Professional Ethics (HS-219)

Week 8 (Handout)

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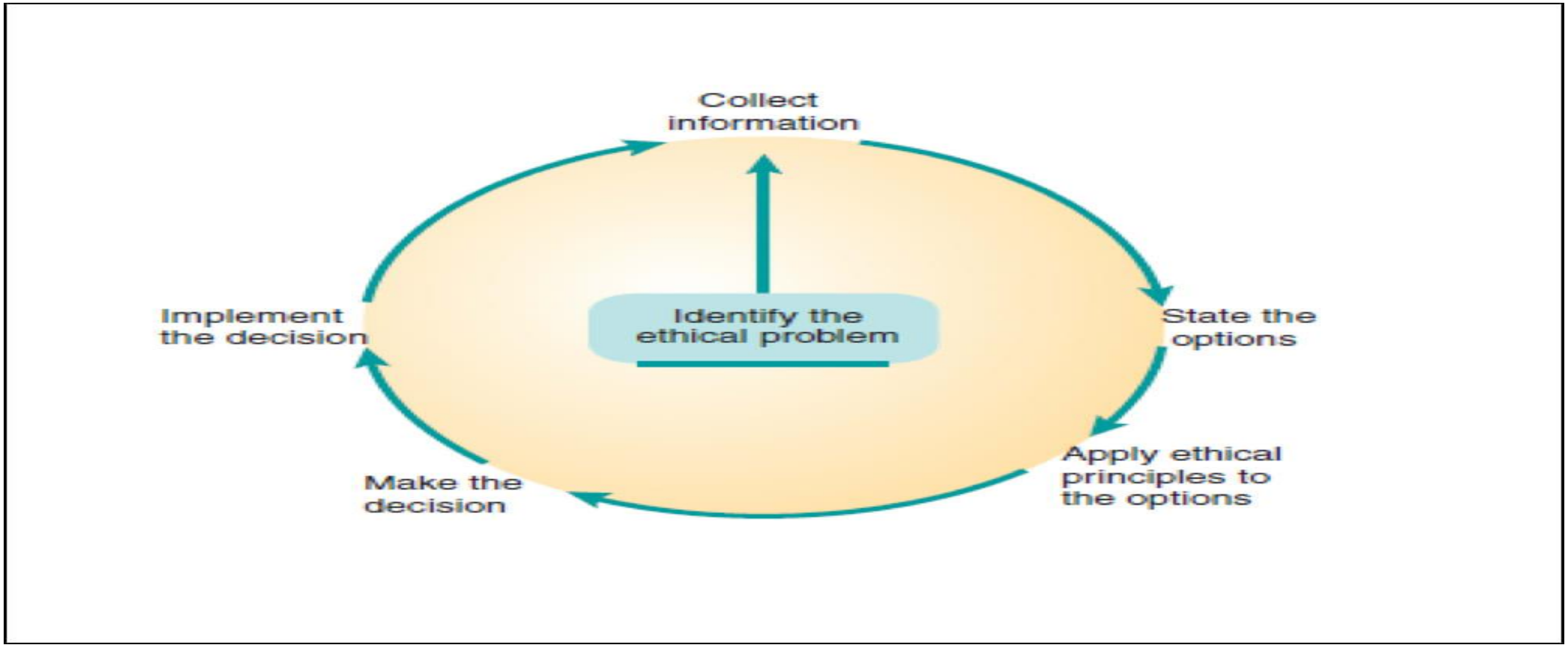
Ethical Problem Solving Techniques



1. Conflict Problems
2. Line Drawing Technique
3. Flow Charting

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Flow Charting

Flow charting is helpful for analyzing a variety of cases, especially those in which there is a sequence of events to be considered or a series of consequences that flows from each other.

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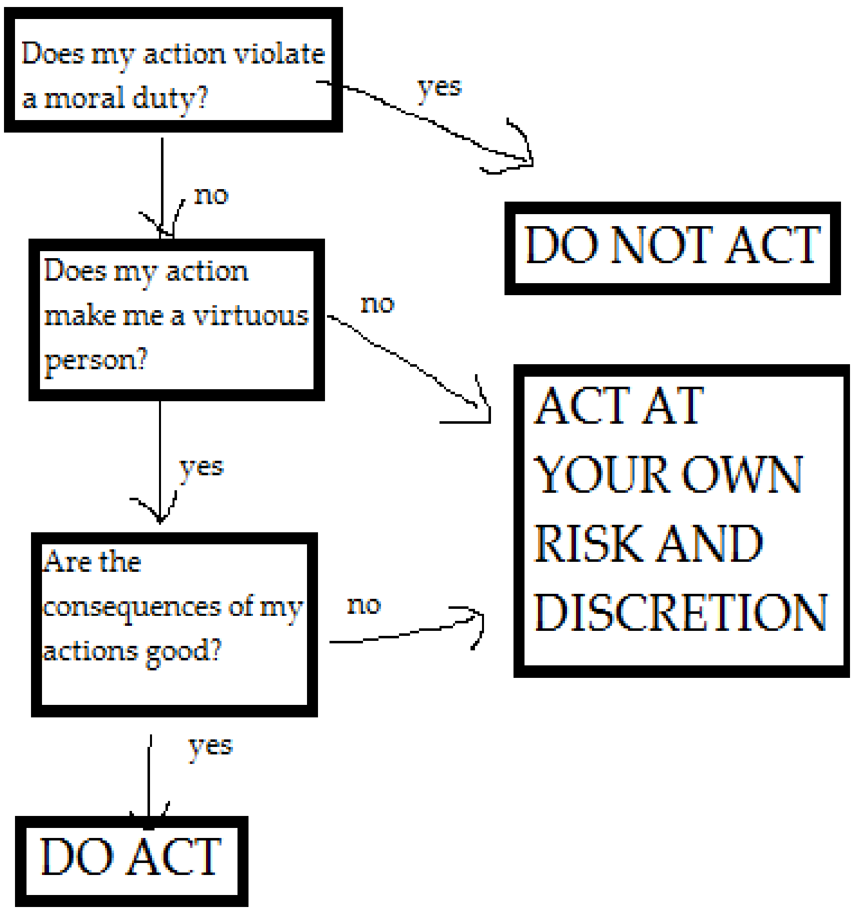
Flow Charting Advantages

Should I perform an action or not?



1. Gives a visual picture of a situation
2. Allows to readily see the consequences that flow from each decision
3. Emphasizes safety issues for the surrounding community

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Flow Charting

Flow charts are very familiar to engineering students. They are most often used in developing computer programs, also finding application in other engineering disciplines and are often used to describe business processes and procedures. In engineering ethics, flow charting will be helpful for analyzing a variety of cases, especially those in which there is a sequence of events to be considered or a series of consequences that flows from each decision. An advantage of using a flow chart to analyze ethical problems is that it gives a visual picture of a situation and allows you to readily see the consequences that flow from each decision.

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As with the line-drawing technique, there is no unique flow chart that is applicable to a given problem. In fact, different flow charts can be used to emphasize different aspects of the same problem. As with line drawing, it will be essential to be as objective as possible and to approach flow charting honestly. Otherwise, it will be possible to draw any conclusion you want, even one that is clearly wrong.

This technique can be illustrated by applying a simple flow chart to a disaster that happened at Union Carbide's plant in Bhopal, India, where MIC, a toxic substance, was mixed with water, creating toxic fumes.

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Case Study

In late 1984, a pressure-relief valve on a tank used to store methyl isocyanate (MIC) at a Union Carbide plant in Bhopal, India, accidentally opened. MIC is a poisonous compound used in the manufacture of pesticides. When the valve opened, MIC was released from the tank, and a cloud of toxic gas formed over the area surrounding the plant. Unfortunately, this neighborhood was very densely populated. Some two thousand people were killed, and thousands more were injured as a result of the accident. Many of the injured have remained permanently disabled. The causes of the accident are not completely clear, but there appear to have been many contributing factors. Pipes in the plant were misconnected, and essential safety systems were either broken or had been taken off-line for maintenance. The effects of the leak were intensified by the presence of so many people living in close proximity to the plant. Among the many important issues this case brings up are questions of balancing risk to the local community with the economic benefits to the larger community of the state or nation. Undoubtedly, the presence of this chemical plant brought significant local economic benefit. However, the accident at the plant also brought disaster to the local community at an enormous cost in human lives and suffering. How can we decide if on balance the economic benefit brought by this plant outweighed the potential safety hazards?

From the book 'Engineering Ethics' by Fledderman, pg. 37

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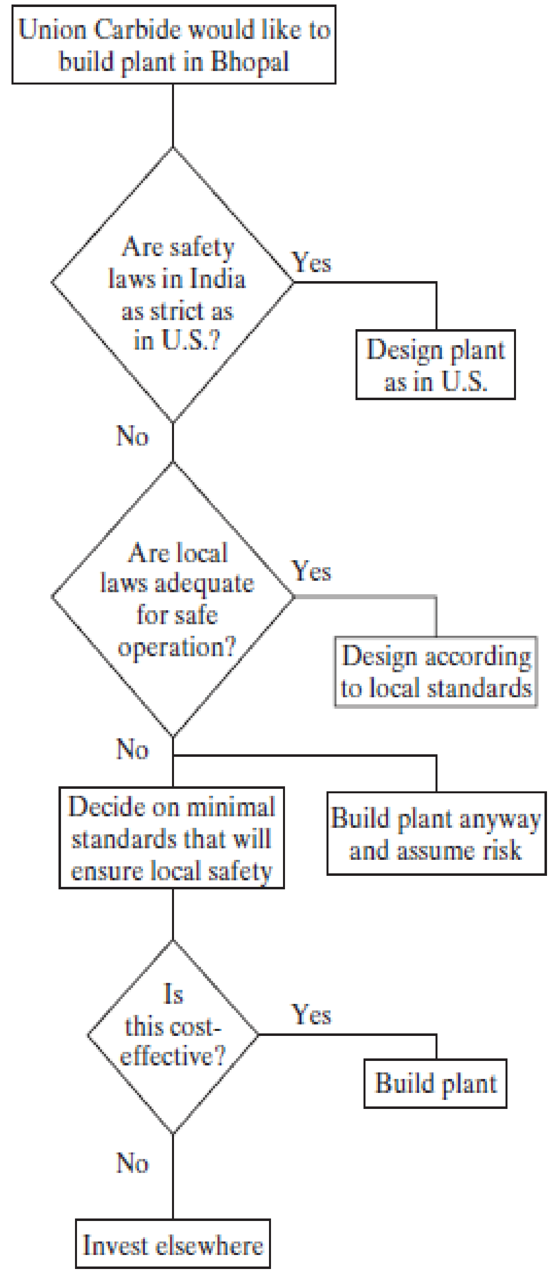
Figure 4.6
Application of a simple flow chart to the Bhopal case, emphasizing potential decisions made during consideration of locating a plant in India.



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One possible flow chart, illustrated in Figure 4.6, deals with the decision-making process that might have gone on at Union Carbide as they decided whether or not to build a plant at Bhopal. This chart emphasizes safety issues for the surrounding community. As indicated on the chart, there were several paths that might have been taken and multiple decisions that had to be made. The flow chart helps to visualize the consequences of each decision and indicates both the ethical and unethical choices. It is obvious that the flow chart used for a real ethical problem will be much larger and more complex than this example in order to thoroughly cover the entire problem.

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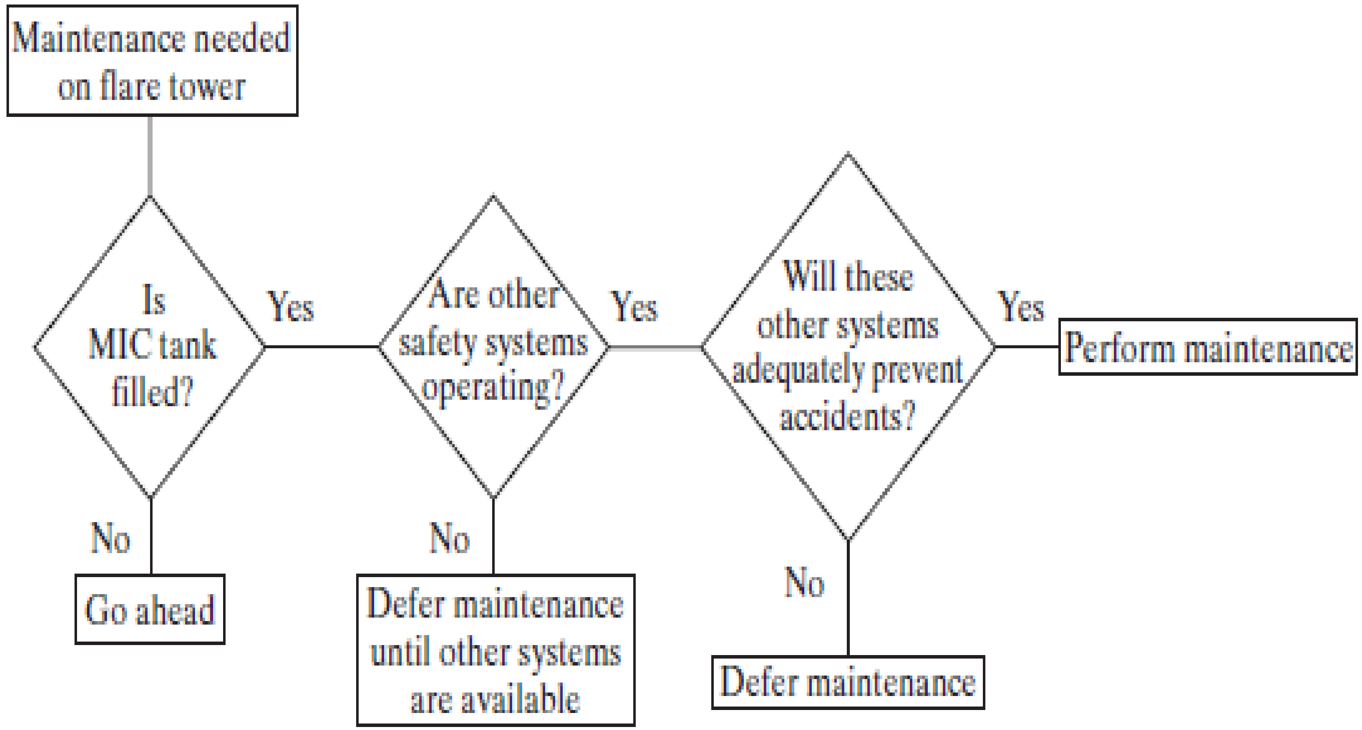
Figure 4.7
An alternative flow chart for the Bhopal case, emphasizing decisions made when considering deactivating the flare tower for maintenance.



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Another possible flow chart shown in Figure 4.7 deals with the decisions required during the maintenance of the flare tower at the Bhopal plant, an essential safety system. It considers issues of whether the MIC tank was filled at the time that the flare tower was taken off-line for maintenance, whether other safety systems were operating when the flare tower was taken out of operation, and whether the remaining safety systems were sufficient to eliminate potential problems. Using such a flow chart, it is possible to decide whether the flare tower can be taken off-line for maintenance or whether it should remain operating. The key to effective use of flow charts for solving ethical problems is to be creative in determining possible outcomes and scenarios and also to not be shy about getting a negative answer and deciding to stop the project.

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Conflict Problems

An area of ethical problem solving relates to the problems that present us with a choice between two conflicting moral values, each of which seems to be correct. How do we make the correct choice in this situation? Conflict problems can be solved in three ways:

1. There are conflicting moral choices, but one is obviously more significant than the other. For example, protecting the health and safety of the public is more important than your duty to your employer. In this type of case, the resolution of the conflict involves an easy choice.

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2. The second solution is sometimes called the “creative middle way”. This solution is an attempt at some kind of a compromise that will work for everyone. The emphasis here should be on the word “creative,” because it takes a great deal of creativity to find a middle ground that is acceptable to everyone and a great deal of diplomacy to sell it to everyone. The sales job is especially difficult because of the nature of compromise, which is often jokingly defined as “the solution where nobody gets what they want.” An example of a creative middle ground would be that rather than dumping a toxic waste into a local lake, one finds ways to redesign the production process to minimize the amount of waste products produced, finds ways to pretreat the waste to minimize the toxicity, or offers to pay for and install the equipment at the municipal water system necessary to treat the water to remove this chemical before it is sent to homes. Obviously, no one will be completely satisfied with these alternatives, since redesigns and pretreatment cost money and take time. Some people will not be satisfied with even a minimized dumping of toxics.

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3. Finally, when there is no easy choice and attempts to find that middle ground are not successful, then all that is left is to make the hard choice. Sometimes, you have to bite the bullet and make the best choice possible with the information available at the time. Frequently, you must rely on “gut feelings” for which path is the correct one.

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The Space Shuttle Challenger and Columbia Accidents

The NASA Space Shuttle Disasters

The space shuttle is one of the most complex engineered systems ever built. The challenge of lifting a space vehicle from earth into orbit and have it safely return to earth presents many engineering problems. Not surprisingly, there have been several accidents in the U.S. space program since its inception, including two failures of the space shuttle. The disasters involving the space shuttles *Challenger* and *Columbia* illustrate many of the issues related to engineering ethics as shown in the following discussion. The space shuttle originally went into service in the early 1980s and is set to be retired sometime in 2011 or 2012.

The Space Shuttle *Challenger* Disaster

The explosion of the space shuttle *Challenger* is perhaps the most widely written about case in engineering ethics because of the extensive media coverage at the time of the accident and also because of the many available government reports and transcripts of congressional hearings regarding the explosion. The case illustrates many important ethical issues that engineers face: What is the proper role of the engineer when safety issues are a concern? Who should have the ultimate decision-making authority to order a launch? Should the ordering of a launch be an engineering or a managerial decision? This case has already been presented briefly, and we will now take a more in-depth look.

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Further reading: 'Engineering Ethics' by Fledderman, pg. 18 of 187

SPACE SHUTTLE CHALLENGER

The space shuttle *Challenger* was launched in extremely cold weather. During the launch, an O-ring on one of the solid-propellant boosters, made more brittle by the cold, failed. This failure led to an explosion soon after liftoff. Engineers who had designed this booster had concerns about launching under these cold conditions and recommended that the launch be delayed, but they were overruled by their management (some of whom were trained as engineers), who didn't feel that there were enough data to support a delay in the launch. The shuttle was launched, resulting in the well-documented accident. On the surface, there appear to be no engineering ethical issues here to discuss. Rather, it seems to simply be an accident. The engineers properly recommended that there be no launch, but they were overruled by management. In the strictest sense, this can be considered an accident—no one wanted the *Challenger* to explode—but there are still many interesting questions that should be asked. When there are safety concerns, what is the engineer's responsibility before the launch decision is made? After the launch decision is made, but before the actual launch, what duty does the engineer have? If the decision doesn't go the engineer's way, should she complain to upper management? Or should she bring the problem to the attention of the press? After the accident has occurred, what are the duties and responsibilities of the engineers? If the launch were successful, but the *postmortem* showed that the O-ring had failed and an accident had very nearly occurred, what would be the engineer's responsibility? Even if an engineer moves into management, should he separate engineering from management decisions?

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Conflict Problems

Let's illustrate the resolution-of-conflict problems by examining the *Challenger* explosion, focusing on the dilemma faced by the engineering manager, Bob. The conflict was clear: There was an unknown probability that the shuttle would explode, perhaps killing all aboard. On the other hand, Bob had a responsibility to his company and the people who worked for him. There were consequences of postponing the launch, potentially leading to the loss of future contracts from NASA, the loss of jobs to many Thiokol workers, and perhaps even bankruptcy of the company. For many, the easy choice here is simply to not launch. The risk to the lives of the astronauts is too great and far outweighs any other considerations. It is impossible to balance jobs against lives. After all, most people who lose their jobs will be able to find other employment. However, not everyone will find this to be such an easy choice; clearly, Bob didn't find it to be so.

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The creative middle ground might involve delaying the launch until later in the day, when the temperature will have warmed up. Of course, this option might not be possible for many reasons associated with the timing of rocket launches and the successful completion of the planned missions. Instead, perhaps, the astronauts could be informed of the engineer's concerns and be allowed to make the choice whether to launch or not. If a risk is informed and a choice is made by those taking the risk, it somewhat relieves the company of the responsibility if an accident occurs. The hard choice is what Bob made. He chose to risk the launch, perhaps because the data were ambiguous. He might also have wanted to help ensure the future health of the shuttle program and to save the jobs of the Thiokol workers. As we know, his gamble didn't pay off. The shuttle did explode, causing the deaths of the astronauts and leading to lengthy delays in the shuttle program, political problems for NASA, and business difficulties for Thiokol.

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