Group 1: Research Paper Proposal

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Topic: Enhancing Requirements Elicitation in Agile Software Development Through the Integration of AI-Driven Tools.

Abstract: As more organizations adopt agile practices, traditional requirements engineering methods may no longer be as effective as they once were. This paper examines how RE processes must evolve to keep pace with faster and more iterative software development cycles. By taking advantage of advancements in artificial intelligence technologies, the modern software development team can improve their odds of a successful outcome during the requirements elicitation process while operating in an agile working environment.

I.   Significance and Relevance of the Research Study (50):
    1) What are the challenges / problems you have identified? (15) (AI Assisted)
        a) **Balancing flexibility and documentation:** Agile methodologies emphasize adaptability and rapid iterations, which can conflict with traditional RE practices that often involve extensive upfront documentation. The challenge lies in finding the right balance between maintaining sufficient documentation for clarity and traceability, while still allowing for the flexibility inherent to an agile process.
        b) **Continuous requirements refinement**: In agile environments, requirements often evolve throughout the development process. This continuous refinement can lead to challenges in managing changing requirements, ensuring all stakeholders remain aligned, and maintaining a clear understanding of the project scope as it evolves over time.
        c) **Stakeholder engagement in fast-paced environments:** Agile methodologies typically involve frequent, short iterations. This rapid pace can make it difficult to ensure consistent and meaningful stakeholder involvement throughout the development process. The challenge is to develop RE practices that facilitate effective stakeholder communication and feedback within the constraints of agile timelines
        d) **Technical Complexity:** Integrating AI technologies into existing development processes can be technically challenging, requiring specialized expertise and resources.
        e) **Cost and Scalability:** Implementing AI solutions can be expensive and scaling them to meet the needs of large-scale projects might present challenges
        f) Data Quality and Quantity: Insufficient or biased data: AI models require high-quality and representative data to provide accurate recommendations. Insufficient or biased data can lead to inaccurate or biased outputs. When

collecting these data in large quantities, it always raises privacy concerns. An article written by Joseph Vinokuroff in Achievion found that most AI-powered tools struggled to accurately elicit requirements in projects with limited or biased data.

g) Technical Complexity: Integrating AI tools with existing development processes can be complex and time-consuming because the majority of organizations lack the necessary technical expertise to implement and maintain these technologies. For example, a survey in South America found that 40% of enterprise or SMB organizations struggled to integrate AI-powered tools into their existing development workflows.

h) User Adoption: Majority of Stakeholders in some industries resist adopting new technologies, especially if they are unfamiliar with AI because its user base will require training and support to effectively use everyday. In a recent study conducted by Chen, W., Liu, C., Xing, F., Peng, G., & Yang, X discusses various challenges associated with AI implementation in manufacturing, including the need for training and expertise, and the difficulty in learning how to use AI-powered requirements elicitation tools in manufacturing.

2) What are the motivations to address the problem? (20)

a) Agile environments are rapidly becoming the standard operating environment for many organizations. More than 90% of respondents to the 15th Annual State of Agile Report stated that their company uses Agile in some capacity, indicating that it has emerged as a leading technique across all industries. If development teams intend to maintain effective and efficient RE practices, they must adapt their processes to meet the demands of the agile method. Failure to adapt will result in a misunderstanding or neglect of the requirements, which can be a devastating blow to the successful outcome of a project.

b) Enhanced Productivity and Efficiency: To reduce time and effort, certain tasks, such as data processing, must be automated for effective RE processes. According to the IEEE Software magazine, automation in RE boosts output by allowing analysts to concentrate on more difficult jobs.

c) Enhanced Innovation: the use of AI can also give a new insight and perspective on requirements hence leading to an even more innovative solution in everyday usage. It would also provide a means of early prototyping and experimentation with the requirements hence minimizing risks and improving outcomes. Wang and Zhang (2022) outline through a study how AI-driven simulations can enhance innovation processes, given that early stages of experimentation with the requirements are enabled to happen. Surprisingly, their research concluded that with the use of AI, teams can detect novel product features at an early stage of the development phase, which could reduce risks and increase quality in the final product.

3) Are the problems/challenges relevant to industry practitioners? (15)

a) Agile working environments are becoming increasingly widespread amongst development teams. This research will be applicable to most industry practitioners. Around 97% of organizations report using Agile development methods to some extent. (State of Agile 2024: Insights, Trends, and Key Findings)

b) The iterative nature of agile development can impact how practitioners will be required to elicit requirements during production. Ineffective practices in agile environments can lead to miscommunication, scope creep, and misaligned expectations, all of which are critical issues for industry practitioners and the success of their projects.

c) The software industry thrives on innovation and adapting to meet demands. Creating effective solutions to flexibility, requirements refinement, and increasing stakeholder engagement is sought after by all practitioners.

II. Formulate 3 - 4 Research Questions (RQ) to address the challenges

1) Agile methods place human effort, experience, and expertise at the core of software development, through a central focus on people and their interactions. Will the use of artificial intelligence negate the human-centric approach to agile software development?

   a) "Even if AI is capable of automating a variety of jobs, it is important to acknowledge the value of human expertise. A symbiotic relationship between AI capabilities and human decision-making should be encouraged by project managers. While AI improves managerial abilities, human intuition and judgment continue to be highly valuable." (related works #1)

   b) "AI can be a key component of agile project management. By automating sprint planning, easing daily stand-up meetings, and improving backlog management, AI can be a key component of agile project management. This enables teams to quickly provide value." (related works #1)

   c) "Agile is obviously beneficial to the advancement of AI, but AI may also assist organizations in becoming more agile." (related works #2)

   d) "Developers can get immediate feedback and suggestions based upon that codebase with the help of intelligent coding assistants created using ML, resulting in substantial time savings." (related works #2)

2) Can AI technologies such as large language models (LLM) and/or natural language processing (NLP) be used to streamline requirements elicitation and documentation processes in Agile environments, thereby reducing manual errors while maintaining stakeholder satisfaction and allowing the flexibility that Agile demands?

   a) "AI can significantly reduce manual errors during requirements elicitation by automating tasks such as data collection and summarization, allowing Agile teams to focus on higher-level decision-making." (related works #1)

b) "By leveraging AI for rapid prototype generation and collaboration, non-technical stakeholders can contribute more effectively to the requirements process without the need for extensive technical knowledge." (related works #1)

c) "AI's ability to process large volumes of unstructured data can help Agile teams refine requirements iteratively, ensuring that key insights from various sources are incorporated throughout the development lifecycle." (related works #2)

d) "NLP-powered tools enable faster creation of formal documentation from natural language descriptions, helping Agile teams maintain the necessary level of documentation without slowing down development cycles." (related works #2)

e) Legacy methods rely on the requirements engineer performing the elicitation to ask the right questions based on their own knowledge. Rajender et al. proposed a method using an AI chatbot with NLP to interact with the users to capture requirements. The knowledge base is integrated with the chatbot to provide domain requirements from various industries such as banking, healthcare, entertainment, etc. This ensures that the chatbot will ask the necessary questions to formulate an adequate, complete, and clear requirements specification.

3) How do AI-based requirements elicitation tools compare with traditional methods in terms of stakeholder satisfaction and engagement?

a) Metrics for traditional elicitation techniques exist such as defect rate, AQL target performance, stakeholder satisfaction, etc. Can a compare and contrast be performed for human-led elicitation vs AI tools?
b) Given the specialized knowledge required to ask the right questions during elicitation, can the economies of scale make it more cost effective to use a properly trained large language model instead of a subject matter expert?
c) Does the loss of human empathy inherent in AI reduce stakeholder engagement?

III. Related Works
1) How industry practitioners / academic researchers addressed the challenges / problems?
2) What has been done? (10)
3) what has not been done? (the research gap) (15)

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