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Exploring How AI Engineers Perceive and Develop Translational Ethical Competency: RFE-Funded Project Updates

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1. Introduction

The rapid deployment of Artificial Intelligence (AI) in high-stakes domains such as healthcare [1], education [2], finance [3], and national security [4] is making it highly probable that engineers will encounter ethical considerations such as fairness, data privacy, accountability, and transparency throughout the system design process. Which means that ethics has taken a central stage in AI governance frameworks, professional guidelines, and computing curricula [5], [6], [7].

Existing research has consistently identified a gap between the abstract ethical principles and their enactment in everyday engineering practice [8], [9], [10], and much of the AI ethics literature focuses on articulating normative principles, or evaluating ethical compliance at the system level [11], [12]. Despite being valuable, they provide limited insight into how practicing engineers reason about the ethical considerations under real-world technical, organizational, design, and policy constraints and how engineering practitioners' ethical considerations are being operationalized in their daily practice.

This limitation is also reflected in the computing and engineering education curricula. Studies as one by Weichert et al. [13] show that ethics instruction remains peripheral in many computing programs, and is often disconnected from core technical courses [14]. Even when ethics is formally introduced, students mostly learn about the abstract ethical principles, and are rarely exposed to how the ethical issues emerge during the design process of AI systems, and how the engineers navigate the trade-offs while tackling the design constraints and product requirements. This existing gap prevents the growth of essential ethical competencies that AI engineers need to have to be able to develop AI systems responsibly.

To address this gap, this NSF-funded project introduces the concept of *Translational Ethical Competency (TEC)*, which is defined as *the ability to systematically apply and operationalize abstract AI ethics principles in concrete engineering practices and design decisions during AI system development and deployment* [15]. The project aims at identifying specific sub-competencies among TEC. To fulfill the goal, we first examine how engineers translate ethical principles into their technical design decisions. We adopted a text-elicitation interview method

[16] to examine how ethical considerations arise and are interpreted and acted upon in AI engineering practice.

This paper presents the underlying reasons for the methodological approach, along with the interview instrument development, the pilot validation of the approach, and the ongoing process of data acquisition. Instead of focusing on the final findings, this paper focuses on methodological development to contribute tools and insights relevant to engineering education research, ethics instruction, and professional development.

2. Background and Motivation

A "principle-to-practice" gap has been repeatedly noted in AI ethics research [17], [18]. Scholars have attributed this gap to several factors, such as the abstraction of ethical frameworks from engineering workflows, misalignment between ethical guidance and organizational incentives, and limited empirical understanding of engineers' decision-making processes [10], [19]. Some authors, such as Pistilli et al. [20] propose policy and governance mechanisms to bridge the gap between ethical ideas and their technical implementation; however, they also acknowledge that these mechanisms rely on engineers' interpretation during the design process. Therefore, there is a need to understand how engineers in practice actually engage with ethical principles. And it requires specific attention to the individual reasoning of practicing engineers who are situated in the broader socio-technical contexts.

From an educational perspective, this challenge raises questions about how ethics is being taught and assessed. The approaches have traditionally focused on the ethical theories, codes of ethics, or the hypothetical scenarios and dilemmas, which, while being informative, have an abstract nature and might not be well-suited to prepare future engineers to navigate the ethical challenges that can arise during complex design environments [21], [22], [23]. Therefore, studying how practicing engineers reason about ethics in real-world settings can provide much-needed insights for developing effective educational models.

3. Methods

We utilize the elicitation interview technique to help participants reconstruct concrete experiences and articulate reasoning that may not be readily accessible through other formats [24]. Also, this approach complements existing empirical studies related to AI and computing ethics, which utilize self-reported surveys and vignettes [25], [26]. Instead of asking participants about their general beliefs in ethics, elicitation interviews allow participants to depict how they

navigate ethical issues in their practical design experiences. Moreover, this technique has already been used effectively in the domain of pedagogy and human-computer interaction (HCI) research [27], [28], [29], [30]; with the proven record of effectiveness, we selected the method to answer the following research question (RQ) in the project's first phase:

- RQ: What are the processes that AI engineers follow to translate ethical principles into their design practices?

The interview method was designed with the following primary goal: to elicit detailed accounts of AI system design decisions among engineers. This goal informed both the structure of the interview protocol and the development of the prompts, emphasizing the concrete artifacts, decision points, and the trade-offs made. We first developed a pilot interview protocol and tested it with participants from computing and engineering backgrounds, including a couple of computer science PhD students, an AI engineer, and a Biomedical engineer. Based on the pilot interviews and internal discussions in the research team, we revised and finalized the interview protocol. The detailed refinement process is documented in Ali et al. [15].

The final interview protocol is divided into four sections: (1) Establishing the context, (2) Eliciting the Translation Process with a Case Study, (3) Eliciting the Translation Process with Participants' Own Experience, and (4) Conceptualizing the Translational Process. The first section included Floridi's Unified Framework of Ethical Principles for AI [31], which recognized beneficence, non-maleficence, autonomy, and justice as traditional bioethics principles, and added explicability as a new enabling principle for AI. The second section included the Autonomous Vehicle case study which was provided to the participants in advance to better prepare them for the interview process. In the third section, the interviewer asked the participant to reflect on their own experience of translating ethics principles into their design practices. The last section was for summarization, where the interviewer recaps the process themself with the assistance of the interviewee to make sure that the interviewer's interpretation of the participants' design practices is accurate.

At the time of writing, 12 interviews have been conducted with engineers who design AI systems in diverse industry contexts. Data collection and analysis are being conducted concurrently following a grounded theory approach [32], consistent with the methodological intent of the approach. With the completion of each interview, transcripts are iteratively coded and compared with other codes using a constant comparative analysis procedure, allowing emerging insights to inform continuous data collection and refinement of analytical categories. This iterative process

is intended to support the development of a robust, empirically grounded explanation of the process through which AI professionals translate ethical principles into their design practices.

4. Preliminary Results and Future Work

Preliminary analysis of transcripts using open coding suggests that in-practice ethical considerations are observed through the lens of organizational policy by the engineers. Several participants referenced their organizational policies and internal governance mechanisms as key resources for reasoning about ethical concerns that emerge during design, which indicates that ethical translation is often mediated by the institutional structures and norms. Consistent with practices utilizing the grounded theory approach, data collection and analysis are proceeding concurrently, where insights from ongoing coding are informing the subsequent interviews through constant comparative analysis. In the proceeding phases of the project, the focus will be on identifying practice-informed implications for AI ethics education. Future work within the scope of this project will also examine the specific competencies needed for translating ethics into design practices of AI practitioners.

5. Implications for Engineering Education

This work has wide-ranging implications for computing and engineering education, as our methodology provides a means to ground the ethics education into professional practice, offering educators rare insight into how ethical reasoning is actually enacted in practice. Secondly, the focus on ethical translation highlights the importance of teaching students how to navigate the trade-offs, constraints, and organizational context alongside ethical principles. Moreover, the successful implementation of text-elicitation may provide educators with the opportunity to engage students with realistic design scenarios. While this study and the results in subsequent studies will focus on AI engineering and designs, the approach is potentially applicable to other engineering domains where ethical considerations are intertwined in complex socio-technical systems.

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