 cases)
2. Reports on problem solutions by group case discussions (3 times)
3. Class discussion participation (peer evaluation)
4. Report on codes of ethics
5. Report on a business ethics program
6. Written exam with case analysis (final)
7. Others (including self-reflection)

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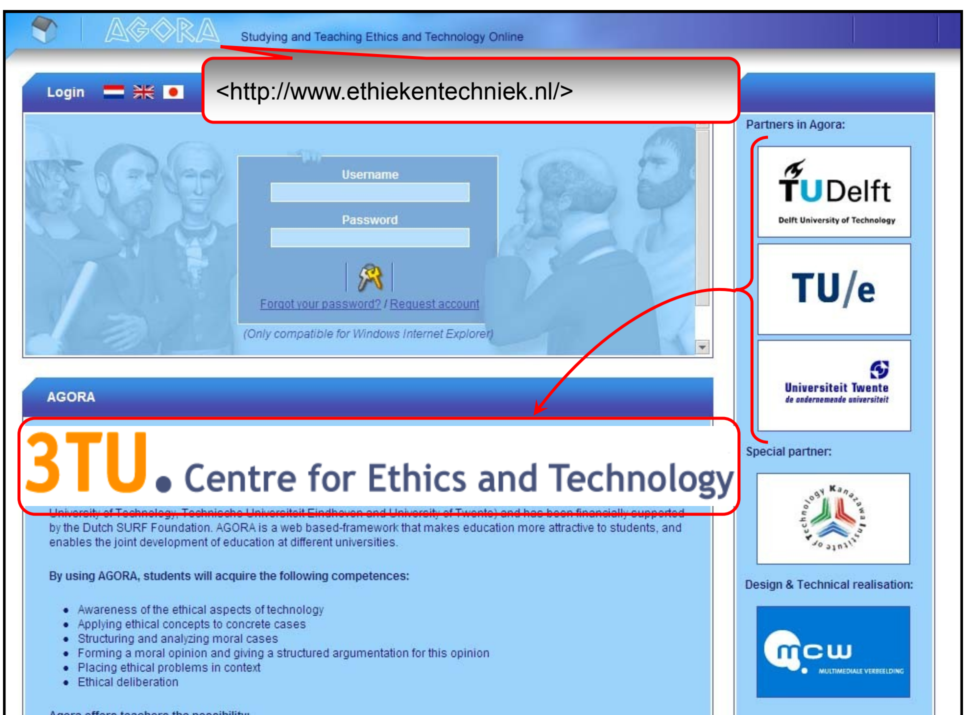
What is Agora?

- An e-learning system for science and engineering ethics education
  - Web-based
    - Access via Internet (IE on Windows)
    - <http://www.ethiekentechniek.nl/>
  - Developed by three Dutch technical universities
  - Operated by 3 TU Centre for Ethics and Technology

TU Delft — Delft University of Technology | TU/e | Universiteit Twente — de ondernemende universiteit

3TU. Centre for Ethics and Technology

61



Structured analyses of cases

- Without structured analyses, students tend to
  - Recognize a case as either-or situation
  - Jump into a conclusion intuitively
- Structured (step-by-step) analyses of cases can help students make better ethical reasoning

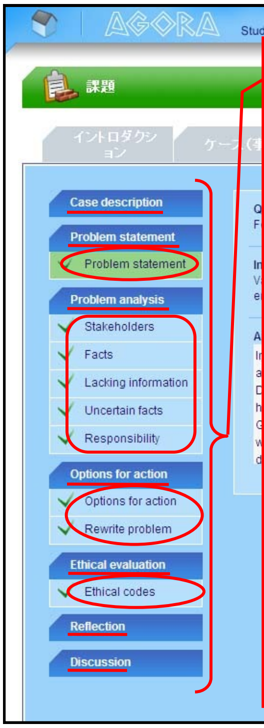
The analysis structure in Agora?

- Seven step※ analysis

≒The Seven-step Guide proposed by Michael Davis

1) Case description: to grasp the case
2) Problem statement: to state problem (step 1)
3) Problem analysis: to check facts (step 2), and to identify relevant factors (step 3)
4) Options for action: to develop list of options (step 4)
5) Ethical evaluation: to test options (step 5), and to make a tentative choice (step 6)
6) Reflection: to review the previous steps for ethical reflection (step 7)
7) Discussion: to discuss among students / participants

※Some steps consist of a few sub-steps



The Analysis Structure in Agora

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6) **Reflection**: to review the previous steps for ethical reflection (step 7)
7) **Discussion**: to discuss among students / participants

Hybrid e-learning with the Agora

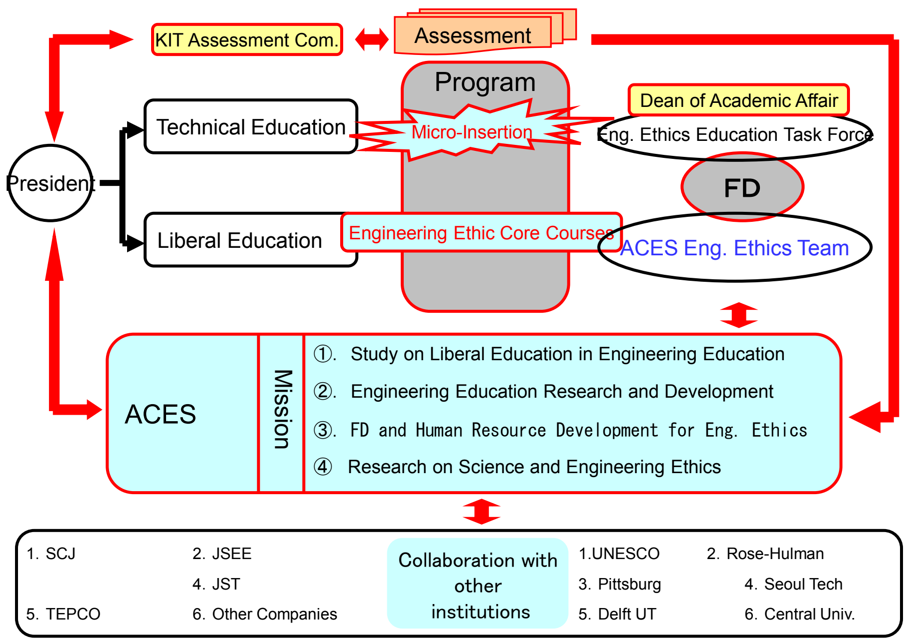
1. Case analysis by individual student using the Agora
2. Group discussion for problem-solving
3. Group report and presentation
4. Class discussion
5. Individual Report using the Agora

Outline

1. Introduction
2. Ethics in the Formation of Engineers
3. Ethics across the curriculum at KIT
4. The required "Science and Engineering Ethics" course for junior-standing students
5. The "Agora" e-learning system
6. Characteristics of the ethics across the curriculum at KIT

Characteristics of the EAC program at KIT

- University-wide effort (considered as part of liberal education as well as of technical education) coordinated by ACES
- Combination of top-down and bottom-up approaches
- Strong emphasis on business environment and ethics in Japan
- Transportable to other institutions (including those in other countries)



Organizational Structure

78

Concluding Remarks

- KIT's EAC is probably one of the most extensive programs in the world in terms of size (and, we hope, quality).
- Various educational materials and tools have been developed, tested, and implemented; and they are working
- However, there are still various sorts of challenge, especially program and learning outcomes assessment, and the further involvement of engineering faculty members

Thus,

- We, the members of ACES at KIT as well as of the Engineering Ethics Committee of JSEE, are looking forward to working together with our Taiwanese colleagues for further development of engineering education and key competency building for our two countries.

Contact and Acknowledgements

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