IIT KHARAGPUR

NPTEL ONLINE
CERTIFICATION COURSES

Ethics in Engineering Practice

Lecture No 31 : Key Questions pertaining to Ethical conduct for Engineers

DR. SUSMITA MUKHOPADHAYAY
VINOD GUPTA SCHOOL OF MANAGEMENT
IIT KHARAGPUR

Key questions answered in the module

❖ What makes a good engineer and good engineering? What values underlie engineering practice today? Which of those values are specifically ethical values? What is the experience of living by those values and working in a society and in organizations that trust you to practice those values? How do these values reflect and affect the person you are and the person you become by practicing them?

❖What are the two key values that lie Engineering practices today?

❖ How, if at all, do you understand religious and ethical values to be related?

❖How can we tackle ethical subjectivism?

Continued

❖What kinds of considerations are relevant to judging an act or course of action morally justified or unjustified?

❖Understanding Justification and examples of lying

Source: These questions and answers have been drawn from Ethics in Engineering Practice and Resercah, Caroline Whitback, Cambridge University.

Key Question 3

How, if at all, do you understand religious and ethical values to be related?

Most existing religions, and all major world religions, uphold ethical as well as religious standards.

These ethical standards apply to moral agents – to their character traits, motives, or actions.

Religions vary somewhat in their relative emphasis on such matters as spiritual and moral virtues of individuals, a particular kind of family structure, and the faith or practice of a nation, religion, or congregation as a whole.

Religions often offer guidance to their members about what they as individuals are particularly called to do.

Key Question 4

How can we handle Ethical subjectivism?

Meaning of Ethical subjectivism

"Ethical subjectivism holds that whether a certain act is right or wrong in a given situation is determined by whether the agent performing that act believes the act is right or wrong"

This view represents ethics as lacking in objective standards, because all that matters is what the agent believes, without consideration of whether those beliefs are well founded or not, can be considered right.

Continued

How can we tackle this problem?

Code of this as the solution?

Or Theories can be used as a way to resolve them?

- ✓ - **Utilitarianism**
- ✓ - **Duty Ethics**
- ✓ - **Rights Ethics**
- ✓ - **Virtue Ethics**

Key Question 5

What kinds of considerations are relevant to judging an act or course of action morally justified or unjustified?

Meaning of Ethical judgments

Ethical judgments - judgments about what is right or wrong, ethically good or bad, or what one ought or ought not do, need the support of justifying reasons.

Any judgment, even a judgment about how fast something is moving, needs the support of reasons/evidence.

Availability of explicit reasons or identifiable evidence is what distinguishes judgments (ethical or other) from the operation of intuition.

Intuition vs. Ethical justification

Intuition is the ability to immediately recognize what is going on in a situation.

There need not be anything mysterious about intuition; it may result from training or experience. The ability to recognize something without being able to articulate the basis for one's recognition is familiar in everyday life.

On the other hand, Ethical justification, that is, reasons/evidence or argument to demonstrate that something is ethically acceptable or desirable is necessary to support any ethical value judgment.

Ethical evaluation is a judgment about the extent to which the object of the evaluation is good or bad, ethically speaking.

Continued

A variety of criteria are relevant to the ethical evaluation of an act or course of action. A reasoned judgment about whether (or the extent to which) some act (or course of action) is morally justified will mention some or all of the following:

- The act produces good or bad consequences
- It respects or violates rights
- It fulfills or shirks obligations
- It honors or ignores agreements and promises

Continued

- The act displays or fosters the development of positive (ethical or other) character traits (virtues) or negative ones (vices). (The consequences upon people's character are generally considered separately from consideration of other sorts of consequences)

Now it is your job to decide which side of the statement in a given situation or an event will make an act morally justified?

Key Question 5

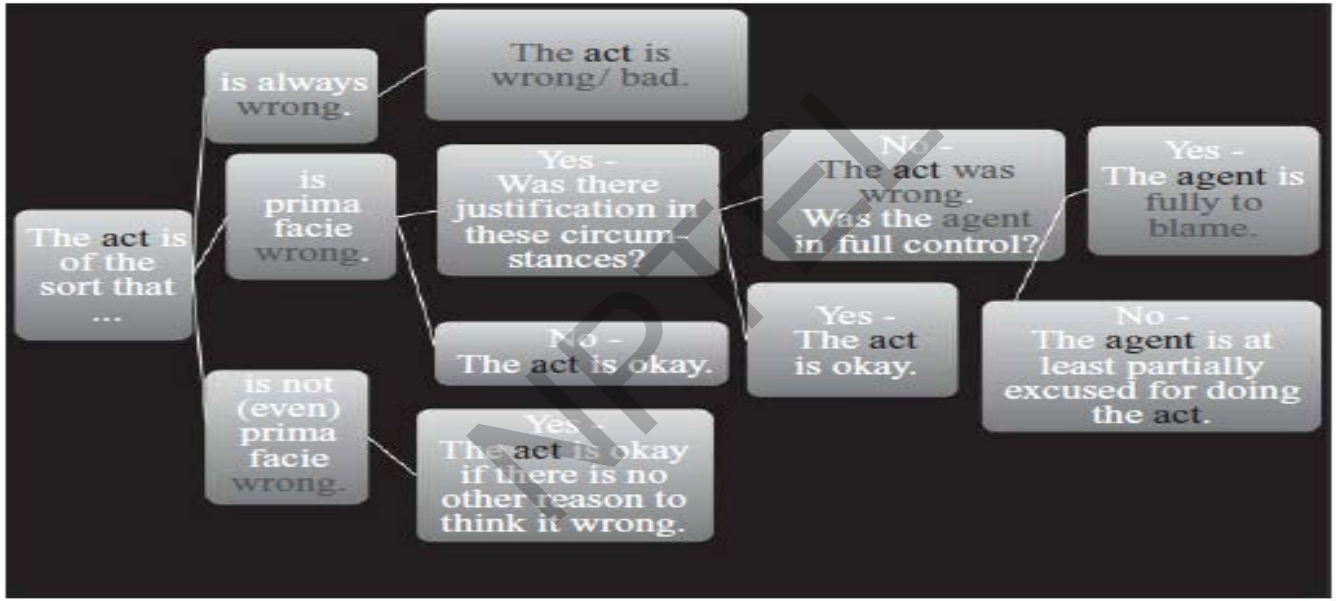
What do we understand by Justifications and Excuses for Lying?

What is your stake on the situation

Suppose you are helping to install some equipment. You are to install one component by yourself. Afterward you are criticized for the way you installed it. Which of the following responses are excuses, which are justifications, and which are something else? Give reasons for your answers.

_ I was given the assignment late in the day and told to finish by 5. There wasn't time to do it
any other way.
_ That is what the building/safety code required.
_ This was my first time, so I made a few mistakes.
_ If you don't like it, do it yourself next time.

Continued



Justifying Acts Contrasted with Excusing the Agents Who Perform Them

Thank You!!

Ethics in Engineering Practice

Lecture No (32-33) : Key Questions pertaining to Central Professional Responsibilities of Engineers

DR. SUSMITA MUKHOPADHAYAY
VINOD GUPTA SCHOOL OF MANAGEMENT
IIT KHARAGPUR

Key questions answered in the module

❖ What characteristics or behavior on the part of the professionals on whose work your own welfare depends would qualify them as trustworthy?

❖What is the relationship between an engineer's professional responsibilities and the duties delineated in the job description for that engineer's position?

❖What is trust? What is the relationship between being a responsible professional and being a trustworthy professional?

❖Is there an emerging consensus on the responsibility for safety among engineers?

Continued

- Why are bugs and glitches more commonly the focus of attention for software and computer professionals, rather than safety problems per se?

- What, beyond having the knowledge of a likely safety hazard, does an engineer need to get the hazard reduced or eliminated?

Key Question 1

What characteristics or behavior on the part of the professionals on whose work your own welfare depends would qualify them as trustworthy?

Introduction

In today's era of specialized knowledge, we all must depend on professionals for our safety, health, and well-being.

What we expect from professionals like engineers is that they use their knowledge and skills and exercise their professional judgment to assure the best of outcomes in situations.

Two things that serve as benchmarks for qualifying them as trustworthy relates to;

Exercising moral judgment and Taking moral responsibility and professional responsibility of the outcomes

Continued

Exercising professional judgment

This requires taking into account a range of factors, marshaling relevant parts of the body of knowledge specific to one's profession, and devising a course of action that achieves a good (or even "the best") outcome in the circumstances.

Taking moral responsibility and professional responsibility of the outcomes

In simple words, the crux of it lies in considering many potentially competing factors that might influence the outcome in that particular situation.

Lets read this case

An Exemplary Professional Response: Landing a Disabled Plane

A handy example of someone who succeeded in taking account of a wide range of relevant factors in the situation and provided an exceptionally *good* outcome is the pilot, Chesley "Sully" Sullenberger, who landed his disabled Airbus A320 airplane in the Hudson River with no loss of life.

The basic facts of the case are that within *90 seconds* after takeoff on January 15, 2009, US Air flight 1549 collided with a flock of birds. That collision disabled *both* of the plane's engines. Captain Sullenberger then took over the flight controls from the copilot, who had been at the helm and who then turned his attention to the complex task of trying to restart the engines.

Sullenberger's judgment under pressure has been consistently praised. Some commentators have pointed out the extensive training that pilots receive. The unique features of the situation, including the location of the plane, could not have been joint features of any of the pilot's training situations, however.

Sullenberger's experience is commonly mentioned. His familiarity in making a host of previous flight decisions would have been an asset to him in noticing and promptly taking account of relevant features of his situation. Not only did he need to decide whether there was time to return to the airport from which he had taken off (or reach another) or to risk ditching the plane in the river but also how to go about landing in the river in a way that made it possible to evacuate the plane. To accomplish this he had to maneuver the plane so that it would float for at least a few minutes. He also chose a location in the river close to an active ferry terminal, where boats could quickly reach the plane and remove its passengers and crew before the plane's wings sank.

Sullenberger demonstrated many virtues, including courage, steadfastness, and what, following Aristotle, is called "practical wisdom" in this emergency. Unlike a test pilot, Sullenberger did not have an ejection seat, so he could not have ejected himself from the aircraft to save only himself. Therefore, acting in the interests of others coincided with his interests in handling the crash. He exited the plane last, however.

Continued

The case on the previous slide as an example illustrates the development of judgment to which education in the ethics of a profession such as engineering is intended to contribute. In this case, Captain Sullenberger exercised professional judgment that brought together his theoretical and practical knowledge as a pilot to bear on the unique circumstances that faced him. His first professional responsibility was for the safety of those on board. His goal was to save their lives, a goal that he achieved.

Key Question 2

What is the relationship between an engineer's professional responsibilities and the duties delineated in the job description for that engineer's position?

Understanding Moral and Professional Responsibilities

Moral responsibility for something means that the person must exercise judgment and care to achieve or maintain a desirable state of affairs with regard to whatever is in that person's care.

For example, accountants are responsible for the accuracy of financial reports, physicians are responsible for health outcome (and certain aspects of public health), and engineers are responsible for safety and performance in the design, manufacture, and operation of technology.

Professional responsibility is the most familiar type of moral responsibility that arises from the special knowledge a person possesses.

Continued

Mastery of a body of advanced knowledge, especially knowledge that bears directly on the wellbeing of others, distinguishes professions from other occupations.

Although some moral demands on professionals are adequately expressible in rules of conduct that specify what acts are permissible, obligatory, or prohibited, there is more to acting responsibly.

Continued

A good consulting engineer not only shuns bribery, checks plans before signing off on them, and the like but also must exercise judgment and discretion to provide a design or product that is safe and of high quality. Moral agents in general and professionals in particular must decide what to do to best achieve good outcomes in matters entrusted to their care.

The difference between moral responsibility and official responsibility relates to the fact that official responsibility is clearly stated to someone by communicating, what they are supposed to do in their job. The description of a job or office specifies official responsibilities

Continued

On the other hand, moral responsibility does not reduce to official responsibility.

Some official responsibility or obligation may even be immoral. “I was just doing my job” or “I was just doing what I was told” is not a generally valid excuse for unethical behavior of an adult.

Understanding the essence of going beyond official responsibilities through a small case

Case

The Responsibility for Safety and the Obligation to Preserve Client Confidentiality

Tenants of an apartment building, annoyed by many building defects, sue the owners to force them to repair those defects. The owner's attorney hires Lyle, a structural engineer, to inspect the building and testify for the owner. Lyle discovers serious structural problems in the building that are an immediate threat to the tenants' safety. These problems were not mentioned in the tenants' suit. Lyle reports this information to the attorney who tells Lyle to keep this information confidential because it could affect the lawsuit. Lyle complies with the attorney's decision.

Source: Adapted from NSPE Board of Ethical Review (BER) Case 90–5

What, if anything, might Lyle do other than keep this information confidential? Which, if any, of those actions would have better fulfilled Lyle's responsibilities as an engineer?

What other information may be needed to make this decision?

Key Question 2

What is trust? What is the relationship between being a responsible professional and being a trustworthy professional?

What does being trustworthy implies?

For professionals or their professional practice to be trustworthy is a matter of both ethics and competence.

Trustworthy practice requires sustained attention to relevant aspects of others' well-being and the knowledge and wisdom to promote or safeguard that well-being. The well-being of many parties may be at stake in a given situation. It is important to consider all of them and, as far as possible, promote the well-being of all.

What would a Trustworthy Structural engineer do?

Before giving a green light to any project, a trustworthy structural engineer would check;

• If there is any concern for public safety, public convenience, and environmental protection that would be disturbed because of the project
• Is there any proficiency in structural design or not; an understanding of the characteristics of building materials and their quality
•An understanding of traffic demands viz. a viz. strength of materials required
•An understanding of the environmental implications of the work
•An estimate of the likelihood and severity of earthquakes, hurricanes, and other
•natural threats to the integrity of the bridge

Continued

The engineer might also need to consider such factors as:

Other technologies that might influence the use of the bridge (e.g., the characteristics of any ships or vehicles that might go under the bridge, or collide with its supports)

An estimate of any likely intentional human threats to the bridge (sabotage or terrorism)

Ethical and technical considerations frequently become inextricably intermingled in the exercise of professional discretion and judgment

Understanding it through a small case

Technical Disagreement and Ethical Responsibility

Hilary is an engineer working for the state environmental protection division. Hilary's supervisor, Pat, tells Hilary to quickly draw up a building permit for a power plant and to avoid any delays. Hilary believes that the plans are inadequate to meet clean air regulations, but Pat thinks that these problems are fixable. Hilary considers whether to ask the state engineering registration board about the consequences of issuing a permit that goes against environmental regulations.

What values, obligations, and responsibilities are at stake in Hilary's deliberations about what to do? Should Hilary consult the state registration board? If so, how ought the information from the state board affect Hilary's decision about what to do after that? (Consider all likely responses of the registration board.)

What, if anything, can and should Hilary do if Hilary's department authorizes the building permit over Hilary's objections?

Is there any other information you would like to have to help you answer these questions, and what difference would it make to your assessments?

Source: Adapted from NSPE BER Case 92–4[a]

[a] The NSPE Board of Ethical Review (BER) cases with judgments offered by the BER based on application of the then current NSPE Code of Ethics are available in hard copy in the volumes V–VIII of *Opinions of the Board of Ethical Review*, Alexandria, VA: National Society of Professional Engineers.

Continued

- Moral problems are sometimes treated as questions of whether to do something; the question of how to go about it is then treated as merely pragmatic.

- However, questions about how to do things often raise ethical questions of fairness, and questions of how far to go, say in protecting safety, are at the core of professional responsibility.

Key Question 3

Is there an emerging consensus on the responsibility for safety among engineers?

Introduction

Why would anyone think that engineers have a special responsibility for safety?

Engineering students are often taught that safety is their responsibility.

First make sure the system doesn't do what you don't want it to do – that's the safety issue; then make sure it does do what you want it to do – that's the performance issue." This admonition is remarkably similar to the admonition to physicians: "First, do no harm."

Continued

Emphasis on the engineer's responsibility for safety is also found in the codes of ethics or ethical guidelines of many engineering societies. These codes specify that it is the engineer's responsibility to protect public health and safety. Indeed, five of these societies – American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), American Institute for Chemical Engineering (AIChE), National Society of Professional Engineers (NSPE), and National Council for Engineering Examiners and Surveyors (NCEES) – continue to say in the latest revisions of their codes of ethics:

Engineers, in the fulfillment of their professional duties, shall [h]old paramount the safety, health, and welfare of the public.

What would you do in this case?

Unanticipated Factor, Auto Safety

You are a new engineer working as part of a design team for a large automobile manufacturer. The company is doing a major redesign of one of its product lines.

Your team is responsible for designing part of the frame of the new car. As part of the company's drive to make cars lighter and more efficient, your team is directed to make some of the structural members out of carbon fiber composites. The cross member that holds the rails of the frame apart was ideally suited for composite replacement.

You test several different composite materials and lay-ups, and finally choose one that you have reason to believe will work. Several prototypes of the car are built, which you checked carefully. Your design is then approved and is about to go into production.

Just today you found a problem with your cross member. A few inches of the cross member from a car that was winter tested showed extensive cracking. After looking at the design, you realize that the cracked portion is in proximity to the exhaust system. You conclude the hot pipe in cold weather created thermal stresses and caused cracking.

What can and should you do and how do you go about it?

Source: Adapted from a scenario by Dan Dunn, Chris Minekime, and John Van Houten (MIT '93)

Key Question 5

Why are bugs and glitches more commonly the focus of attention for software and computer professionals, rather than safety problems per se?

An issue of concern for software engineers

The central problem for software engineers (and others who design and test software) is that of creating bug-free software.

Sometimes the bugs clearly threaten human health and safety.

Bugs are especially likely to threaten safety in safety-critical systems, such as traffic control systems, but whether bugs threaten life and limb may depend on other circumstances that have nothing to do with the software and the technology it immediately affects.

Continued

The harms caused by bugs, glitches, and errors vary considerably with the larger system in which the software functions. Thus, threats to safety may be more difficult to predict than the results of mistakes in mechanical or chemical engineering.

The software engineer's central responsibility is therefore best phrased as a responsibility to avoid errors that produce bugs/glitches, rather than to foresee which errors might cause the bugs that will present safety hazards and take special care to prevent those specific errors.

Continued

A Software Bug That Threatened the U.S. Air Force's Superfighters

This example concerns the U.S. Air Force's latest superfighter, the F-22 "Raptor." The Raptors cost more than $300,000,000 each, but for a while, a software bug caused havoc in these pricey planes when they crossed the international dateline. The glitch came to light when, in February 2007, a group of ten Raptors headed across the Pacific for exercises in Japan. These Raptors suffered simultaneous total nav-console crashes as their longitude shifted from 180° west to 180° east. Tanker planes accompanying the raptors had somewhat older navigation kits, so the tanker planes did not experience the same nav-console crashes. The pilots of these tanker planes were able to guide the Raptor pilots back to Hickman Air Force Base in Hawaii. The glitch was fixed later that month and the planes flew to Kadena (see Figure 4.5).[a,b]

Because of the accompanying tanker planes, the software bug wasted time and money, but did not cost lives.

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[a] Page, Lewis. 2007. "US Superfighter Software Glitch Fixed." *The Register*, February 28 (accessed at http://www.theregister.com/2007/02/28/f22s_working_again).

[b] Johnson, Maj. Dani. 2007. "Raptors Arrive at Kadena." *Air Force Link*, February 19 (accessed at http://www.af.mil/news/story.asp?id=123041567).

Key Question 5

Q5. What, beyond having the knowledge of a likely safety hazard, does an engineer need to get the hazard reduced or eliminated?

Whistle blowing – a worthy relevance?

Preparing engineers to recognize safety hazards, although vitally important, is clearly not enough to prevent many accidents.

Because engineers often recognize a hazard but do not have the authority to remedy it and may be unable to get decision makers in their organization to attend to it, engineering ethics has widely discussed whistle-blowing by engineers – that is, an engineer taking a concern outside her organization.

However, whistle blowing in this sense always marks organizational failure.

Continued

There is a growing consensus among engineering organizations on the subject of raising safety concerns, both through lodging complaints (within an organization) and through whistle blowing (outside the organization).

First, engineers have a right to force attention to many types of error and misconduct – such as waste and misrepresentation in work done under government contract – even by going outside the organization. Second, engineers have not only a right, but a moral obligation, to bring the matter to light when human life or health is threatened.

Your views on the case

Publicly Criticizing a Project as Unsafe

Garcia, a renowned structural engineer, is hired for a nominal sum by a large city newspaper to visit the site of a state bridge-construction project. This project has been plagued by construction delays, cost increases, and litigation, primarily because of several well-publicized on-site accidents.

Garcia visits the bridge and performs a one-day visual inspection. In very general terms, her report identifies potential problems and proposes additional testing and other solutions. In a series of feature articles based on Garcia's report, that city newspaper alleges that the bridge has major safety problems that will jeopardize its completion date. Allegations of misconduct and incompetence are made against the project engineers, the contractors, and the state highway department. The state holds an investigation, in which Garcia states that her report only identified potential problems with the safety of the bridge and was not intended to be conclusive.

What is your ethical evaluation of Garcia's agreement with the newspaper?

In light of this experience, what safeguards might an engineer seek as a condition of accepting an assignment like Garcia's?

Source: Adapted from NSPE Case No. 88–7[a]

[a]This case, "Public Criticism of Bridge Safety," and the board's discussion of it and three related cases appear in *Opinions of the Board of Ethical Review* Volume VI, Alexandria, VA: National Society of Professional Engineers, 1989, pp. 117–119.

Thank You!!

Ethics in Engineering Practice

Lecture No (34, 35) : Key Questions relating to Rights and Responsibilities regarding Intellectual property rights

DR. SUSMITA MUKHOPADHAYAY
VINOD GUPTA SCHOOL OF MANAGEMENT
IIT KHARAGPUR

Key questions answered in the module

❖ How broadly should one share ideas? How readily should one copy the ideas of others? Does it matter what the ideas are or the human wants and needs that those ideas help meet?

❖Why are some creations accorded copyright protection? Under what, if any, circumstances is it fair to copy a copyrighted work without explicit permission?

❖How does one know what knowledge or information is proprietary? What considerations are relevant in deciding how a computer professional or engineer can best keep confidential the proprietary knowledge of a client or employer?

Continued

- What is the difference between having a property right, such as a patent or copyright for something one has invented or written, and credit for having written or invented it?

- On the one hand the "not invented here" attitude, which disregards advances made outside of one's own organization, is widely blamed for slowing advances in quality and safety. On the other hand, legal specifications of copyright and patents and other intellectual property protections are intended to limit the use that others can make of one's designs. What are fair and prudent means of learning from others? What other ethical issues arise in learning from the innovations of others?

Key Question 1

How broadly should one share ideas? How readily should one copy the ideas of others? Does it matter what the ideas are or the human wants and needs that those ideas help meet?

Introduction

It has been long argued that intellectual labor involved in the creation of research, artistic, and technological works provides the basis of property rights.

If the creators of the product in question are paid for producing the product, then arguably the product and any resulting trademarks, patents, copyrights, or other property rights belong to the employer or client who paid them (although the creators still deserve credit as authors or inventors of those patented or copyrighted creations).

Continued

Consider a surgeon who develops a technique that can save lives but keeps the technique a “trade secret” to enhance her prestige.

Is withholding the technique morally wrong? Would it be wrong for another surgeon to try to learn that technique, by, say, electronic eavesdropping or asking an operating room assistant?

Continued

Ethics codes and guidelines of engineering professional societies also provide some guidance. The section of the NSPE's code of ethics on intellectual property addresses more than proprietary (i.e., ownership) interests and gives standards for fairly crediting others as well. It outlines the following as professional obligations:

Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.

Continued

Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the Engineer for others without express permission.

Engineers, before undertaking work for others in connection with which the Engineer may make improvements, plans, designs, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership.

Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property.

Key Question 2

Why are some creations accorded copyright protection? Under what, if any, circumstances is it fair to copy a copyrighted work without explicit permission?

Continued

Copyright is a legal right to exclusive publication, production, sale, or distribution of some work.

A copyright is most commonly held by the author, the composer, or the publisher of a work. It may be assigned to others or inherited, however, so the copyright holder need not be the party who deserves credit for authoring the work. The intellectual property that is protected by the copyright is the “expression,” not the idea. Ideas cannot be copyrighted.

The idea behind fair use of copyrighted material is that some copying of copyrighted material may be justified if it **does not undermine a copyright holder’s property interest or is in the public interest (e.g., because it facilitates education).**

Key Question 3

How does one know what knowledge or information is proprietary? What considerations are relevant in deciding how a computer professional or engineer can best keep confidential the proprietary knowledge of a client or employer?

Introduction to the issue

One of the important questions is what factors determine the extent to which knowledge acquired in working for one client or employer can be used when working for another. A frequent complication is that one's clients or employers may be competitors of one another.

Computer professionals, like other engineers, need to know how to distinguish between standard design elements (which one may learn about in courses or on a job and use in another job) and customized (and perhaps patented) knowledge belonging to one employer or client. This problem situation is illustrated in the scenario, "One Client Teaches You Something that Would Help Another Client."

Continued

One Client Teaches You Something That Would Help Another Client[a]

You are the lead software developer working for a small software developing company. You develop a specific type of software for several companies that are maneuvering for market share in a competitive industry. In your job as lead developer you work with clients to assess their specific needs and implement patches and updates to the software that you have developed for them. It is a big job to update the software in response to complex requests. Therefore, if a solution can be found without needing to update the software, resources are saved for all parties.

A few weeks ago Company A came to you about a major difficulty with your software. You were busy resolving another issue with Company B at the time and the Company B project had priority. Before you got back to Company A, its IT person called to inform you that he solved the issue by using a very specific configuration of Company A's network. He described the configuration to you in detail and you were satisfied that the issue was solved without the need to update your software.

Now, Company B contacts you with the same issue. What should you do?

What facts in this situation are morally relevant to deciding whether (or how much of) Company A's configuration solution is confidential information? For example, does it matter whether Company A volunteered its configuration solution or you asked for it? Does it matter if part of the configuration solution is something you learned about elsewhere but had not thought about in this application? Do you know how much, if any, of what you learn from Company A in the course of delivering services to it is proprietary and therefore confidential? If you do not know, how could you find out?

[a] Adapted from a scenario by Kyle Kaliebe (CWRU '05).

Continued

Certainly, it matters if the information you have received is proprietary. It could be so by being part of a confidential business plan or other sort of trade secret, a patented device or process, or copyrighted code. Your responsibility for being aware that some knowledge is proprietary knowledge is very different in the case of trade secrets.

Key Question 4

Q4. What is the difference between having a property right, such as a patent or copyright for something one has invented or written, and credit for having written or invented it?

(CONTINUED IN NEXT MODULE)

Thank You!!