

Awareness and Perception of Engineering Ethics and Design Failure

1. Introduction

Engineering plays a crucial role in shaping modern society, from infrastructure and transportation systems to medical technology and digital communication. However, engineering failures—whether in design, testing, material selection, or ethical judgment—can lead to catastrophic consequences, including loss of life, environmental damage, and financial loss. Historical failures such as the Bhopal Gas Tragedy, the Challenger Disaster, and the Boeing 737 MAX incidents highlight the importance of ethical responsibility in engineering decision-making. The purpose of this study is to assess public and student awareness of engineering ethics, perceptions regarding the causes of engineering design failures, and attitudes toward the responsibilities of engineers, organizations, and regulatory bodies. This report evaluates ethical concerns in engineering practice, the importance of transparency, the role of societal impacts, and the significance of ethical education in preventing failures.

2. Methodology

A questionnaire-based survey was developed to measure awareness and understanding of engineering ethics and the factors that contribute to engineering failures. The survey consisted of multiple-choice questions, scenario-based ethical dilemmas, and Likert-scale items. A total of 100 respondents, including engineering students, young professionals, and members of the general public, participated in the study. The questionnaire assessed several key variables: understanding of ethical responsibilities, recognition of common causes of engineering failures, willingness to report ethical violations, perceptions of safety versus cost, and opinions on accountability within engineering organizations. Data were collected both online and offline, ensuring diverse responses across backgrounds. The responses were analyzed qualitatively to identify patterns in perceptions, common ethical concerns, and opinions on improving ethical behavior in engineering.

3. Discussion

The responses demonstrated that most participants recognized engineering failures as a combined result of technical errors and ethical lapses. Many respondents believed that poor design decisions, inadequate safety checks, and management pressure to cut costs were leading causes of engineering failures. Participants emphasized that the safety of people and the environment should always be prioritized over cost efficiency and project deadlines. Respondents also acknowledged that ethical responsibility is shared among individuals, engineering teams, management, and regulatory authorities, rather than being limited to a single entity.

A significant number of participants supported the idea that early detection of flaws or risks must be reported immediately, even if doing so may delay project timelines or lead to conflict with management. Many expressed that unethical actions—such as approving substandard materials or hiding safety concerns—can escalate into severe failures with long-term consequences. Furthermore, respondents felt that education on engineering ethics should be an integral part of all engineering programs, as ethical training helps students and professionals make informed, responsible decisions when faced with pressure or complex scenarios. Participants also showed strong awareness of how engineering failures impact society, affecting not only individuals but also public trust, economic stability, and environmental well-being. There was widespread agreement that transparency, accountability, and proper safety protocols

are essential for preventing failures. The role of regulatory bodies was recognized as crucial for ensuring compliance with safety standards, but respondents also believed that the ethical mindset of engineers themselves is equally important.

4. Findings, Suggestions, and Recommendations

Findings:

The study found that participants possess a high level of awareness of engineering ethics and recognize the importance of ethical behavior in preventing engineering failures. Respondents strongly believed that safety must always take precedence over cost, deadlines, or company pressure. There was a clear understanding that engineering failures often stem from avoidable mistakes, ethical negligence, or deliberate shortcuts. Majority of participants felt that responsibility for design failures is shared among engineers, management, and regulatory institutions. Respondents also displayed strong support for incorporating mandatory ethics training into engineering curricula.

Suggestions and Recommendations:

Based on the findings, several key recommendations are proposed:

- Strengthen ethics education in engineering programs to prepare future engineers for real-world dilemmas.
- Increase transparency and accountability within engineering organizations to discourage unethical decision-making.
- Establish stricter government regulations and safety standards to minimize the risk of design failures.
- Encourage engineers to report concerns or flaws without fear of retaliation, promoting a culture of honesty and responsibility.
- Enhance quality control and testing processes to detect early signs of failure.
- Foster collaboration between organizations, regulatory bodies, and educational institutions to improve ethical awareness and safety practices.
- Promote continuous professional development in ethics, safety, and responsible engineering practices.

5. Conclusion

The study concludes that there is a strong understanding among respondents regarding the importance of ethics in engineering and the significant role it plays in preventing design failures. Participants expressed a clear awareness of the consequences that unethical decisions can cause and recognized the need for responsible behavior, transparency, and adherence to safety standards in engineering practice. ISRO, NASA, and other major engineering organizations have demonstrated how ethical principles guide successful and safe technological achievements, serving as examples for future professionals.

To ensure a safer and more responsible engineering landscape, there is a need for enhanced ethics training, improved regulations, and an organizational culture that prioritizes safety and integrity. With proper education, accountability, and ethical awareness, engineering failures can be minimized, leading to improved public safety, environmental protection, and technological advancement.