Advancing Requirements Engineering Through Generative AI: Assessing the Role of LLMs

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1. Executive Summary

This chapter explores how Large Language Models can transform Requirements Engineering by automating elicitation, specification, analysis, and validation tasks, presenting a SWOT analysis and preliminary evaluation results.

2. Purpose & Research Question

• The purpose is to explore the potential of LLMs in driving RE processes to improve efficiency and accuracy of requirements-related tasks, focusing on requirements elicitation, analysis, specification, and validation. *(Explicitly Stated)*

• The rationale stems from RE's critical importance in software development and its persistent challenges, including communication complexities, uncertainty, and inadequate automation support, which LLMs could address through their natural language capabilities. *(Explicitly Stated)*

• RQ: How can LLMs be effectively integrated into the four major RE stages (elicitation, specification, analysis, validation) to address current challenges and what are their strengths, weaknesses, opportunities, and threats? *(Inferred)*

3. Theoretical Framework

• No explicit theoretical framework was mentioned, though the study employs SWOT analysis as an analytical framework to systematically evaluate LLM applications across RE stages. *(Inferred)*

4. Methodology

• The research employs a qualitative approach combining conceptual analysis with a preliminary evaluation, using SWOT analysis to systematically assess LLM applications across RE stages. *(Explicitly Stated)*

• Key techniques include prompt engineering with ChatGPT (GPT-3.5), stakeholder simulation, requirements generation and analysis, and comparative mapping of elicited requirements against actual project requirements. *(Explicitly Stated)*

• The preliminary evaluation involved four participants (two experienced engineers and two research students) using ChatGPT to elicit requirements for ActApp, a real-world health app for type-2 diabetes patients, comparing results against 20 expert-validated requirements. *(Explicitly*

Stated)

• Primary analysis methods included requirement matching (full/partial/no match categorization), precision and recall calculations with weighted true positives, and qualitative assessment of LLM-generated outputs and participant experiences. *(Explicitly Stated)*

5. Major Findings & Contributions

• Finding 1: LLMs demonstrated significant potential in requirements elicitation, with experienced participants achieving nearly 50% recall of relevant requirements using only a project brief and single ChatGPT session. *(Explicitly Stated)*

• Finding 2: LLMs can discover 'unknown' requirements not initially identified by human experts, addressing a key RE challenge, though this comes with the burden of managing false positives and potentially irrelevant candidate requirements. *(Explicitly Stated)*

• Contribution: The study provides a comprehensive SWOT analysis framework for LLM application across all RE stages, identifying specific strengths (automation, efficiency), weaknesses (lack of empathy, domain nuance), opportunities (real-time processing), and threats (biases, over-reliance) that guide future research and practice. *(Explicitly Stated)*

6. Study Limitations & Gaps

• Limitations include the preliminary nature of the evaluation with only four participants, focus primarily on elicitation stage, use of only ChatGPT (GPT-3.5), and challenges with LLM context limitations and systematic inaccuracies. *(Explicitly Stated)*

• Gaps remain in understanding long-term integration of LLMs into RE workflows, empirical validation across diverse domains, handling of complex stakeholder negotiations, and addressing ethical concerns and regulatory compliance at scale. *(Inferred)*

7. Study Implications

• For Research: Future work should conduct comprehensive empirical evaluations of prompt engineering techniques, develop specialized LLM agents for RE, and establish benchmarks for LLM performance across RE stages and domains. *(Explicitly Stated)*

• For Practice/Policy: Practitioners should integrate *(Explicitly Stated)*