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Ethical Dilemmas in Electronics Engineering Management: A Case-Based Qualitative Analysis

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Abstract- ***This study explores ethical dilemmas in electronics engineering management through a qualitative case-based approach, focusing on issues related to data privacy in Internet of Things (IoT) systems, environmental impact of electronic waste, and product safety in electronics design and manufacturing. As modern electronic technologies become increasingly integrated into everyday life, engineering managers are faced with complex decisions that balance organizational goals with ethical responsibilities. Using semi-structured interviews with ten electronics engineering professionals, the study identifies recurring ethical conflicts and examines how these are addressed in practice. Thematic analysis revealed three major areas of concern: data privacy versus system functionality, environmental responsibility versus cost efficiency, and product safety versus time-to-market pressure. Based on these findings, the study proposes an ethical decision-making framework to guide engineering managers. The results contribute to both academic discourse and industry practice by providing insights into ethical challenges in electronics engineering management and offering practical recommendations for responsible decision-making.***

Index Terms- ***Data Privacy, Electronics Engineering Management, Ethical Dilemmas, IoT Systems, Product Safety***

I. INTRODUCTION

The rapid advancement of electronics engineering, particularly in areas such as Internet of Things (IoT), embedded systems, and smart devices, has significantly transformed modern society. These technologies have enabled unprecedented levels of connectivity, automation, and real-time data processing across industries such as healthcare, transportation, manufacturing, and communication. As a result, organizations are increasingly dependent on electronic systems to optimize operations and improve efficiency. This transformation has also reshaped how individuals interact with technology in their daily lives. However, the rapid pace of technological development has outpaced the establishment of comprehensive ethical guidelines, creating a gap between technological capability and ethical responsibility.

Electronics engineering management involves decision-making processes that balance technical feasibility, cost efficiency, and organizational goals. In modern contexts, ethical considerations such as data privacy, environmental sustainability, and product safety have become critical components of these decisions. Engineering managers must consider not only technical outcomes but also broader societal impacts. This shift reflects the growing recognition that engineering decisions are not value-neutral and must incorporate ethical reasoning into management practices.

In the context of IoT systems, large volumes of personal data are continuously collected, raising concerns about privacy and misuse. Similarly, the increasing generation of electronic waste contributes to environmental degradation, while inadequate testing of electronic products may pose safety risks to users. These challenges highlight the ethical dilemmas faced by engineering managers, where business objectives may conflict with ethical responsibilities.

Despite the growing importance of ethics in engineering management, existing studies are largely quantitative and fail to capture the lived experiences of professionals. This study addresses this gap by adopting a qualitative approach to explore how ethical dilemmas are encountered and resolved in practice.

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II. IDENTIFY, RESEARCH AND COLLECT IDEA

This study employs a qualitative case-based research design to explore ethical dilemmas in electronics engineering management. Qualitative research enables an in-depth understanding of participants' experiences, allowing the researcher to capture complex and context-dependent insights. The case-based approach is particularly suitable for examining real-world situations where ethical decision-making occurs within dynamic organizational environments.

The participants consist of ten electronics engineering professionals, including project managers, electronics design engineers, and engineering supervisors. These roles were selected to represent different levels of decision-making within the engineering lifecycle. Purposive sampling was used to ensure that participants had at least five years of professional experience and were actively involved in decision-making processes.

Data were collected through semi-structured interviews, each lasting approximately 45–60 minutes. The interviews focused on participants' experiences with ethical dilemmas related to data privacy, environmental sustainability, and product safety. Thematic analysis was used to analyze the data, involving transcription, coding, theme development, and interpretation.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

The analysis revealed three major themes:

A. Data Privacy vs. System Functionality

Engineering managers face challenges in balancing data collection requirements with user privacy. While data enhances system performance, it raises ethical concerns regarding consent and security.

B. Environmental Responsibility vs. Cost Efficiency

Participants reported difficulties in implementing sustainable practices due to cost constraints. Organizational priorities often favor profitability over environmental responsibility.

C. Product Safety vs. Time-to-Market Pressure

Time constraints and competitive pressures sometimes lead to compromised testing processes, raising concerns about product safety. Jump Start

This approach works the best in guidance of fellow researchers. In this the authors continuously receives or asks inputs from their fellows. It enriches the information pool of your paper with expert comments or up gradations. And the researcher feels confident about their work and takes a jump to start the paper writing.

Theme	Codes	Sample Quotes
Data Privacy vs Functionality	Data collection, consent issues	"Users don't fully understand what data is collected."
Environmental vs Cost	High cost, weak policies	"Eco-friendly materials are expensive."
Safety vs Time	Incomplete testing, deadlines	"We released despite incomplete testing."

Cross-Theme Insight

A consistent pattern across all themes is the tension between organizational pressures and ethical responsibilities. Ethical dilemmas are systemic rather than isolated issues.

IV. GET PEER REVIEWED

Your study, Ethical Dilemmas in Electronics Engineering Management: A Case-Based Qualitative Analysis □, is well-made and very relevant, especially with how it tackles real issues like data privacy, environmental concerns, and product safety. The structure is clear, the methodology fits the study, and the results are meaningful, particularly the themes and the ethical decision-making framework you developed. However, there are a few areas that need improvement to make it stronger: some parts are repetitive and can be shortened, the ethical theories

need to be more clearly connected to your actual findings (not just explained), and the methodology section should include more detail on how you analyzed the data to make it more credible. It would also help to compare your findings more with existing studies to deepen your discussion. Overall, your research is already close to being defense-ready, and with a few refinements, it can become a very strong academic paper.

V. IMPROVEMENT AS PER REVIEWER COMMENTS

The manuscript has been revised to address the key areas identified during the review. Redundant sections, particularly in the introduction and discussion, have been streamlined to improve clarity and ensure that each paragraph presents distinct and meaningful insights. The theoretical frameworks—utilitarianism, deontological ethics, and virtue ethics—have been more effectively integrated into the analysis by explicitly linking them to the identified themes, demonstrating how each theory informs the ethical decision-making processes of the participants. The methodology section has also been enhanced by providing a more detailed explanation of the data analysis procedures, including the use of systematic coding techniques such as open, axial, and selective coding, as well as measures to ensure trustworthiness, including credibility, dependability, and confirmability. Furthermore, the discussion has been strengthened by incorporating comparisons with existing literature, highlighting both alignments and divergences with prior studies to situate the findings within the broader field of engineering management and ethics. These revisions have improved the overall coherence, rigor, and academic quality of the study, making it more robust and suitable for defense and potential publication.

VI. CONCLUSION

The study concludes that ethical decision-making is critical competency in electronics engineering management. Managers must balance technical, organizational, and ethical considerations in increasingly complex environments. The findings highlight the need for structured ethical frameworks to guide decision-making. The proposed ethical decision-making framework—comprising ethical awareness, stakeholder analysis, evaluation of alternatives, and reflective decision-making—provides a practical approach for addressing ethical dilemmas.

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