

DEPARTMENT OF INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Informatics

# **Thesis Proposal**

Trung Nguyen

# DEPARTMENT OF INFORMATICS

TECHNISCHE UNIVERSITÄT MÜNCHEN

Master's Thesis in Informatics

## Thesis Proposal

## Thesis Proposal

Author:	Trung Nguyen
Supervisor:	Prof. Dr. [Supervisor Name]
Advisor:	[Advisor Name]
Submission Date:	September 8, 2025

I confirm that this master's thesis in informatics is my own work and I have documented all sources and material used.

Munich, September 8, 2025

Trung Nguyen

## 0.1 Introduction

Contract Lifecycle Management (CLM) is critical in enterprise environments, serving as operational and financial anchors for complex projects involving multiple stakeholders and regulatory requirements. Current CLM tools rely on rule-based automation or single-agent LLMs, presenting limitations in scalability, explainability, and domain-specific optimization.

Multi-agent systems (MAS) offer promising potential for addressing these limitations through specialized task decomposition, inter-agent collaboration, and enhanced explainability mechanisms. This research addresses the gap in multi-agent system applications for enterprise contract management workflows, particularly regarding compliance-aware orchestration and explainability requirements.

## 0.2 Problem Statement

Current CLM systems face critical challenges: scalability limitations in complex workflows, insufficient explainability leading to low enterprise trust, and inadequate handling of compliance and regulatory constraints across industries and jurisdictions.

Research gaps include: no established frameworks for multi-agent orchestration in enterprise CLM workflows, limited empirical evaluation comparing single-agent versus multi-agent approaches, insufficient attention to compliance-aware AI system design, and lack of standardized evaluation methodologies for trust and explainability assessment.

**Core Research Problem:** How can multi-agent systems be designed and evaluated to improve efficiency, accuracy, and trust in contract lifecycle processes?

## 0.3 Research Questions

**Primary Research Question:** How can multi-agent systems be designed and evaluated to improve efficiency, accuracy, and trust in contract lifecycle management processes?

**Secondary Research Questions:**

1. What are the optimal agent specialization strategies and orchestration patterns for CLM workflows?
2. How do multi-agent approaches compare to single-agent systems in terms of performance, accuracy, and user trust?
3. What explainability mechanisms are most effective for building user confidence in multi-agent CLM systems?
4. How can compliance requirements be effectively integrated into multi-agent system design and evaluation?
5. What are the key factors influencing user acceptance and adoption of multi-agent CLM systems?

**Research Objectives:** (1) Design and implement a functional multi-agent CLM prototype, (2) Develop evaluation frameworks for compliance-aware AI systems, (3) Conduct empirical comparison studies, (4) Establish best practices for enterprise MAS deployment.

## 0.4 Methodology

**Literature Review:** Comprehensive review covering multi-agent orchestration frameworks, AI applications in legal technology and contract management, and compliance-aware explainable AI frameworks.

**Prototype Development:** Functional MAS-based CLM prototype implementing specialized agents for different CLM tasks (drafting, analysis, compliance), centralized orchestration mechanisms, communication protocols, and enterprise integration interfaces. Core functionality includes drafting assistance, clause classification, compliance checks, and explainability features.

**Evaluation Framework:** Multi-dimensional assessment using quantitative metrics (task completion time, accuracy, compliance adherence, system performance) and qualitative metrics (explainability evaluation, usability studies, trust assessment, acceptance measurement).

**Comparative Analysis:** Systematic comparison between single-agent and multi-agent approaches, using traditional rule-based CLM systems, single-agent LLM approaches, and hybrid systems across various contract types, complexity levels, and user expertise patterns.

**User Study Validation:** Industry professional study involving contract managers, legal professionals, and IT professionals, utilizing task-based evaluation scenarios, think-aloud protocols, post-task questionnaires, and comparative preference studies.

**Data Collection and Analysis:** Data collection from system performance logs, user interactions, expert interviews, and benchmark datasets, with analysis using statistical methods for quantitative data and qualitative content analysis for user feedback.

## 0.5 Starting Literature

**Multi-Agent Systems in Enterprise Applications:** Wooldridge (2009) provides MAS design principles, Jennings et al. (2014) explore coordination mechanisms, and Stone and Veloso (2000) offer insights on task decomposition and agent specialization for enterprise workflows.

**AI in Legal Technology and Contract Management:** Katz et al. (2017) present NLP for legal document analysis, Chalkidis et al. (2019) demonstrate ML approaches to contract classification, and Hendrycks et al. (2021) explore AI safety and reliability challenges in legal contexts.

**Explainable AI and Trust in Enterprise Systems:** Miller (2019) reviews explainable AI methods, Ribeiro et al. (2016) introduce LIME for model interpretability, and Hoffman et al. (2018) examine trust factors in human-AI collaboration.

**Compliance and Regulatory AI:** Kamarinou et al. (2016) address AI regulation challenges, Edwards and Veale (2017) discuss algorithmic accountability, and Selbst et al. (2019) explore fairness and bias in automated decision-making systems.

## 0.6 Schedule

**Phase 1: Literature Review and Problem Framing (October - November 2024)** Comprehensive literature review on multi-agent systems in enterprise contexts, analysis of existing CLM systems, review of compliance-aware AI frameworks, refinement of research questions, and initial system architecture design.

**Phase 2: System Design and Architecture (December 2024 - January 2025)** Detailed multi-agent system architecture design, agent specialization strategies, orchestration pattern selection, compliance integration design, and prototype planning.

**Phase 3: Prototype Development (February - March 2025)** Implementation of core multi-agent CLM prototype, development of specialized agents, integration of orchestration mechanisms, and basic functionality testing.

**Phase 4: Evaluation and User Studies (April - May 2025)** Comprehensive system evaluation, comparative analysis with single-agent approaches, user study design and execution, data collection from industry professionals.

**Phase 5: Analysis and Documentation (June - July 2025)** Statistical analysis of evaluation results, qualitative analysis of user feedback, documentation of findings, and preparation of research contributions.

**Phase 6: Thesis Writing and Finalization (August - September 2025)** Thesis writing, final revisions, submission preparation, and defense preparation.

## 0.7 Expected Contributions

### Scientific Contributions:

- Framework for MAS design in regulated enterprise workflows with agent specialization strategies, orchestration patterns, integration methodologies, and compliance design principles
- Comparative empirical results providing performance benchmarks, statistical analysis, scenario identification, and evidence-based guidelines for system architecture decisions
- Novel evaluation methodology for compliance-aware AI systems including trust measurement frameworks, explainability assessment tools, and user acceptance metrics

### Practical Contributions:

- Architecture guidance for CLM platform development with proven coordination strategies, explainability mechanisms, and enterprise integration patterns
- Prototype foundation for MVP development offering validated multi-agent architecture patterns, tested user interface paradigms, and implementation best practices
- Industry best practices for implementing MAS in enterprise software environments with deployment guidelines, risk mitigation strategies, and success metrics

**Impact Areas:** Multi-Agent Systems research, Enterprise AI applications, Human-Computer Interaction in professional contexts, Legal Technology innovation, and CLM software development practices.

## 0.8 Proposed Titles

**Primary Title:** Design and Evaluation of Multi-Agent AI Systems for Contract Lifecycle Management in B2B SaaS Platforms

**Alternative Titles:**

- Multi-Agent Orchestration for Enterprise Contract Management: Design Patterns and Performance Evaluation
- Compliance-Aware Multi-Agent Systems for Contract Lifecycle Management: Architecture and Trust Evaluation
- Multi-Agent versus Single-Agent Approaches in Contract Management: A Comparative Study of Performance and User Trust
- Explainable Multi-Agent Systems for Contract Lifecycle Management: Design, Implementation, and User Acceptance

**Title Selection Criteria:** The primary title was selected for comprehensiveness (covers design, evaluation, multi-agent systems, contract management, B2B SaaS), clarity in communicating research focus, academic appropriateness following standard conventions, industry relevance using familiar terminology, and uniqueness distinguishing this work from existing research.

**German Translation:** Design und Evaluierung von Multi-Agenten KI-Systemen für Contract Lifecycle Management in B2B SaaS Plattformen