Professional Ethics (HS-219)

Week 1 (Handout)

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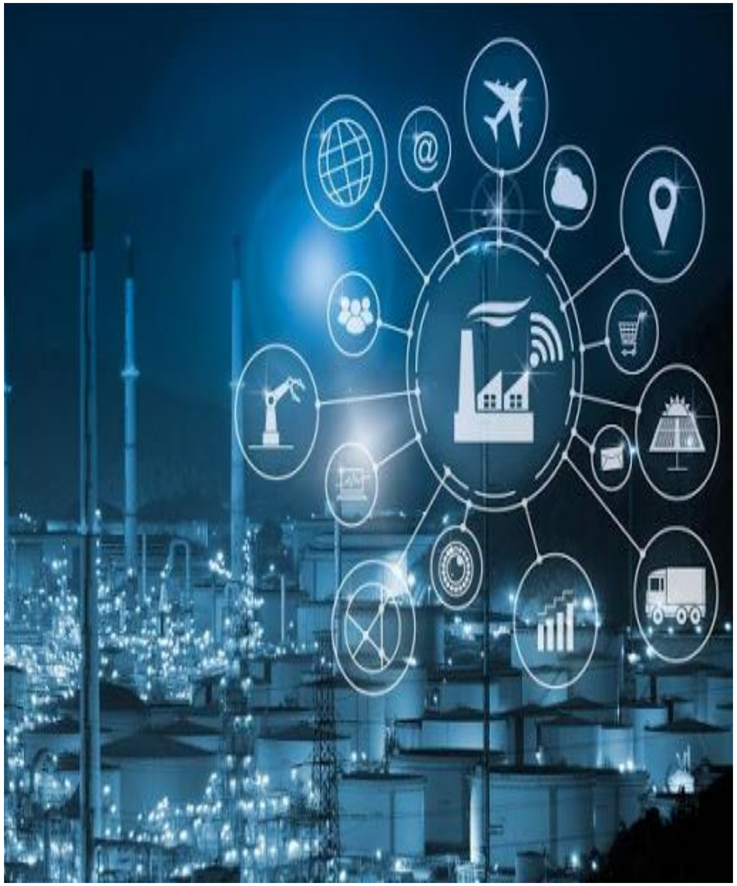
What is Engineering?

Engineering is the profession in which a knowledge of the mathematical and natural sciences is gained by study, experience, and practice and it is applied with judgment to develop ways to utilize economically, the materials and the forces of nature for the benefit of mankind.



Who is an Engineer?

Engineers turn ideas into reality; they create useful products and systems through design and manufacturing/construction. Engineers are expected to exhibit the highest standards of honesty and integrity because their profession has a direct and vital impact on the quality of life for all the people.

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Reflective Questions

Do you wonder how things work?
Do you wonder why things are the way they are?
Do you suggest new ideas or ways of solving problems that arise?
Do you think of ways to improve current things?
Do you picture situations and analyze all the steps?

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Ethics

Ethics is the study of the characteristics of morals. Ethos (Greek) and Mores (Latin) are terms having to do with "custom," "habit," and "behavior.

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Why Study Ethics?

The work of engineers can affect public health and safety and can influence business practices and even politics.

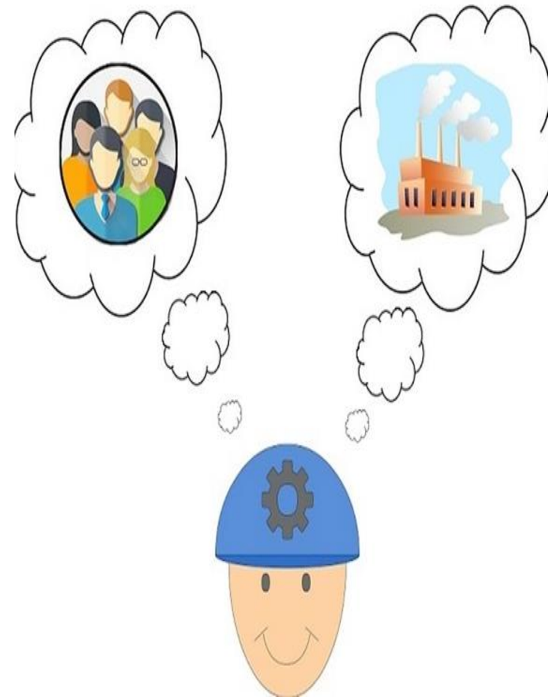
To sensitize you to important ethical issues before you have to confront them.

You will learn techniques for analyzing and resolving ethical problems when they arise.

Increases ethical sensitivity

Increases knowledge of relevant standards of conduct

Improves ethical judgments



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Professional Ethics

Professional ethics are principles that govern the behavior of a person or group in a business environment. Like values, professional ethics provide rules on how a person should act towards other people and institutions in such an environment.

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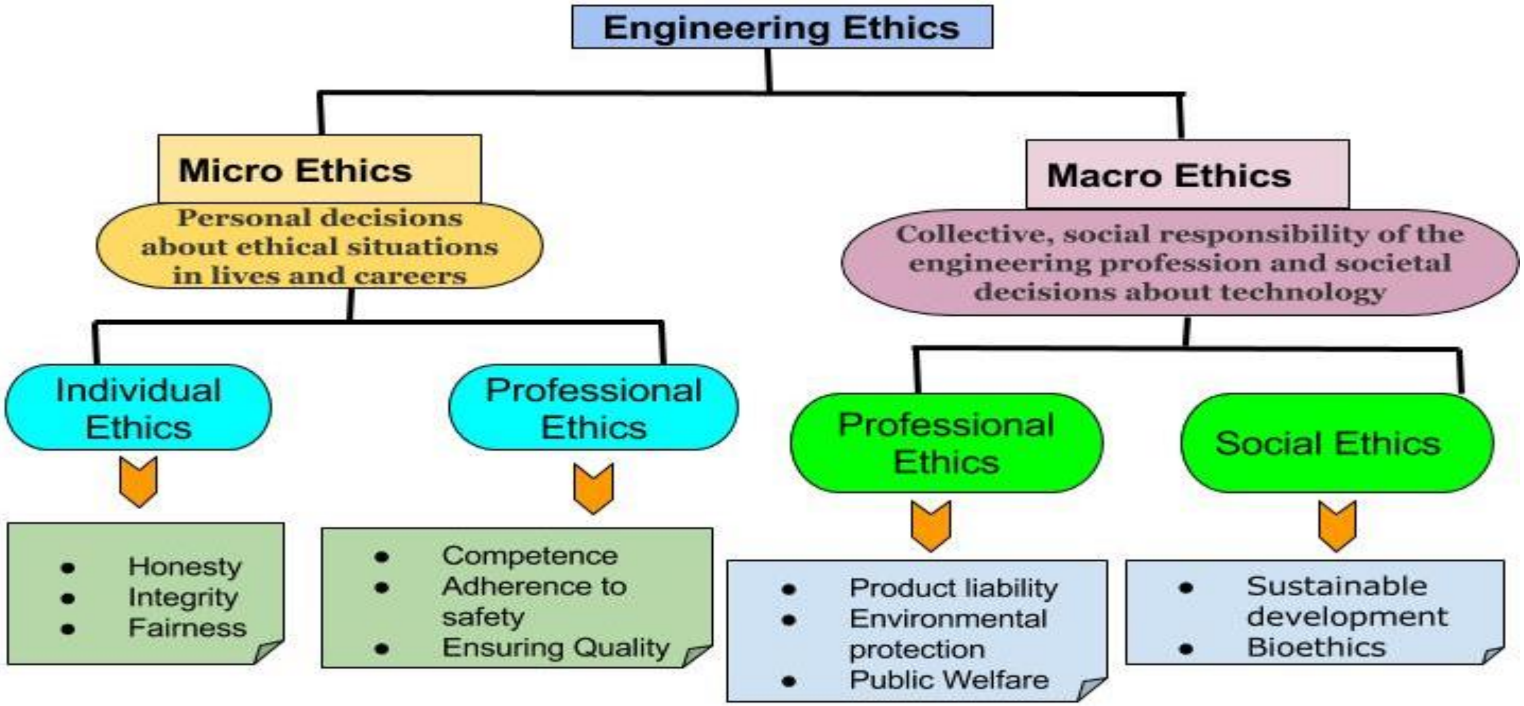
Engineering Ethics



Engineering ethics is the rules and standards governing the conduct of engineers in their role as professionals.

- The study of moral issues and decisions confronting individuals and organizations involved in engineering.
- The study of related questions about moral conduct, character and relationships of peoples and organizations involved in technological development.

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Micro/Macro Issues

Micro issues concern the decisions made by individuals and companies in pursuing their projects. Macro issues concern more global issues, such as the directions in technological development, the laws that should or should not be passed, and the collective responsibilities of groups such as engineering professional societies and consumer groups. Both micro and macro issues are important in engineering ethics, and often they are interwoven.

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Example

Consider debates about sport utility vehicles (SUVs). Micro issues arose concerning the Ford Explorer and also Bridgestone/Firestone, who provided tires for the Explorer. During the late 1990s, reports began to multiply about the tread on Explorer tires separating from the rest of the tire, leading to blowouts and rollovers. By 2002, estimates were that 300 people had died, and another 1,000 people were injured, and more recent estimates place the numbers much higher. Ford and Bridgestone/ Firestone blamed each other for the problem, leading to the breakup of a century-old business partnership. As it turned out, the hazard had multiple sources. Bridgestone/Firestone used a flawed tire design and poor quality control at a major manufacturing facility. Ford chose tires with a poor safety margin, relied on drivers to maintain proper inflation within a very narrow range, and then dragged its feet in admitting the problem and recalling dangerous tires.

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Example Cont..

In contrast, macro issues center on charges that SUVs are among the most harmful vehicles on the road, especially given their numbers. The problems are many: gas-guzzling, excessive polluting, instability because their height leads to rollovers, greater "kill rate" of other drivers during accidents, reducing the vision of drivers in shorter cars behind them on freeways, and blinding other drivers' vision because of high-set lights. Keith Bradsher estimates that SUVs are causing approximately 3,000 deaths in excess of what cars would have caused: "Roughly 1,000 extra deaths occur each year in SUVs that roll over, compared with the expected rollover death rate if these motorists had been driving cars. About 1,000 more people die each year in cars hit by SUVs than would occur if the cars had been hit by other cars. And up to 1,000 additional people succumb each year to respiratory problems because of the extra smog caused by SUVs." Bradsher believes these numbers will continue to increase as more SUVs are added to the road each year and as older vehicles are resold to younger and more dangerous drivers.

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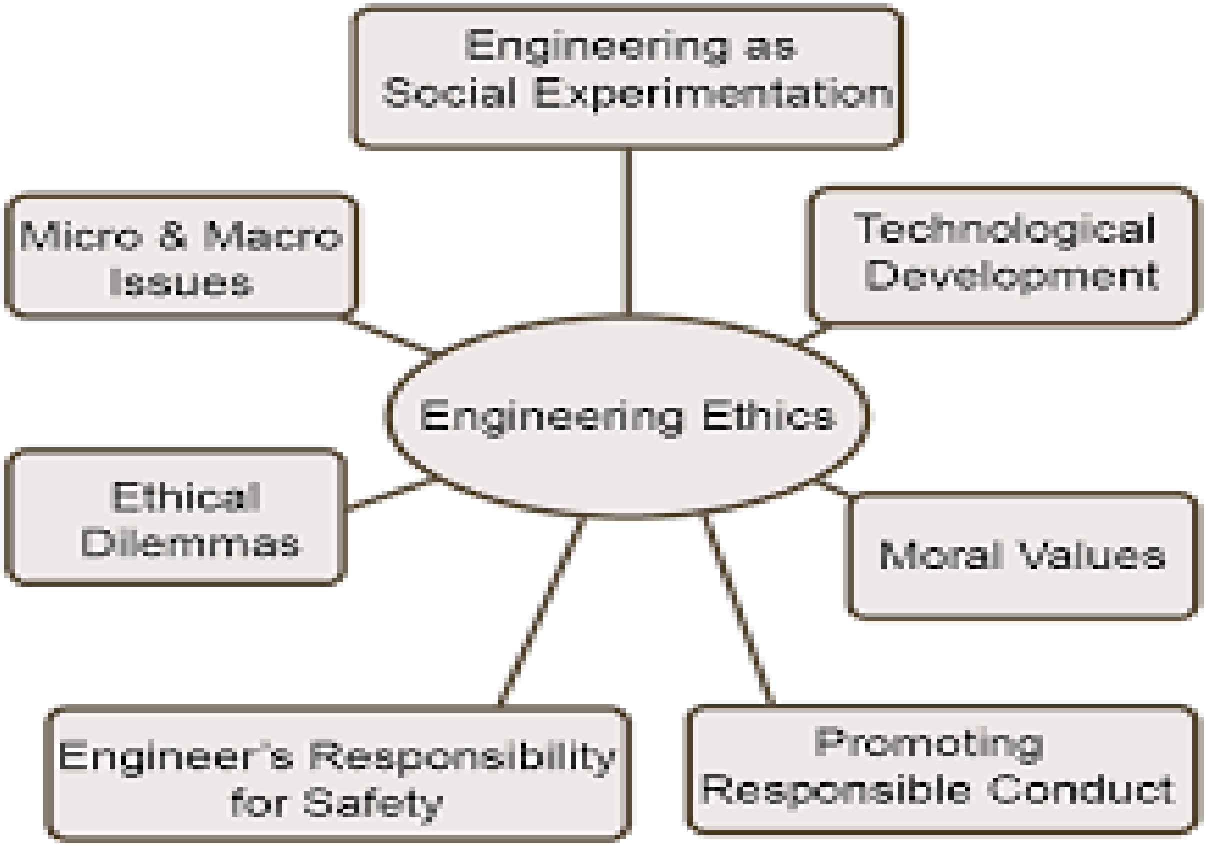
Engineering Ethics



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Personal vs Professional Ethics

Personal ethics deals with how we treat others in our day-to-day lives. Many of these principles are applicable to ethical situations that occur in business and engineering.

However, professional ethics often involves choices on an organizational level rather than a personal level. Many of the problems will seem different because they involve relationships between two corporations, between a corporation and the government, or between corporations and groups of individuals.

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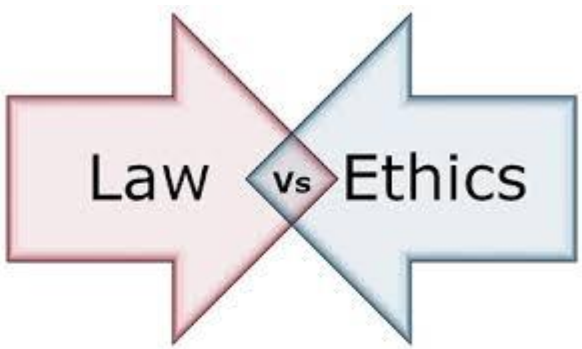
Ethics and Law

Ethics comprises of guidelines and principles that inform people about how to live or how to behave in a particular situation.



The law is defined as the systematic body of rules that governs the whole society and the actions of its individual members.

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20 Engineering Achievements of the Twentieth Century

The top 20 engineering achievements of the twentieth century, as identified by the **National Academy of Engineering** include: electrification, automobiles, airplanes, water supply And distribution, electronics, radio and television, agricultural mechanization, computers, telephones, air-conditioning and refrigeration, highways, spacecraft, Internet, imaging technologies in medicine and elsewhere, household appliances, health technologies, petrochemical technologies, laser and fiber optics, nuclear technologies, and high-performance materials.

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Reflective Questions

Should "the SUV issue" be examined within engineering as a whole, or at least by representative professional and technical societies? If so, what should be done?

Or

In a democratic and capitalistic society, should engineers play a role only as individuals but not as organized groups?

Should engineers remain uninvolved, leaving the issue entirely to consumer groups and lawmakers?

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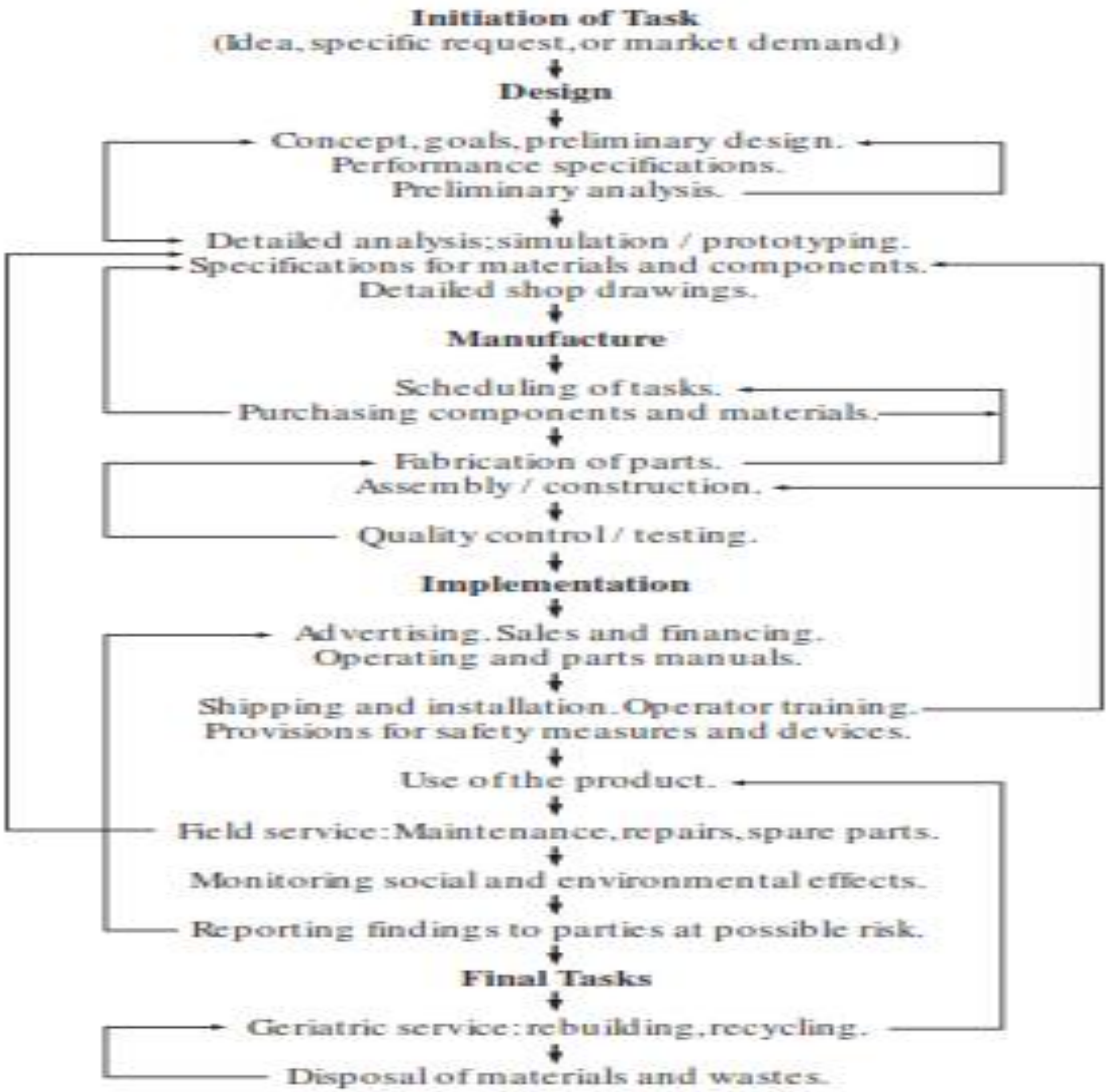
Progressions of Engineering Tasks



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Progressions of Engineering Tasks

The idea of a new product is first captured in a conceptual design, which will lead to establishing performance specifications and conducting a preliminary analysis based on the functional relationships among design variables. These activities lead to a more detailed analysis, possibly assisted by computer simulations and physical models or prototypes. The end product of the design task will be detailed specifications and shop drawings for all components.

Seldom is the process carried out in such a smooth, continuous fashion as indicated by the arrows progressing down the middle of Figure attached in the previous slide. Instead of this uninterrupted sequence, intermediate results during or at the end of each stage often require backtracking to make modifications in the design developed thus far. Errors need to be detected and corrected. Changes may be needed to improve product performance or to meet cost and time constraints. An altogether different, alternative design might have to be considered. In the words of Herbert Simon, "Design is usually the kind of problem solving we call ill-structured . . . You don't start off with a well-defined goal. Nor do you start off With a clear set of alternatives, or perhaps any alternatives at all.

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Progressions of Engineering Tasks

Manufacturing is the next major task. It involves scheduling and carrying out the tasks of purchasing materials and components, fabricating parts and subassemblies, and finally assembling and performance-testing the product. Selling comes next, or delivery if the product is the result of a prior contract. Thereafter, either the manufacturer's or the customer's engineers perform installation, personnel training, maintenance, repair, and ultimately recycling or disposal. Goals and alternatives have to emerge through the design process itself: One of its first tasks is to clarify goals and to begin to generate alternatives." This results in an iterative process, with some of the possible recursive steps indicated by the thin lines and arrows on either side of Figure in the previous slide. As shown, engineers are usually forced to stop during an initial attempt at a solution when they hit a snag or think of a better approach. They will then return to an earlier stage with changes in mind. Such reconsiderations of earlier tasks do not necessarily start and end at the same respective stages during subsequent passes through design, manufacture, and implementation. That is because the retracing is governed by the latest findings from current experiments, tempered by the outcome of earlier iterations and experience with similar product designs.

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Progressions of Engineering Tasks

Changes made during one stage will not only affect subsequent stages but might also require a reassessment of prior decisions. Dealing with this complexity requires close cooperation among the engineers of many different departments and disciplines such as chemical, civil, electrical, industrial, and mechanical engineering. It is not uncommon for engineering organizations to suffer from “silo mentality,” which makes engineers disregard or denigrate the work carried out by groups other than their own. It can be difficult to improve a design or even to rectify mistakes under such circumstances.

Engineers do well to establish contact with colleagues across such artificial boundaries so that information can be exchanged more freely. Such contacts become especially important in tackling morally complex problems. To repeat, engineering generally does not consist of completing designs or processes one after another in a straightforward progression of isolated tasks. Instead, it involves a trial-and-error process with backtracking based on decisions made after examining results obtained along the way. The design iterations resemble feedback loops, and like any well-functioning feedback control system, engineering takes into account natural and social environments that affect the product and people using it.

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Progressions of Engineering Tasks

Table 1–1 Engineering tasks and possible problems

Tasks	A selection of possible problems
Conceptual design	Blind to new concepts. Violation of patents or trade secrets. Product to be used illegally.
Goals; performance specifications	Unrealistic assumptions. Design depends on unavailable or untested materials.
Preliminary analysis	Uneven: Overly detailed in designer's area of expertise, marginal elsewhere.
Detailed analysis	Uncritical use of handbook data and computer programs based on unidentified methodologies.
Simulation, prototyping	Testing of prototype done only under most favorable conditions or not completed.
Design specifications	Too tight for adjustments during manufacture and use. Design changes not carefully checked.
Scheduling of tasks	Promise of unrealistic completion date based on insufficient allowance for unexpected events.
Purchasing	Specifications written to favor one vendor. Bribes, kickbacks. Inadequate testing of purchased parts.
Fabrication of parts	Variable quality of materials and workmanship. Bogus materials and components not detected.
Assembly/ construction	Workplace safety. Disregard of repetitive-motion stress on workers. Poor control of toxic wastes.
Quality control/testing	Not independent, but controlled by production manager. Hence, tests rushed or results falsified.
Advertising and sales	False advertising (availability, quality). Product oversold beyond client's needs or means.
Shipping, installation, training	Product too large to ship by land. Installation and training subcontracted out, inadequately supervised.
Safety measures and devices	Reliance on overly complex, failure-prone safety devices. Lack of a simple "safety exit."
Use	Used inappropriately or for illegal applications. Overloaded. Operations manuals not ready.
Maintenance, parts, repairs	Inadequate supply of spare parts. Hesitation to recall the product when found to be faulty.
Monitoring effects of product	No formal procedure for following life cycle of product, its effects on society and environment.
Recycling/disposal	Lack of attention to ultimate dismantling, disposal of product, public notification of hazards.

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Progressions of Engineering Tasks

The problems in the previous slide i.e. Table 1–1 can arise from shortcomings on the part of engineers, their supervisors, vendors, or the operators of the product. The underlying causes can have different forms:

1. *Lack of vision*, which in the form of tunnel vision biased toward traditional pursuits overlooks suitable alternatives, and in the form of groupthink promotes acceptance at the expense of critical thinking.[7]
2. *Incompetence* among engineers carrying out technical tasks.
3. *Lack of time* or *lack of proper materials*, both ascribable to poor management.
4. A *silo mentality* that keeps information compartmentalized rather than shared across different departments.
5. The notion that there are safety engineers *somewhere down the line* to catch potential problems.
6. *Improper use or disposal of the product* by an unwary owner or user.
7. *Dishonesty* in any activity shown in Figure 1–2 and pressure by management to take shortcuts.
8. *Inattention* to how the product is performing after it is sold and when in use.

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NORMATIVE ETHICS VERSUS DESCRIPTIVE ETHICS

NORMATIVE ETHICS	DESCRIPTIVE ETHICS
Normative ethics is the study of ethical action	Descriptive ethics is the study of people's views about moral beliefs
Analyses how people ought to act	Analyses people's moral values, standards and behaviour
Attempts to evaluate or create moral standards and prescribes how people ought to act	Describes how people behave and what types of moral standards they claim to follow

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Descriptive Ethics

In one descriptive sense, let’s consider Henry Ford’s ethics, or the ethics of American engineers, referring thereby to **<u>what specific individuals or groups believe and how they act</u>**, without implying that their beliefs and actions are justified. In another descriptive sense, social scientists study ethics when they describe and explain what people believe and how they act; they conduct opinion polls, observe behavior, examine documents written by professional societies, and uncover the social forces shaping engineering ethics.

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Normative Ethics

In its **normative senses**, "**engineering ethics**" refers to justified moral values in engineering, but what are moral values? What is morality? Dictionaries tell us that morality is about right and wrong, good and bad, values and what ought to be done. But such definitions are incomplete, for these words also have non moral meanings.

Thus, to start a car a person ought to put the key in the ignition; that is the right thing to do. Again, chocolate tastes good, and beauty is an aesthetic value. In contrast, morality concerns moral right and wrong, moral good and bad, moral values, and what morally ought to be done. Saying this is not especially illuminating, however, for it is a circular definition that uses the word we are trying to define. As it turns out, morality is not easy to define in any comprehensive way. Of course, we can all give examples of moral values, such as honesty, courage, compassion, and justice.

For example: If we say that morality consists in promoting the most good, we are invoking an ethical theory called utilitarianism. If we say that morality is about human rights, we invoke rights ethics. And if we say that morality is essentially about good character, we might be invoking virtue ethics.

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