

# Protocol on the Evaluation of the Knowledge-based Multi-Agent Architecture Design (MAAD) Framework

## 1 Protocol

1. **Introduction:** Architecture design is a critical step in software development. However, creating a high-quality architecture is often costly due to the significant need for human expertise and manual effort. Recently, agents built upon Large Language Models (LLMs) have achieved remarkable success in various software engineering tasks. Despite this progress, the use of agents to automate the architecture design remains largely unexplored. To address this gap, we proposed a Knowledge-based Multi-Agent Architecture Design (MAAD) framework. MAAD uses agents to simulate human roles in the traditional software architecture design, thereby automating the design. To empower these agents, MAAD incorporates knowledge extracted from three key sources: 1) existing system designs, 2) authoritative literature, and 3) architecture experts. By designing the MAAD framework, we aim to advance the full automation of application-level system development.

2. **Open Question:** The open question of our interview is based on the Research Question of our study:

- *RQ1: How effective is MAAD in automating the software architecture design?*

**Rationale:** If the generations of MAAD are both useful and accurate, it could substantially reduce the time and expertise required in practice. RQ1 evaluates the usefulness and correctness of MAAD-generated artifacts via expert feedback, and then uncovers deployment challenges and practitioner concerns.

3. **Participants:** We will conduct in-depth interviews with practitioners who have rich industrial architecture design experience. During each interview, we will:

- Review sample artifacts produced by MAAD and solicit feedback on their correctness, clarity, and practical utility.
- Discuss any limitations or issues observed.
- Elicit suggestions and identify the principal challenges they foresee when integrating LLM-based agents into existing architecture workflows.

4. **Data Analysis:** Interview transcripts will be analyzed using open coding and the Constant Comparison method<sup>1</sup>. This qualitative approach will enable us to identify recurring themes, categorize practitioner perspectives, and refine our understanding of both MAAD’s strengths and its deployment challenges.

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<sup>1</sup>S. Adolph, W. Hall, and P. Kruchten, “Using grounded theory to study the experience of software development,” *Empirical Software Engineering*, vol. 16, no. 4, pp. 487–513, 2011.

## 2 Interview

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### Interview Title: Interview on Evaluation of a Knowledge-based Multi-Agent Architecture Design (MAAD) Framework

**Problem Statement:** Traditional architecture design remains largely dependent on human expertise, which often leads to limited productivity, inconsistent decision-making, and challenges with scalability. Architects must navigate numerous decision points (e.g., pattern selection, module decomposition, and communication protocols), accommodating shifting requirements and balancing competing quality attributes (e.g., performance, security, maintainability). This process is not only time-consuming and error-prone, but it also face increasing pressure due to the demands of continuous deployment and agile lifecycles. Furthermore, architecture design is inherently complex and heavily relies on the individual architect’s experience, especially in unfamiliar domains. It requires more than concepts and techniques they possess but also demands deep domain-specific knowledge. As a result, architects are often able to provide only a limited number of design alternatives. In light of these challenges, automating architecture design is essential to accelerate end-to-end software delivery without compromising architectural integrity.

**Our Approach:** We proposed a Knowledge-based Multi-Agent Architecture Design (MAAD) framework. MAAD uses agents to simulate human roles in the traditional software architecture design, thereby automating the design process. To empower these agents, MAAD incorporates knowledge extracted from three key sources: 1) existing system designs, 2) authoritative literature, and 3) architecture experts. By designing the MAAD framework, we aim to advance the full automation of application-level system development.

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### Interview Questions

#### Open-ended Questions (OQs):

**OQ1:** How would you assess the correctness and practical value of the MAAD framework’s outputs—specifically the requirements analysis, architectural views, generated documentation, and evaluation report? To what extent do you believe these artifacts could support or accelerate a real-world architecture design?

(Free text)

**OQ2:** Based on your experience, what are the main challenges in deploying LLM-powered agents for automated architecture design? What strategies or improvements would you recommend to make such a framework more effective and trustworthy in practice?

(Free text)

**OQ3:** MAAD integrates knowledge from existing system designs, scholarly literature, and expert input. To what extent does the framework effectively leverage these diverse knowledge sources? What enhancements to MAAD’s knowledge-integration process would enable it to better emulate the cognitive processes of human architects?

(Free text)