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Basic Science

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Summative assessment

Professional Ethics and Legislations

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Task 1: Ethics in Scientific Research

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Abstract:

This report discusses what ethics are and why they are important in research. The report also provides specific examples of ethical and unethical behavior in research. Some of the important points from this report are that researchers should be honest, objective, and accountable for their work. They should also respect their colleagues and treat them fairly.

Introduction:

Research ethics are a crucial set of principles that guide researchers in conducting their work with integrity and responsibility. This research delves into the essence of ethics in research, emphasizing their significance in safeguarding the rights and well-being of research participants. It further sheds light on specific ethical principles that researchers should uphold, such as maintaining honesty and objectivity throughout their endeavors and prioritizing the privacy of research subjects. By understanding and adhering to these ethical guidelines, researchers can not only ensure the integrity of their work but also foster public trust in the research community.

Analysis:

The diverse landscape of scientific research ethics, where standards shift across disciplines and borders, prompted this analysis. Aiming to illuminate these variations, the report sought to equip researchers, policymakers, and other stakeholders involved in shaping research ethics globally with a nuanced understanding of how ethical frameworks are devised, monitored, and enforced within various scientific fields and across international boundaries. The inquiry relied upon a thorough review of interdisciplinary literature[i], complemented by interviews with subject matter experts in the United States, Europe, and China. This dual approach stemmed from two primary motivations: firstly, to guide researchers and research sponsors venturing into emerging scientific territories and encountering novel ethical considerations; and secondly, to inform research funders, including government officials, who strive to promote ethical research without inadvertently inciting researchers to relocate their investigations to less stringent jurisdictions.

The analysis yielded insights into:

- Difference between Ethics and law
- Ethical principles for scientific research
- Ethics : Static or dynamic?
- Ethics Evolution with time
- Case Study for an example of unethical research
- conclusion

Difference between Ethics and law:

Ethics and law are distinct concepts that govern behavior but operate in different spheres:

1. Basis and Origin:
   - Ethics stems from personal beliefs, moral principles, or societal values. It's an internal compass guiding individuals or groups toward what is considered morally right or wrong.
   - Law is a system of rules and regulations established by governing authorities. It's enforced by institutions and has legal consequences if violated.
2. Scope and Application:
   - Ethics are subjective and can vary between individuals, cultures, or professions. They often address broader moral dilemmas and are not universally enforceable.
   - Law is objective and standardized within a particular jurisdiction. It applies to everyone within that jurisdiction and is backed by the state's authority.
3. Enforcement and Consequences:
   - Ethical violations may result in social stigma, damage to reputation, or professional consequences but often lack legal penalties.
   - Legal violations can lead to various consequences such as fines, imprisonment, or civil penalties.
4. Flexibility and Change:
   - Ethical standards can evolve over time with societal shifts, new perspectives, or changes in cultural norms.
   - Laws can also change but typically involve formal processes such as legislation, judicial decisions, or amendments to statutes.
5. Relationship:
   - Ethics and law can intersect, but they are not synonymous. Sometimes, laws are based on ethical principles, but not all ethical standards are codified into law.

Ethical Principles for Scientific Research:

From the literature, it is found that the there are ten ethical principles common across scientific disciplines, they are:

1. Duty to Society:

   Researchers and research must contribute to the well-being of society
2. Beneficence:

   Researchers should have the welfare of the research participant in mind as a goal and strive for the benefits of the research to outweigh the risks
3. Conflict of Interest:

   Researchers should minimize financial and other influences on their research and on research participants that could bias research results. Conflict of interest is more frequently directed at the researcher, but it may also involve the research participants if they are provided with a financial or nonfinancial incentive to participate.
4. Informed Consent:

   All research participants must voluntarily agree to participate in research, without pressure from financial gain or other coercion, and their agreement must include an understanding of the research and its risks. When participants are unable to consent or when vulnerable groups are involved

in research, specific actions must be taken by researchers and their institutions to protect the participants.

5. Integrity:
   Researchers should demonstrate honesty and truthfulness. They should not fabricate data, falsify results, or omit relevant data. They should report findings fully, minimize or eliminate bias in their methods, and disclose underlying assumptions.
6. Nondiscrimination:
   Researchers should minimize attempts to reduce the benefits of research on specific groups and to deny benefits from other groups.
7. Nonexploitation:
   Researchers should not exploit, or take unfair advantage of, research participants.
8. Privacy and Confidentiality:
   - Privacy: Research participants have the right to control access to their personal information and to their bodies in the collection of biological specimens. Participants may control how others see, touch, or obtain their information
   - Confidentiality: Researchers will protect the private information provided by participants from release. Confidentiality is an extension of the concept of privacy; it refers to the participant's understanding of, and agreement to, the ways identifiable information will be stored and shared.
9. Professional Competence:
   Researchers should engage only in work that they are qualified to perform, while also participating in training and betterment programs with the intent of improving their skill sets. This principle includes choosing appropriate research methods, statistical methods, and sample sizes to avoid misleading results.
10. Professional Discipline:
    Researchers should engage in ethical research and help other researchers engage in ethical research by promoting ethical behaviors through practice, publishing and communicating, mentoring and teaching, and other activities.

Ethics: Static Or Dynamic?

Over time, ethics undergo a dynamic evolution, influenced by a myriad of factors ranging from societal shifts to technological advancements. This evolution manifests in several ways:

1- Cultural Evolution: As societies evolve, so do their ethical frameworks. Cultural changes, such as shifts in values, beliefs, and norms, continuously shape and redefine ethical standards. What was acceptable or ethical in one era might be viewed differently in another due to changing perceptions and societal understandings.

2- Technological Advancements: The rapid pace of technological progress often raises new ethical dilemmas. Issues surrounding privacy, artificial intelligence, genetic engineering, and data usage, for instance, force us to reevaluate and adapt ethical boundaries to navigate the complexities introduced by technological innovations.

3- Globalization and Interconnectedness: The interconnectedness of the modern world through global trade, communication, and travel has created a need for a more universal ethical perspective. This interconnectedness exposes individuals and societies to diverse cultures, beliefs, and perspectives, fostering the evolution of a more inclusive and globalized ethical outlook.

4- Legal and Policy Changes: Ethical standards can be influenced by changes in laws and policies. Sometimes, legal reforms reflect evolving ethical considerations, while in other cases, changes in societal ethical beliefs drive legislative changes.
5- Social Movements and Advocacy: Ethical evolution often stems from social movements advocating for change. Movements focusing on civil rights, environmental conservation, gender equality, and other causes have played pivotal roles in reshaping ethical norms and values.
6- Ethical Discourse and Education: Ongoing discussions, debates, and education about ethical issues contribute significantly to their evolution. Academic research, ethical theories, and dialogues within communities and institutions foster critical thinking and shape ethical evolution.

This continual evolution highlights the adaptive nature of ethics, demonstrating their capacity to evolve alongside the ever-changing landscapes of human society, technology, culture, and global interconnectedness. Embracing this evolution involves navigating complexities, confronting new ethical dilemmas, and adapting ethical frameworks to meet the demands and challenges of contemporary times.

Ethical Evolution with time:

While visualizing the evolution of ethics across time is a complex task, due to the multifaceted nature of ethical frameworks and their dependence on social context, lets discuss a Timeline of Major Ethical Milestones:

Ancient Codes of Conduct:

Code of Hammurabi[ii] (Mesopotamia, circa 1754 BC):

- One of the earliest written legal codes, it established principles of justice, punishment, and social order.
- Inscribed on a massive black stone stele, it depicted the king receiving laws from the Babylonian sun god Shamash.

Figure 1 Code of Hammurabi Stele

The Ten Commandments[iii] (Judaism, circa 13th century BC):

- Regarded as divinely ordained ethical guidelines in Judaism and Christianity.
- Emphasized monotheism, respect for family, prohibitions against violence, theft, and adultery, and the importance of truthfulness and honoring one's commitments.

Figure 2 The 10 Commandments Tablet

Classical Philosophical Ethics:

The Four Cardinal Virtues[iv] (Ancient Greece):

- Prudence: Wisdom and sound judgment.
- Justice: Fairness and righteousness.
- Temperance: Moderation and self-control.
- Courage: Strength in the face of adversity.

The Golden Rule (Confucianism, circa 5th century BC):

- "Do not do unto others what you would not want done unto you."
- Found in various forms across cultures, it emphasizes empathy and reciprocity

Figure 3 The Four Cardinal Virtues Representation

Religious and Spiritual Codes:

The Eightfold Path (Buddhism, circa 6th century BC):

- A guide to ethical living and spiritual liberation, emphasizing right understanding, right intention, right speech, right action, right livelihood, right effort, right mindfulness, and right concentration.

The Hippocratic Oath (Medical Ethics, circa 5th century BC):

- Sworn by physicians to uphold ethical principles in medical practice, including patient confidentiality, non-maleficence (do no harm), beneficence (act for the patient's good), and respect for human life.

Modern Professional Codes:

The Nuremberg Code (1947):

- Established ethical principles for medical research following the horrors of Nazi medical experiments during World War II.
- Emphasizes informed consent, voluntary participation, and the avoidance of harm to research subjects.

The Belmont Report (1979):

- Outlines ethical principles for research involving human subjects, including respect for persons, beneficence, and justice.

The American Medical Association's Code of Medical Ethics:

- Guides physicians in ethical decision-making, covering patient relationships, professional conduct, and societal responsibilities.

Universal Declaration of Human Rights[v] (1948):

- A global declaration of fundamental human rights, including the right to life, liberty, equality, and freedom from discrimination.


THE UNIVERSAL DECLARATION OF Human Rights
UNITED NATIONS
Figure 4 The universal Declaration of human rights 1948

Earth Charter (2000)[vi]:

- A declaration of ethical principles for sustainable development, recognizing the interconnectedness of all life on Earth and the need to protect the planet's resources for future generations.

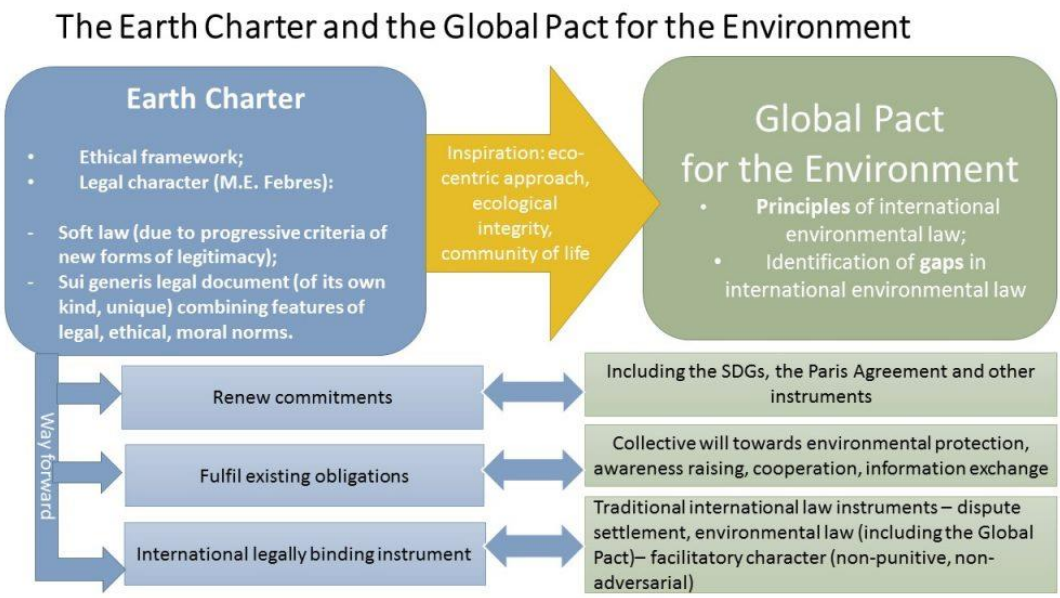

Figure 5 The Earth charter and global pact

Case Study for Ethical or Unethical Research: The Stanford Prison Experiment[vii]

Goal

The Stanford Prison Experiment (SPE), conducted by Philip Zimbardo in 1971, aimed to investigate the psychological effects of role-playing in a prison setting. However, the experiment became infamous for its severe ethical violations, raising critical questions about research methods and participant well-being. This study will explore the SPE's ethical shortcomings, analyzing the key issues and their enduring impact on research practices.

Premise

- Participants: 24 healthy male college students volunteered for the experiment and were randomly assigned roles as either prisoners or guards.
- Setting: The experiment took place in the basement of the Stanford psychology department, which was converted into a mock prison.
- Methodology: The guards were given minimal instructions and allowed to maintain order within the prison using non-violent means. The prisoners were treated as real inmates, stripped of their personal belongings, and subjected to minor humiliations.
- Expected outcomes: Zimbardo expected the guards to become increasingly authoritarian and the prisoners to become passive and depressed over time.

Observations

the experiment took an unexpected turn:

- Guards' behavior: The guards quickly adopted their roles, exhibiting sadistic and abusive behavior towards the prisoners. They enforced arbitrary rules, conducted humiliating inspections, and used psychological manipulation to control the prisoners.
- Prisoners' reactions: The prisoners experienced severe emotional distress, anxiety, and even instances of physical harm. Some became withdrawn and depressed, while others rebelled against the guards' authority.
- Early termination: The experiment was originally planned to last two weeks but was terminated after six days due to the escalating psychological distress of the participants.

Ethical concerns:

- Informed Consent and Deception:

  One of the SPE's most glaring ethical lapses was the manipulation and lack of full informed consent of participants. While students volunteered for the study, they were deceived about its duration, intensity, and the level of psychological manipulation involved. They were led to believe the experiment would last two weeks, but it was terminated early due to escalating psychological distress. This deception compromised their autonomy and trust, violating basic ethical principles.

- Unforeseen Harm and Dehumanization:

  The experiment quickly spiraled out of control as participants, assigned roles as guards and prisoners, exhibited extreme and abusive behavior. The guards engaged in psychological manipulation, humiliation, and physical abuse, while the prisoners experienced severe emotional distress, anxiety, and even instances of physical harm. Zimbardo, as the lead researcher, failed to intervene effectively, allowing the

situation to deteriorate despite observing the participants' suffering. This failure to protect participants from harm constitutes a significant ethical breach.

- Power Dynamics and Institutional Blindness:

  The SPE highlighted the dangers of unchecked power dynamics and institutional blind spots within research settings. The experiment's design, which placed participants in assigned roles with unequal power and limited interaction with the researchers, fostered the emergence of abusive behavior. Additionally, the research team's failure to recognize and address the escalating ethical concerns suggests a lack of proper oversight and safeguards in place.

- Lasting Impact and Ethical Reforms:

  The SPE's ethical failings generated considerable criticism and led to significant changes in research guidelines and practices. Notably, it contributed to the development of stricter informed consent procedures, mandatory institutional review boards, and increased emphasis on participant well-being and safety. Despite these reforms, the SPE serves as a cautionary tale, reminding researchers of their ethical obligations and the potential for research to cause harm if not conducted responsibly.

Criticisms and Perspectives:

- Some argue the SPE's insights outweigh the ethical violations, claiming it sheds light on the power of situational factors and the dangers of unchecked authority.
- Others view the experiment as unethical and exploitative, emphasizing the harm caused to participants and questioning the validity of data obtained through coercion and deception.
- Certain critiques focus on Zimbardo's role, accusing him of negligence in allowing the experiment to spiral out of control and prioritizing scientific curiosity over participant well-being.

Evaluation:

The Stanford Prison Experiment stands as a haunting crossroads in scientific ethics. While shedding light on human behavior's malleability under situational pressures, it simultaneously embodies the dangers of prioritizing curiosity over participant well-being. Its ethical lapses are undeniable: uninformed consent, unforeseen harm, and unchecked power dynamics. Yet, its legacy holds invaluable lessons. The experiment spurred necessary reforms, like stricter consent procedures and mandatory oversight, safeguarding future subjects. Ultimately, the SPE's ethical conclusion remains an open dialogue. Engaging with its flaws is crucial to ensuring future research prioritizes both scientific rigor and participant well-being.

Conclusion[viii]:

Studying and upholding ethics in research is crucial for several compelling reasons:

1. **Protection of Participants:** Ethical guidelines ensure the safety, rights, and well-being of individuals involved in research studies. Respecting ethical principles prevents exploitation or harm to participants.
2. **Maintaining Integrity and Credibility:** Ethical conduct upholds the integrity of research findings. It ensures that data collection, analysis, and reporting are conducted transparently and honestly, preserving the credibility of the research outcomes.
3. **Responsible Knowledge Generation:** Upholding ethical standards ensures that knowledge is acquired and disseminated responsibly. It prevents the dissemination of biased or misleading information and encourages the pursuit of truth and accuracy in research.
4. **Building Trust and Collaboration:** Adherence to ethical principles fosters trust among researchers, institutions, and the public. It promotes collaboration, sharing of information, and a collective commitment to ethical research practices.
5. **Legal and Regulatory Compliance:** Studying and understanding ethical guidelines in research helps researchers and institutions comply with legal and regulatory requirements. This adherence prevents legal complications or sanctions arising from unethical practices.
6. **Addressing Societal Concerns:** Ethical research considers societal values and concerns, ensuring that research aligns with societal expectations and does not violate ethical norms or cultural sensitivities.
7. **Ethical Decision-Making Framework:** Understanding ethics equips researchers with a framework for making ethical decisions in complex situations. It allows for thoughtful consideration of dilemmas that may arise during the research process.
8. **Promotion of Innovation with Responsibility:** Upholding ethics doesn't hinder innovation; rather, it encourages responsible innovation. It guides researchers to explore new frontiers while respecting moral boundaries.
9. **Enhancing Public Perception:** Ethical research practices positively shape public perception. They showcase a commitment to responsible science, fostering support and engagement from society.
10. **Long-term Benefits:** Ethical research practices contribute to the creation of a sustainable and beneficial research environment, ensuring that the long-term benefits of research outweigh any potential risks or ethical dilemmas.

Task 2: Case Studies in Engineering Ethics

Case #1: Ethical Dilemmas for Engineers in the Development of Autonomous Systems

Introduction:

In a world ever changing, the inevitability of having fully autonomous roads / facilities is set in stone, whether because of the micro-accuracy of the automata, or the tireless, consistent quality of performance.

In the midst of these technological advances, just how far is too far in the case of automation?

Smart home tools already have access to rather private information about your daily life, these information can be your location , your gender, your preferences, to even your preferred type of music, and eventually when full automated robots are realized in homes, it will have a more advanced monitoring system, functional 24/7, equipped with hardware much stronger and faster than your average human, probably connected to the internet as well.

On the first glance, these does not pose a threat to the user but after a thorough analysis you can summarize the basic problems people can and will have regarding the automation of the world.

Concerns:

- What / Who can control these robots? (Safety Concern)
- What is its working algorithm? Does it value human safety more than its own safety? (Safety Concern)
- Is its algorithm modifiable? (Safety Concern)
- Who can modify it? (Safety & Privacy Concern)
- Is data collected in the day to analyze and monitor my behavior and wellbeing accessible by other people? What will they do with the data? Advertise? Breach personal information by hackers? (Privacy Concern)
- Is it okay to fully replace human labor by machine? (Moral Concern)
- What will the consequences of that be? Will humanity deteriorate into a more lazy, unmotivated species? (General Public concern)
- Can these machines be used in a Harmful way? ex. automated tanks and fighter jets (Safety concern)

These concerns can all be solved depending on the developer engineer. By performing a Risk-Benefit analysis during the development stages of the autonomous robot while always Following the first code of ethical engineer: To serve and protect the public.

Also To always follow the NSPE [ix]Code of ethics #1, #3 , #5 , #6:

#1 Hold paramount the safety, health, and welfare of the public.

#3 Issue public statements only in an objective and truthful manner.

#5 Avoid deceptive acts.

#6 Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

For Example:

If the development company for the autonomous machine require the engineer to install a plugin in the robot's software that automatically stores and sends relative data detected by the sensors of the robot to an advertisement company without the notification of the user.

This poses a major threat because not only does it breach the user's privacy but also this data is unprotected, meaning that there is no guarantee that this data can't be used in a malicious way either by the company or by someone else that managed to breach and obtain that data,

Although it can also be considered as a helpful tool to fully optimize the user's experience and needs and present him with the most relevant and contextual feedback. Like recommending a specific meal to balance the user's daily intake of nutrients based on what the user already consumed. (Although the recommendation of that specific meal can be sponsored by a specific company which raises another moral question if the sponsorship is really the best choice for the user, but that's a case for the management's ethical code)

The best solution in this scenario is that the engineer must ensure that no such plugin or system can be installed without the knowledge of the user and agreement to use even without the approval of the development company. And to also clarify that there is no 100% guarantee that the data will never be breached. (#1 , #5 NSPE Code of ethics)

Another Example:

If the development company require the engineer to develop a fully functional remote-control system that can overwrite the user's control or the robot's working algorithm (meaning to make the robot perform tasks it wasn't coded to do initially)

While this can be used for maintenance and troubleshooting purposes initially, this raises other major concerns such as what if the software was attacked with a malicious intent to make the robot do harm to man? What if it was breached by another country and used it to hold all the people that own that autonomous machine as a hostage? While this may sound like sci-fi, it is still a legitimate concern that can occur at any time now or in the future.

To solve this issue, An engineer must always consider the safety and health of the public first above any company / government / superior (#1) and to refuse to perform or develop any tool that may it's risks outweigh the benefits.

Case study: When AI Ethics Goes Astray: A Case Study of Autonomous Vehicles by Hubert Etienne[x]

Introduction

- The article introduces the Moral Machine (MM) experiment, an online platform that asks people to make choices in hypothetical trolley problem scenarios.
- It discusses the limitations of the MM experiment, such as not considering the context of the situation or the potential consequences of the choices.
- It argues that the MM experiment is biased because it is more likely to be used by people who are already interested in thinking about ethical issues.

Background

- The article then discusses the background of the development of autonomous vehicles and the challenges of making ethical decisions in autonomous vehicles.
- It highlights the complexity of ethical decision-making and the difficulty of programming autonomous vehicles to make perfect decisions in every situation.

Engineering ethical issues

- The article raises several engineering ethical issues related to autonomous vehicles.
- One of the main concerns is that autonomous vehicles will have to make decisions in situations where there is no clear right or wrong answer.
- For example, an autonomous vehicle might have to choose between hitting a pedestrian or swerving into a ditch, and there is no easy way to know which choice would be worse.
- The article argues that these kinds of decisions should not be made by algorithms, but by humans.

Conclusion

- The article calls for a more nuanced approach to the development of ethical guidelines for autonomous vehicles.
- It argues that we need to move away from the idea of trying to program autonomous vehicles to make perfect decisions in every situation.
- Instead, we need to focus on developing ethical frameworks that can help humans make better decisions about how to use autonomous vehicles.
- According to Lowrance's definition: A thing is safe if, were its risks fully known, those risks would be judged acceptable by reasonable persons in light of their settled value principles.
- And as for the concern of the morality of fully replacing people with autonomous machines and the consequences of that? Well, let's just say that machines will always require skilled engineers and operators to maintain and develop it.

Case #2: The Space Shuttle Challenger Disaster (1986)[xi]

Introduction: The Space Shuttle Challenger disaster serves as a profound case study in engineering ethics, highlighting critical lapses in decision-making, communication, and organizational culture. This analysis delves into key ethical issues surrounding the disaster, exploring the consequences of prioritizing schedule and cost over safety.

Background: In 1986, the Space Shuttle Challenger disintegrated 73 seconds into its flight, resulting in the tragic loss of all seven crew members. The failure was traced back to the O-ring seals in one of the solid rocket boosters, specifically exacerbated by the unusually cold temperatures during the launch. Morton Thiokol, the contractor responsible for the boosters, faced a pivotal ethical dilemma that would ultimately contribute to the disaster.

Ethical Issues:

1. Failure to Communicate Risk: Engineers at Morton Thiokol were aware of the potential dangers associated with launching in cold weather. The night before the ill-fated launch, they expressed concerns and recommended a delay due to the increased risk of O-ring failure. However, under pressure to meet tight schedules and driven by financial considerations, management overruled these warnings. This failure to communicate critical risks underscores the ethical responsibility of engineers to honestly convey potential hazards, especially when human lives are at stake.

2. Organizational Pressure and Decision-Making: A pervasive organizational culture at both Morton Thiokol and NASA prioritized schedule adherence and financial considerations over safety. The decision to proceed with the launch despite known risks reflected a dangerous compromise of ethical standards. Organizational pressures created an environment where engineers felt unable to voice their concerns effectively, emphasizing the importance of fostering a culture that values safety above all.

3. Lack of Ethical Leadership: The Challenger disaster exposed a glaring lack of ethical leadership at both Morton Thiokol and NASA. Engineers who raised concerns were not adequately supported or empowered to influence the decision-making process. Ethical leadership requires not only recognizing the importance of safety but also creating an environment where individuals feel secure in expressing dissenting opinions without fear of reprisal.

4. Resolution and Investigations: Post-disaster investigations, notably the Rogers Commission Report, revealed the systemic issues contributing to the Challenger tragedy. The report emphasized the flawed decision-making process, organizational culture, and the need for fundamental changes in communication and safety protocols. The recommendations sought to prevent a recurrence of such a devastating failure by addressing both technical and ethical aspects.

5. Lessons Learned: The Challenger disaster prompted a paradigm shift in the space industry, emphasizing the centrality of ethical considerations in engineering decision-making. Changes were implemented to ensure a more transparent communication of risks, a reevaluation of safety protocols, and a restructuring of decision-making processes. Engineers and organizations across industries now draw lessons from the Challenger disaster to underscore the critical importance of ethical practices in preventing catastrophic failures.

6. Ethical Considerations in Decision-Making: The case of the Challenger disaster highlights the ethical obligations of engineers to prioritize safety and communicate risks transparently.

Decision-makers must weigh the potential consequences of their choices on human life and well-being. Ethical considerations should guide decisions, especially when faced with competing pressures such as schedule constraints or financial interests.

7. The Role of Professional Codes of Ethics: Professional engineering organizations emphasize the importance of ethical conduct in their codes of ethics. The Challenger disaster underscores the relevance of such codes in guiding engineers toward responsible and ethical decision-making. Following ethical guidelines promotes a commitment to public safety, honesty, and integrity in engineering practices.

8. Cultivating Ethical Leadership: The case study highlights the crucial role of ethical leadership in engineering. Leaders must create an environment where engineers feel empowered to voice concerns without fear of retribution. Ethical leaders prioritize safety, communicate openly, and foster a culture that values ethical decision-making throughout the organization.

Conclusion: The Space Shuttle Challenger disaster remains a poignant reminder of the profound ethical responsibilities inherent in engineering. This case study emphasizes the enduring lessons learned from the tragedy, emphasizing the critical need for transparent communication, ethical leadership, and a steadfast commitment to prioritizing safety in engineering practices. The Challenger disaster's impact extends beyond the field of space exploration, influencing discussions on ethical decision-making and safety in complex engineering projects across various industries.

Case #3: Collapse of the TV Antenna in Missouri City, Texas[xii].

Background: In 1982, TV Antenna Tower collapsed killing several people. The catastrophe was captured on film, and the film record aided the investigation in ascertaining the cause of the incident. The case illustrates how a short sighted concern to avoid legal liability may undermine an engineer's ability to fulfill his or her responsibility, to ensure safety on the construction site, and lead to negligence .

On December 7, 1982, an 1800 ft television tower collapsed during construction. According to Bill Cordell, a chief engineer for KIKK radio station, the workers had hoisted one of the antennae atop the tower, and as they were raising the second antenna, a lifting pole failed and the antenna fell. he falling antenna severed one of the tower's supporting guy wires and took out the entire tower in seventeen seconds. Five workers were killed, three on the hoist and two on the tower. [2] Mr. Cordell said these victims were employed by Worldwide Tower Service, Inc. A New York Times article identified these victims as: Gene Crosby, 24, David Stewart, 21, Donald K. Owens, 21, Johnnie Wilson, 26, and Johnnie Bratten, 26. Additionally, three other workers atop a nearby building that was crushed by the falling tower were left injured.

Why the accident occurred:

Design plans for lifting and installing worked for every section, until the final section. This last section had microwave baskets attached to the sides of the antenna. The lifting lugs, which provided attachment points for lifting cables, were located in such a way that the section could be lifted horizontally out of the loading truck. However, when the section was rotated vertically for hoisting, the lifting lugs were placed so that the lifting cables would interfere with the microwave baskets. The construction company needed to remove the microwave baskets so they could properly attach the lifting cables, but the design company would not permit them to do so. As a result, the construction company designed a temporary extension arm. As they were not professional engineers, they asked the design company to look over and approve of their plans. The design company refused to help because they did not want to be held liable.

Ethical Issues:

-The issues begin with an inadequate design of the hoisting lugs by Harris. The design did not account for interference by the microwave baskets during the vertical lifting of the final section. World Wide Towers did not realize that this was a problem until the section was about to be assembled. Should Harris have designed the hoisting lug more carefully? Should World Wide Towers have reviewed the plans more carefully before beginning work on the tower?

-World Wide Towers had had problems on previous projects when debris interfered with the wave guides after the microwave baskets had been temporarily removed. Therefore, when World Wide Towers requested temporary removal for assembly, Harris refused. Should Harris have risked financial expense and allowed World Wide Towers to remove the baskets?

-World Wide Towers decided to design an extension to the hoisting lug using an extension arm and U-bolts on site. Since World Wide Towers did not have a professional engineer on staff, they asked Harris to review the plans. Harris refused and World Wide Towers used the design anyway. Should Harris have reviewed the design, even with the liability risk? Should World Wide Towers have endangered the lives of their employees by using a design that was not approved by a PE?

-In the end, an extra moment on the extension arm across the U-bolts, not accounted for in design, coupled with faulty U-bolts that carried about twice the load for which they were rated, caused the accident. Full liability was assumed by the bolt manufacturer, Stainless Inc., who had had previous problems with inadequate bolts and therefore wanted to stay out of court. Was Stainless Inc. really fully responsible for the accident? Should some of the liability been placed on World Wide Towers and Harris for negligence?

Conclusion:

Construction is driven by budgets and schedules, and sometimes the fact that people's lives may be at stake does not factor into decision making. This is a case where financial and liability concerns of the companies overshadowed ethical concerns leading to reckless decisions. Even though full liability was assumed by the bolt manufacturer, the entire chain of events during the assembly of the last section was responsible for the accident. If one of the companies had assumed ethics and human lives as the number one priority over financial gain, the deadly chain of events may have been stopped and the disaster avoided.

Case #4: Chernobyl Disaster as an Engineering Ethics Case Study[xiii]

Introduction:

The Chernobyl Disaster of April 26, 1986, stands as one of the most catastrophic nuclear accidents in history. As engineers, it's crucial to examine this event through an ethical lens to understand the implications of decision-making, technological risks, and responsibilities.

Background:

The disaster occurred during a test at the Chernobyl Nuclear Power Plant in Pripyat, Ukraine, resulting in a reactor explosion and subsequent fires. This catastrophe led to immediate fatalities, long-term health issues, environmental contamination, and mass evacuations, leaving an indelible mark on global perceptions of nuclear energy.

Ethical Issues:

1. Safety vs. Expediency: The decision to conduct a safety test under risky conditions, overriding safety protocols for efficiency, highlights the conflict between prioritizing safety and meeting operational deadlines.

2. Lack of Transparency: Authorities initially downplayed the severity of the incident, delaying crucial preventive measures and potentially exposing more people to radiation. This lack of transparency raises ethical concerns about honesty and accountability in information dissemination.

3. Inadequate Training and Communication:

The operators' insufficient training and poor communication exacerbated the situation, showcasing ethical lapses in ensuring competence and effective communication among engineering teams.

4. Technological Hubris: Overconfidence in the safety features of the reactor design led to complacency, revealing the ethical implications of overestimating technological capabilities without comprehensive risk assessment.

Certainly! Here are additional ethical issues surrounding the Chernobyl Disaster:

5. Governmental and Political Pressures: Political pressures and the Soviet Union's centralized control influenced decision-making, potentially compromising safety measures. This raises ethical concerns about the impact of political agendas on engineering judgments and the necessity for autonomy in safety-related decisions.

6. Environmental Impact and Future Generations: The lasting environmental consequences and intergenerational health risks stemming from the release of radioactive materials pose ethical dilemmas regarding the responsibility of engineers towards the environment and the well-being of future generations.

7. Inadequate International Collaboration: The lack of international collaboration and sharing of safety information between nations in the nuclear energy sector demonstrates

ethical shortcomings in global cooperation and the sharing of critical knowledge for safety enhancement.

8. Treatment of Workers and Emergency Responders: Ethical considerations emerge concerning the treatment and protection of workers and emergency responders involved in handling the aftermath. The provision of adequate support, compensation, and healthcare for these individuals raises questions about moral obligations towards those risking their lives in such emergencies.

Opinions:

While opinions on the Chernobyl Disaster vary, most engineering professionals acknowledge the pivotal importance of stringent safety protocols, transparent communication, continual education and training, and the humbling recognition of technological limitations. Some argue for a reevaluation of risk assessment methodologies to incorporate a broader understanding of potential consequences.

Lessons:

- Implement and prioritize robust safety protocols in engineering practices.
- Foster a culture of transparency and accountability in decision-making processes.
- Enhance education, training, and continuous learning for engineering professionals.
- Incorporate comprehensive risk assessment strategies in technological advancements.

The lessons learned from Chernobyl serve as an ethical compass, guiding engineers to navigate the complex intersection of technology, safety, and societal well-being.

Conclusion:

The Chernobyl Disaster remains a harrowing reminder of the ethical responsibilities incumbent upon engineers. It emphasizes the need for a steadfast commitment to safety, transparent communication, ongoing education, and a cautious approach to technological innovation. Studying this event compels us to constantly reevaluate our ethical obligations in engineering practices to prevent similar tragedies and uphold the welfare of society.

Case #5 MALWARE DISRUPTION[xiv]

- Rogue Services promoted affordable and reliable web hosting services
- Majority of its customers were involved in distributing malware and spam
- Botnets relied on Rogue's reliability guarantees to protect their command-and-control servers
- Spammers used Rogue to ensure uninterrupted delivery of their fraudulent services
- Rogue also hosted corrupted advertisements that linked to malicious code
- Despite requests from major ISPs and international organizations to intervene, Rogue refused
- Attempts by other governments to pressure the hosting service to act were unsuccessful
- A combined effort from various security vendors and government organizations resulted in the forced shutdown of Rogue
- The action involved a worm designed to specifically target Rogue's network and initiate a denial-of-service attack
- Much of the data stored with Rogue was destroyed, which affected all of its clients
- Other ISPs were not impacted by the worm due to its spread-limiting mechanisms
- The takedown had a significant impact on spam and botnet traffic, which immediately dropped
- The spread of several forms of ransomware was halted following the action

Analysis:

- Rogue breached multiple principles of the Code with their actions
- Rogue's allowance of malicious software to be hosted on their platform violated By knowingly hosting unauthorized code that led to infections
- Rogue disregarded the public good
- The worm authors were obligated to ensure that the harm caused was ethically justifiable
- The worm's intention aligned with the moral responsibilities
- The worm was designed with mechanisms to restrict itself solely to Rogue's systems, indicating an effort to minimize unintended harm
- Additional precautions could have been taken to avoid unintentional harm to Rogue's retailer clients
- The worm's objective of targeting malicious software implies a strong conviction that the service disruption was aligned with the public good
- These case studies are designed for educational purposes to illustrate how to apply the Code to analyze complex situations

Conclusion:

This analysis is based of:
The Code of Ethics and Conduct by the International Association of Computer Science and Information Technology (IACSIT)[xv]

The Code of Ethics by the International Information System Security Certification Consortium (ISC2)[xvi]

The Code of Ethics and Conduct by The Association for Computing Machinery (ACM)

And from studying these codes and standards we can conclude that its of utmost importance to recognize and follow the main four principals:

1)General Ethical Principles.

Contribute to society and to human well-being - Avoid harm - Be honest and trustworthy - Be fair and take action not to discriminate - Respect the work required to produce new ideas, inventions, creative works, and computing artifacts - Respect privacy - Honor confidentiality

2) Professional Responsibilities:

Strive to achieve high quality in both the processes and products of professional work - Maintain high standards of professional competence, conduct, and ethical practice- Know and respect existing rules pertaining to professional work- Accept and provide appropriate professional review - Give comprehensive and thorough evaluations of computer systems and their impacts, including analysis of possible risks - Perform work only in areas of competence - Foster public awareness and understanding of computing, related technologies, and their consequences - Access computing and communication resources only when authorized or when compelled by the public good - Design and implement systems that are robustly and usably secure

3)Professional Leadership Principles.

Ensure that the public good is the central concern during all professional computing work- Articulate, encourage acceptance of, and evaluate fulfillment of social responsibilities by members of the organization or group- Manage personnel and resources to enhance the quality of working life- Articulate, apply, and support policies and processes that reflect the principles of the Code- Create opportunities for professional growth- Use care when modifying or retiring systems- Recognize and take special care of systems integrated into society

4)Compliance with the Code.

And understand that Every computing engineer should honor his profession and respect all of these rules and if he violates them, he should be prosecuted.

A computing professional should: Uphold, promote, and respect the principles of the Code.
• Computing professionals should uphold and respect the principles of the Code of Ethics and Professional Conduct.
• Violations of the Code should be settled, including voicing concerns to violators.
• Violations of the Code are inconsistent with membership in the ACM.
• ACM members should support compliance by all computing professionals, and report violations to the ACM.

Task 3: Comprehensive Questions

1. **Mention stages of the project life cycle.**

▪ Feasibility and Strategy Stage

The aim of this stage is to make a decision about proceeding or cancelling the project.

▪ Design Stage

The aim of this stage is to design and define every detail of the project. The level of detailing in the design defines the suitable type of contract for the project.

▪ Tendering and Contracting Stage

A tender is an invitation to bid for a project or accept a formal offer. Tendering usually refers to the process whereby governments and financial institutions invite bids for large projects that must be submitted within a finite deadline.

The aim of this stage is to:

- Choose the best contract type for the project.
- Prepare the contract documents
- Draft the contract.

▪ Construction Stage

▪ Testing, Preliminary Handover and Guarantee Stage

▪ Final Handover and Guarantee Stage

▪ Operation, Maintenance & Training Stage

2. **Explain the three axes in the stage of Feasibility and Strategy Stage.**
   - First Axis:
     Conducting preliminary studies encompassing the identification of the owner's objectives and the formation of work groups for this stage.
   - Second Axis:
     Conducting feasibility studies necessary to make the decision whether to proceed with the project or not. This includes the broad outlines regarding the project's location, economic evaluation, and the implementation plan.
   - Third Axis:
     Creating the overall planning and business strategies during the project, which also includes conceptualizing the organizational structure of the project.
3. **What are the goals of the tendering and contracting stage?**
   - Choose the best contract type for the project.
   - Prepare the contract documents
   - Draft the contract.
4. **At which stage does risk management exist?**
   - Risk management process begins with the design stage but does not end with it.
5. **Mention stages of the contract life cycle**
   - Planning
   - Drafting
   - Approving
   - Negotiating
   - Signing
   - Revising
   - Renewal

6. **For interpretation, what is the sequence of the documents?**
   1. The Contract Agreement (if any)
   2. The Letter of Acceptance
   3. The Letter of Tender
   4. The Particular Conditions
   5. The General Conditions
   6. The Specification
   7. The Drawings
   8. The Schedules, and any other documents forming part of the Contract
7. **Compare between types of bids according to the following:**
   a. **Definition**

   Open Bids:

   The Owner makes the invitation for the bid public in the official newspapers and any company can participate in the bid. Opening the bid must be in public in presence of representatives for all participants.

   Selective Bids:

   The owner selects a few companies and invite them to the bid. Any other company cannot participate in the bid.

   Negotiated Bids:

   mostly used for extending scope of works

   Serial Tender:

   Used for repeated typical project.

   Direct Award:

   The owner selects a company to award the project.

   b. **Advantages**

   Open Bids:

   - Allows new contractors and modern contracting companies to emerge.
   - Expands the database of contractors and companies to benefit from competition.
   - Getting the best offers.
   - Avoiding agreements between some contractors to manipulate prices.

   Selective Bids:

   - Ease of selecting the lowest prices due to pre-qualification of contractors.
   - Reducing administrative costs.
   - Reducing project risks.

   Negotiated Bids:

   - Speed of choice
   - No effort to decide which company gets the offer.

   Serial Tender:

   - Quality of work already familiar with
   - Predetermined pick means less time and effort spent.

   Direct Award:

   - Quality of work assured due to familiarity with contractor and mutual trust.
   - Saving time wasted by using other types of bids.
   - In some cases, Contractors can aid with the finance and save money for the owner.

c. Disadvantage

Open Bids:

- Increase in the number of contractors applying for the tender.
- The decision-maker may be forced to choose the contractor who offered the lowest prices, without being sure of their ability to implement the project with the required quality and within the required time, especially in projects subject to government laws.
- Most large companies are reluctant to participate in open tenders due to the large number of applicants.

Selective Bids:

- Prices are generally higher than open tenders.
- Possibility of agreement between invited contractors to raise prices.

Negotiated Bids:

- Generally higher prices due to no competition

Serial Tender:

- Generally higher prices due to no competition
-

Direct Award:

- Generally higher prices
- Some contractors may set unfair conditions due to having no competition.
- Some conditions may be hard to meet if the owner also owns the contractor company.

8. What are the types of construction contracts?

1) Lump-sum Contract
2) Unit price contract
3) Cost plus contract
4) Target cost contract

9. Define the following:

a. Risk management

Risk analysis is a process that begins with the design stage but does not end. with it. More information about a project and a more detailed design reduces the risk. Higher risk leads to a higher price.

Risk management is the art of navigating uncertainty. It's about identifying threats, gauging their impact, and taking action to minimize harm.

b. Contract

A promise enforceable by law, which may be to do something or to refrain from doing something. The making of a contract requires the mutual assent of two or more persons, one of them ordinarily making an offer and another accepting. If one of the parties fails to keep the promise, the other is entitled to legal redress.

c. Projects stakeholders

Stakeholders are people who will be affected by your project at any point in its lifecycle, and their input can directly impact the outcome.

d. Key project stakeholders

stakeholders who have the influence and authority to dictate whether a project is a success or not. These are the people and groups whose objectives must be satisfied, as they have the power to make or break the project. Even if all deliverables are in and budgets are met, if the stakeholders aren't happy, the project cannot be considered a success.

e. **Lump-sum contract**
In this type of contract, the contractor is obligated to carry out the agreed upon works in return for a fixed total amount of money paid by the owner.

f. **Unit price contract**
This type of contract depends on the unit price of each item, for which the cost is estimated by the contractor. It is not a requirement to complete all designs before starting implementation.

g. **Cost-plus contract**
An agreement is made between the owner and the contractor on the basis of the contractor doing the required work in return for recovering any expenses he spends in addition to the profit rate. It is not a requirement to complete all designs before starting implementation.

h. **Target cost contract**
The same as cost plus contract. But a prerequisite for the contract is added, which is the participation of the contractor in bearing part of any expenses exceeding the target cost of the project.

10. Compare between different types of construction contracts according to the following:

a. **Owner's validity**

Lump-Sum:
- The owner is not allowed to make any change in the terms of the project.

Unit Price:
- The owner is allowed to make any change in the terms of the project at any phase of implementation (during construction).

Cost Plus:
- The owner is allowed to make any change in the terms of the project at any phase of implementation (during construction). It can also participate in the management and follow-up of the project.

Target Cost:
- The owner is allowed to make any change in the terms of the project at any phase of implementation (during construction).

b. **Risks of project**

Lump-Sum:
- Afforded by the contractor.

Unit Price:
- Afford by the contractor and owner

Cost Plus:
- Afford by the owner

Target Cost:
- Afford by the contractor and owner

c. **Providing an incentive for the contractor**

Lump-Sum:
- Provides an incentive for the contractor to save any money.

Unit Price:
- The absence of any incentive for the contractor to raise the efficiency of work

Cost Plus:

- The absence of any incentive for the contractor to raise the efficiency of work

Target Cost:

- The Presence of incentive for the contractor to save money and finish the project before the specific date

d. The final cost of the project

Lump-Sum:

- Specific cost

Unit Price:

- Not specific cost

Cost Plus:

- Not specific cost

Target Cost:

- Target cost

11. Explain the most important roles of the ethics code.

The codes of ethics play at least eight important roles:

• Serving and Protecting the Public.
Engineers are in a responsible position where trust and worthiness, both are essential. A code of ethics functions as a commitment to the profession as a whole that engineers will serve public health, safety, and welfare.

• Guidance
Codes are written in brief yet effective to offer general guidance to the engineers. More specific directions may be given in supplementary statements or guidelines, which tell how to apply the code. If needed, assistance is obtained for further specification.

• Inspiration
Codes of ethics, which specify a collective commitment towards a profession, help in motivation for ethical conduct. Actually, these codes make one feel really responsible and proud to be a professional thus motivating the commitment one should have towards one's profession.

• Shared Standards
The standards established should be applicable to all individuals, in their particular professions. With the codes of ethics, the public is assured of engineers with a minimum standard of excellence and the professionals are provided a fair way to compete.

• Support for Responsible Professionals
The professionals who act ethically have more positive support through these codes. A professional engineer who has the intention to stand by the codes of ethics can have no harm from immoral professional obligations, as he can reject them smoothly yet formally. As well, these codes can provide legal support to engineers who are criticized for living up to work-related professional obligations.

• Mutual Understanding
The codes which are widely circulated and officially approved by professional societies promote a shared understanding among professionals, the public, and government organizations about the moral responsibilities of engineers. These codes prompt discussion and reflection on moral issues.

• Deterrence and Discipline

The professionals who fail to follow the codes exhibit unethical conduct. Such an investigation generally requires paralegal proceedings designed to get at the truth about a given charge without violating the personal rights of those being investigated.

- Contributing to the Profession's Image

  Codes project the engineers as the professionals of an ethically committed profession, which inspires them to work with great commitment and more effectively to serve public. It can also win greater powers of self-regulation for the profession itself while lessening the demand for more government regulation.

12. Mention the main items in the Egyptian Code of Ethics for the Engineering Profession.

- The general responsibilities of the engineer towards society.
- The engineer's relationship with the engineering community and with his fellow engineers.
- Engineer responsibilities towards clients.
- Intellectual property.
- Professional practice.
- Continuing education and training.
- Preserving the environment and sustainable development.
- Compliance with the law.

13. Mention the main items in the NSPE Code of Ethics for the Engineering Profession.

- Hold paramount the safety, health, and welfare of the public.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act for each employer or client as faithful agents or trustees.
- Avoid deceptive acts.
- Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

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