

Engineering Ethics

(Hum 4441)

Lecture 9

Analysis of Issues In Ethical Problems

- ❑ A first step in solving any ethical problem is to completely understand all of the issues involved. Once these issues are determined, frequently a solution to the problem becomes apparent.
- ❑ The issues involved in understanding ethical problems can be split into three categories:
 - Factual
 - Conceptual
 - Moral
- ❑ Understanding these issues helps to put an ethical problem in the proper framework and often helps point the way to a solution.



Types of Issues in Ethical Problem Solving

Factual issues: involve **what is actually known about a case – i.e., what the facts are**. Although this concept seems straightforward, the **facts of a particular case are not always clear and may be controversial**.

In engineering, there are controversies over facts as well. For example, **global warming is of great concern to society as we continue to emit greenhouse gases into the atmosphere**. This is thought to lead to a generalized warming of the atmosphere as emissions from automobiles and industrial plants increase the carbon dioxide concentration in the atmosphere. This issue is of great importance to engineers since they might be required to design new products or redesign old ones to comply with stricter environmental standards if this warming effect indeed proves to be a problem. However, the **global warming process is only barely understood, and the need to curtail emission of these gases is a controversial topic**.

If it were known exactly what the effects of emitting greenhouse gases into the atmosphere would be, the engineer's role in reducing this problem would be clearer.

Types of Issues in Ethical Problem Solving

- ❑ **Conceptual issues** have to do with the meaning or applicability of an idea/action.
- ❑ In engineering ethics, this might mean defining what constitutes a bribe as opposes to an acceptable gift, or determining whether the certain business information is proprietary. In the case of the bribe, the value of the gift is probably a well-known fact. What isn't known is whether accepting it will lead to the unfair influence on a business decision.
- ❑ For example, conceptually it must be determined if the gift or tickets to a sporting event by a potential
- ❑ Supplier of parts for your project is meant to influence your decision or is just a nice gesture between friends.
- ❑ Of course, like factual issues, conceptual issues are not always clear-cut and will often result in controversy as well.

Types of Issues in Ethical Problem Solving

- ❑ **Moral issues:** once the factual and conceptual issues have been resolved, at least to the extent possible, all that remains is to **determine which moral principle is applicable to the situation.**
- ❑ **Resolution of moral issues is often more obvious.** Once the problem is defined, it is usually clear with moral concept applies, and the correct decision becomes obvious.
- ❑ In the example of a “gift” offered by a sales representative, **once it is determined whether it is simply a gift or is really a bribe, then the appropriate action is obvious.** If we determine that it is indeed a bribe, then it cannot ethically be accepted.

Types of Issues in Ethical Problem Solving

- ❑ **Factual issues:** can often be resolved through research to establish the truth. It is not always possible to achieve a final determination of the “truth” that everyone can agree on, but generally, further research helps clarify the situation, can increase the areas of agreement, and can sometimes achieve consensus on the facts.
- ❑ **Conceptual issues:** are resolved by agreeing on the meaning of terms and concepts. Sometimes agreement isn’t possible, but as with factual issues, further analysis of the concepts at least clarifies some of the issues and helps to facilitate agreement.
- ❑ **Moral issues:** finally, moral issues are resolved by agreement as to which moral principles are pertinent and how they should be applied.
- ❑ Often, all that is required to solve a particular ethical problem is a deeper analysis of the issues involved according to the appropriate principles. Once the issues are analyzed and agreements is reached on the applicable moral principles, it is clear what the resolution should be.

Challenges

- ❑ In many situations, it is difficult or impossible to determine the relevant facts, especially when the factual issues have to do with the prediction of the likely consequences of events in the future.
- ❑ Arguments over the definitions of "bribe" or "proprietary" may be very difficult to resolve.
- ❑ People can disagree over moral issues.

Case Study: Waste Isolation Pilot Plant (WIPP), Carlsbad, NM U.S.A.

WIPP is designed to be a permanent repository for nuclear waste generated in the United States. It consists of a system of tunnels bored into underground salt formations. These salt beds are considered by geologists to be extremely stable, especially to incursion of water which could lead to seepage of the nuclear wastes into ground-water. However, there are many who oppose this facility, principally on the grounds that transportation of the wastes across highways has the potential for accidents that might cause health problems for people living near these routes.

Case Study: Waste Isolation Pilot Plant (WIPP), Carlsbad, NM U.S.A.

	Factual Issues (with ethical implications)
F1	Development of nuclear technology will result in nuclear waste.
F2	Nuclear waste, if left unattended, is dangerous.
F3	A Waste Isolation facility stores nuclear waste safely.

	Conceptual Issues (with ethical implications)
C1	When WIPP was first conceived, was there awareness that there were communities/townships along the planned waste transportation route?
C2	When WIPP was first conceived, were there checks/studies made first about the availability of suitably fortified safe transports?
C3	Were there consultations with the communities/townships, and were there any reasonable/useful proposals/suggestions considered?

Case Study: Waste Isolation Pilot Plant (WIPP), Carlsbad, NM U.S.A.

	Ethical Issues
E1	Transportation of nuclear waste through the communities/townships presents various dangerous situations for them. <i>[Rights- & Virtue- Ethics]</i>
E2	Transportation of nuclear waste violates the civil rules (if these were existing) of transportation of hazardous materials through the communities/townships. <i>[Rule- Utilitarianism]</i>

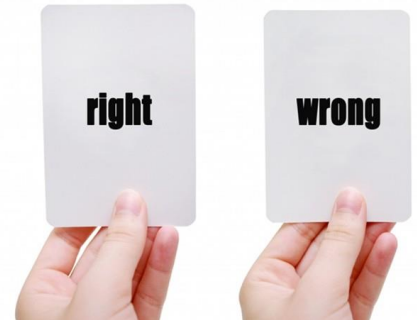
Resolving Moral Dilemmas

1. Moral clarity

- *Identify the relevant moral values.*
- **Need to know something is wrong!** *Do not ignore problems!*
- Loyalty to employer, responsibilities to public and environment (and complex relations between these)

2. Know the facts

- Get hard, documented facts, discuss with other
- **Be clear about key concepts**
- Competence matters in gathering technical facts



Resolving Moral Dilemmas

3. Consider options

- Diversity of actions to take. Need to evaluate/discuss.
- Initially, ethical dilemmas seem to force us into a two-way choice: Do this or do that. Either bow to a supervisor's orders or blow the whistle to the town authorities.
- Long-term, short-term perspectives, repercussions.
- “Creative middle solution”

4. Make a reasonable decision

- Weigh all factors, recognize “gray areas”/compromises.
- It is a deliberation aimed at integrating all the relevant reasons, facts, and values—in a morally reasonable manner.
- An engineering design problem.

Case Study

- **Engineer A** is employed by a software company and is involved in the design of specialized software in connection with the operations of facilities affecting the public health and safety (i.e., nuclear, air quality control, water quality control). As the part of the design of a particular software system, Engineer A conducts extensive testing and although the tests demonstrate that the software is safe to use under existing standards, **Engineer A is aware of new draft standards** that are about to be released by a standard setting organization-standards which the newly designed software may not meet. Testing is extremely costly and the company's clients are eager to begin to move forward. The software company is eager to satisfy its clients, protect the software company's

Case Study

finances, and protect existing jobs; but at the same time, the management of the software company wants to be sure that the software is safe to use. A series of tests proposed by Engineer A will likely result in a decision whether to move forward with the use of the software. The tests are costly and will delay the use of the software by at least six months, which will put the company at a competitive disadvantage and cost the company a significant amount of money. Also, delaying implementation will mean the state public service commission utility rates will rise significantly during this time. The company requests Engineer A's recommendation concerning the need for additional software testing.

Analyzing the case...

- **Moral clarity:**

- What is wrong? What is the core issue/question?
- Will the software meet the new standards?
- Why are there new standards?
 - Experience shows new failure modes
 - New tests designed to test new failure modes
- Engineer's role in new standards?
 - Development of new standards
 - Following new standards

Analyzing the case...(continued)

- **Know the facts**

- It is critical software (health/safety of public)
- New standards to test new failure modes (that are needed to understand)
- Testing is costly, company finances at stake
- Need to protect existing jobs
- Testing will delay release by > 6 months
- Testing will hurt competitive advantage?
- Utility rates will rise

Analyzing the case...(continued)

- **Consider options**

- **Option 1:** Ignore the new tests, take risk to public safety/welfare, save time/money
- **Option 2:** Conduct the tests, risk jobs, hurt finances, become certain software will work, protect safety/welfare of the public
- **Option 3:** Creative middle of the road solution: Is there are limited version of full tests that could be conducted that would partially test, but save some money/time?

Analyzing the case...(continued)

- **Make a reasonable decision**

- Pick Option 2 since safety/health/welfare of the public is paramount
- If company says no, pick Option 3 and try to do a limited test for the failure mode (your competence in coming up with an economical test is critical here). In this option, all constraints considered, you *try* to protect the safety, health, and welfare of the public

Resolving moral dilemmas, “line-drawing”

- **Harris et al.** idea to try to make solving moral dilemmas more analytical/ quantitative
- Given moral dilemma
 - Establish key features, issues
 - Establish extremes of features/issues and paradigms (indicating totally ethical vs. clearly unethical aspects)
 - Construct a line drawing
 - Evaluate “test case”

Techniques for solving Ethical issues

(Line Drawing)

- **Line Drawing:** The line-drawing technique is especially useful for situations in which the applicable moral principles are clear, but there seems to be a great deal of “gray area” about which ethical principle applies.
- Line drawing is performed by drawing a line along which various examples and hypothetical situations (*also called “scenarios”*) are placed.
- At one end is placed the “positive paradigm (PP),” an example of something that is unambiguously morally acceptable.
- At the other end, the “negative paradigm (NP),” an example of something that is unambiguously not morally acceptable at all, is placed.

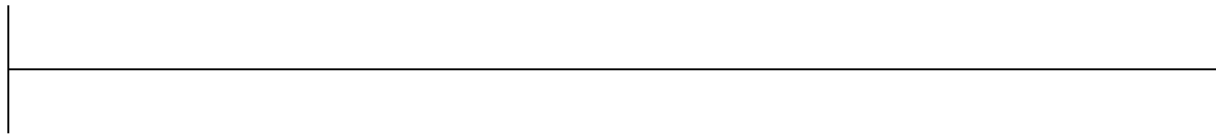
Elementary line-drawing technique

Negative paradigm

Positive paradigm

(NP)

(PP)



The **Positive Paradigm (PP)** is an example of something that is unambiguously morally acceptable while the **Negative Paradigm (NP)** is an example of something that is clearly not morally acceptable. In between is placed the problem under consideration along with other similar examples. Those examples that more closely conform to the positive paradigm are placed near it, and examples closer to the negative paradigm are placed near another end. By carefully examining and comparing the problem with examples in between, it is possible to determine whether the problem is more like the positive or negative end.

Case Study: Pentium Chip Case

- In 1994–95, it was discovered and widely reported that the latest version of the Intel Pentium chip had flaws. At first, Intel sought to hide this information, but later came around to a policy of offering consumers chips in which the flaw had been corrected.

Case Study: Pentium Chip Case

- For our **positive paradigm**, we will use the statement that “products should perform as advertised.” The **negative paradigm** will be “**Knowingly sell products that are defective and that will negatively affect customers’ applications.**” A few examples that we can add to the line are as follows:
 1. **There is a flaw in the chip, but it truly is undetectable and won’t affect any customer’s applications.**
 2. **There are flaws in the chip, the customer is informed of them, but no help is offered.**
 3. **A warning label says that the chip should not be used for certain applications.**
 4. **Recall notices are sent out, and all flawed chips are replaced.**
 5. **Replacement chips are offered only if the customer notices the problem.**

Case Study: Pentium Chip Case

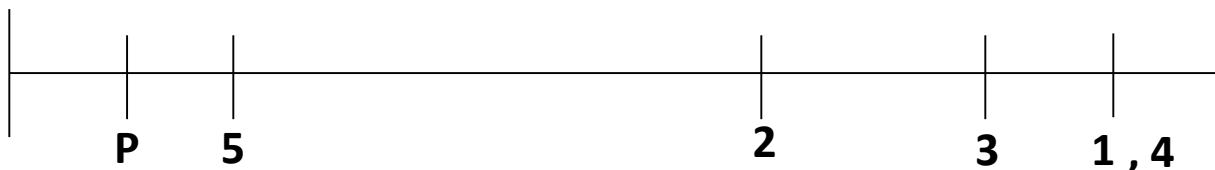
- For our positive paradigm, we will use the statement that “products should perform as advertised.” The negative paradigm will be “Knowingly sell products that are defective and that will negatively affect customers’ applications.” A few examples that we can add to the line are as follows:
 - There is a flaw in the chip, but it truly is undetectable and won’t affect any customer’s applications.**
 - There are flaws in the chip, the customer is informed of them, but no help is offered.**
 - A warning label says that the chip should not be used for certain applications.**
 - Recall notices are sent out, and all flawed chips are replaced.**
 - Replacement chips are offered only if the customer notices the problem.**

Negative paradigm

Positive paradigm

(NP)

(PP)



Sell defective products

*products should
be as advertised*

Case Study: dispose of a slightly hazardous waste

- It is proposed that our company dispose of a slightly hazardous waste by dumping into a lake. A nearby town takes its drinking water supply from this lake. The research shows that with the amount of waste in the lake will be 5 parts per million (ppm). The EPA limit for this material has been set at 10 ppm. At the 5 ppm level, we expect no health problems, and consumers would not be able to detect the compound in their drinking water.

Case Study: dispose of a slightly hazardous waste

❑ *Analysis problem:*

- **Positive paradigm:** The water supply for the town should be clean and safe.
- **Negative paradigm:** Toxic levels of waste are put into the lake.
- ❑ Let's establish some other hypothetical examples for consideration:
 1. The company dumps the chemical into the lake. At 5 ppm, the chemical will be harmless, but the town's water will have unusual taste.
 2. The chemical can be effectively removed by the town's existing water treatment system.
 3. The chemical can be removed by the town with equipment that will be purchased by the company
 4. The chemical can be removed by the town with equipment for which the taxpayer will pay.
 5. Occasionally, exposure to the chemical can make people feel ill, but this only lasts a week.
 6. At 5 ppm, some people can get fairly sick, but the sickness only lasts a week, and there is no long-term harm.
 7. Equipment can be installed at the plant to further reduce the waste level 1 ppm.

Case Study: dispose of a slightly hazardous waste

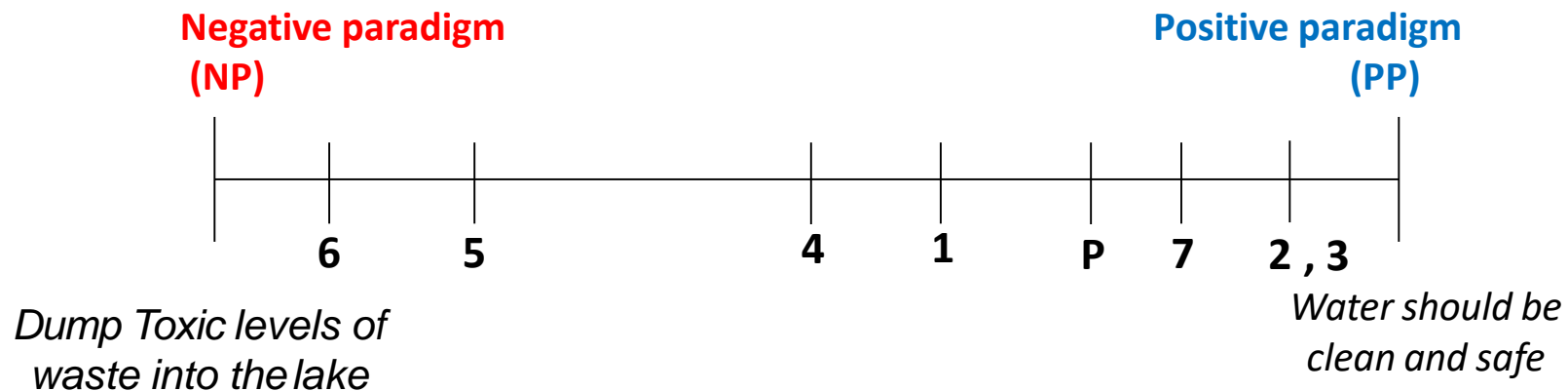
□ Analysis problem:

○ **Positive paradigm:** The water supply for the town should be clean and safe.

○ **Negative paradigm:** Toxic levels of waste are put into the lake.

□ Let's establish some other hypothetical examples for consideration:

1. The company dumps the chemical into the lake. At 5 ppm, the chemical will be harmless, but the town's water will have unusual taste.
2. The chemical can be effectively removed by the town's existing water treatment system.
3. The chemical can be removed by the town with equipment that will be purchased by the company
4. The chemical can be removed by the town with equipment for which the taxpayer will pay.
5. Occasionally, exposure to the chemical can make people feel ill, but this only lasts a week.
6. At 5 ppm, some people can get fairly sick, but the sickness only lasts a week, and there is no long-term harm.
7. Equipment can be installed at the plant to further reduce the waste level 1 ppm.



Line-drawing, bribery example

- Victor is an engineer in a large construction firm. He has been assigned the task of being the sole person to recommend rivets for the construction of a large apartment building. After some research and testing, he decides to recommend ACME rivets for the job, which he determines are of the lowest cost and highest quality. On the day after Victor's decision was made, an ACME representative visits him and gives him a voucher for an all-expense-paid trip to the annual ACME Technical Forum, which meets in Jamaica. The trip will have considerable educational value, but will also provide day trips to the beach and other points of interest.
- **Question:** If Victor accepts, has he been bribed?

Line-drawing, bribery example

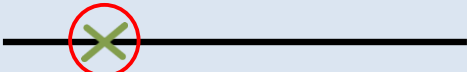



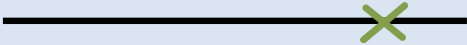

- In this case, we can easily identify features that contribute heavily in favor of this being a clear-cut instance of bribery.

Features of Bribery	Paradigm Instances of Features of Bribery
Gift size	Large (>\$10,000)
Timing	Before recommendation
Reason	Personal gain
Responsibility for decision	Sole
Product quality	Worst in industry
Product cost	Highest in market

Table: Paradigm Case of Bribery

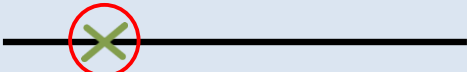



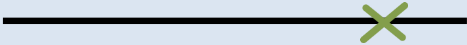

- The advantage of listing major features of clear-cut applications of a concept such as bribery is that these features can help us decide less clear-cut cases as well. Consider the following case, which we will call the test case (the case to be compared with clear-cut cases).

Line-drawing, bribery example

Feature	Paradigm (bribery)	Test case	Paradigm (not bribery)
Gift size	Large		Small (<\$10)
Timing	Before decision		After decision
Reason	Personal gain		Educational
Responsibility	Sole		None
Product quality	Worst		Best
Product cost	Highest		Lowest

Victor is an engineer in a large construction firm. He has been assigned the task of being the sole person to recommend rivets for the construction of a large apartment building. After some research and testing, he decides to recommend ACME rivets for the job, which he determines are of the lowest cost and highest quality. On the day after Victor's decision was made, an ACME representative visits him and gives him a voucher for an all-expense-paid trip to the annual ACME Technical Forum, which meets in Jamaica. The trip will have considerable educational value, but will also provide day trips to the beach and other points of interest.

Line-drawing, bribery example

Feature	Paradigm (bribery)	Test case	Paradigm (not bribery)
Gift size	Large		Small (<\$10)
Timing	Before decision		After decision
Reason	Personal gain		Educational
Responsibility	Sole		None
Product quality	Worst		Best
Product cost	Highest		Lowest

May not be a bribe, but still may not be a good idea!

Case Study: Sign agreement issue

- John signs an agreement with Global Semiconductors. The contract obligates him not to reveal trade secrets. This condition is timeless. John later moves to another company—Worldwide Intelligent Chips. In the new company, he finds uses for some ideas he conceived while working at Global Semiconductors. These ideas were never developed into an industrial process at Global Semiconductors. Although Global Semiconductors is not in competition with Worldwide Intelligent Chips, John has an uneasy feeling and wonders where to draw the line between legitimate and illegitimate use of knowledge.

Case Study: Sign agreement issue

❑ *Analysis problem:*

- **Positive paradigm:** conforming to agreement (he does not reveal anything).
- **Negative paradigm:** violation of agreement and loss of reputation (uses the idea of Global Semiconductors).

❑ Let's establish some hypothetical examples for consideration:

1. Only uses former working experience to guide new development. Do it in the direction, but in a different new way.
2. Reveals secrets to Worldwide Intelligent Chips. The new products sell well without anyone noticing the illegal use of ideas of Global Semiconductors.
3. John reveals secrets to worldwide Intelligent Chips. Inside the company the proposal is turned down because the boss fears the potential copyright problems and litigations. Personal reputation is damaged.
4. Not personally reveal the idea, but ask the boss to buy the idea from Global Semiconductors.
5. Since these two companies are not competing, John can advise the boss to negotiate with Global Semiconductors about the ideas to seek cooperation. This may bring in a win-wing situation.

Case Study: Sign agreement issue

❑ **Analysis problem:**

○ **Positive paradigm:** conforming to agreement (he does not reveal anything).

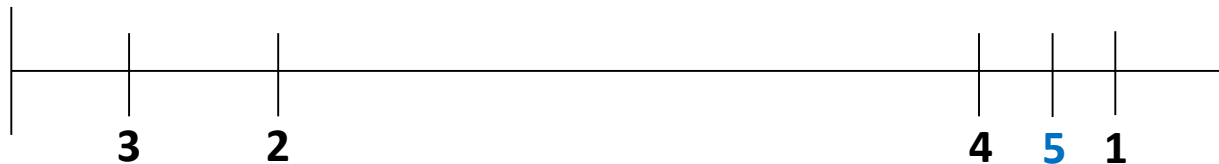
○ **Negative paradigm:** violation of agreement and loss of reputation.

❑ Let's establish some hypothetical examples for consideration:

1. Only uses former working experience to guide new development. Do it in the direction, but in a different new way.
2. Reveals secrets to Worldwide Intelligent Chips. The new products sell well without anyone noticing the illegal use of ideas of Global Semiconductors.
3. John reveals secrets to worldwide Intelligent Chips. Inside the company the proposal is turned down because the boss fears the potential copyright problems and litigations. Personal reputation is damaged.
4. Not personally reveal the idea, but ask the boss to buy the idea from Global Semiconductors.
5. Since these two companies are not competing, John can advise the boss to negotiate with Global Semiconductors about the ideas to seek cooperation. This may bring in a win-win situation.

**Negative paradigm
(NP)**


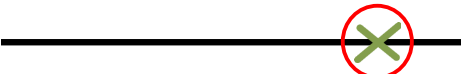


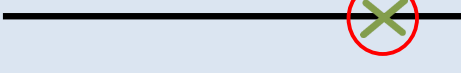

**Positive paradigm
(PP)**



*violation of agreement
and loss of reputation*







*conforming to
agreement*

Line-drawing, Sign agreement issue

Feature	NP – illegal use of ideas	Test case	PP – keeping silent
Personal Gain	Larger		Smaller
Personal reputation	Poor		Great
Profits of Worldwide	Larger		Smaller
Damage to Global	Potential		No
Potential problems	Litigations & copyrights		None
Responsibility	Huge		No

John signs an agreement with Global Semiconductors. The contract obligates him not to reveal trade secrets. This condition is timeless. John later moves to another company—Worldwide Intelligent Chips. In the new company, he finds uses for some ideas he conceived while working at Global Semiconductors. These ideas were never developed into an industrial process at Global Semiconductors. Although Global Semiconductors is not in competition with Worldwide Intelligent Chips, John has an uneasy feeling and wonders where to draw the line between legitimate and illegitimate use of knowledge.

Line-drawing, Sign agreement issue

Feature	NP – illegal use of ideas	Test case	PP – keeping silent
Personal Gain	Larger		Smaller
Personal reputation	Poor		Great
Profits of Worldwide	Larger		Smaller
Damage to Global	Potential		No
Potential problems	Litigations & copyrights		None
Responsibility	Huge		No

Since these two companies are not competing, John can advise the boss to negotiate with Global Semiconductors about the ideas to seek cooperation. This may bring in a win-win situation.

Line Drawing (Drawbacks)

- ❑ This helpful method can lead to incorrect results if used improperly.
- ❑ Line drawing is only effective if it is used objectively and honestly. One can reach wrong conclusions by using incorrect paradigms, by using dishonest placement of examples along the line.
- ❑ Clearly, we do have conflicting professional and personal interests. Such competing interests can make it difficult to fulfill his or her duties impartially.
- ❑ So, before we start off using this method, we should behave with integrity, objectivity and impartiality, uninfluenced by any personal considerations, as the Code of Ethics prescribes.