IOSUD - Polytechnic University Timișoara
Doctoral School of Engineering

Artificial Intelligence Models for Decision-Making Systems

Doctoral Thesis - Abstract

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in Engineering and Management

author Marta PALADE
scientific supervisor Prof.univ.dr.dr.ing. Anca DRĂGHICI

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This doctoral research explores the transformative influence of Generative Artificial Intelligence (GenAI) on modern software development practices. Employing a multi-dimensional approach that spans organizational, technical, and operational perspectives, the study offers a comprehensive analysis of how GenAI is redefining key aspects of software engineering—including estimation, coding, testing, and project management.

The investigation is structured around several core inquiries: assessing organizational readiness for GenAI adoption; evaluating the capabilities and limitations of advanced large language models (LLMs) such as ChatGPT and Claude; examining the extent to which these tools can support decision-intelligence within software engineering tasks (e.g., algorithm design, test case creation); and exploring their integration into agile workflows, particularly through an AI-assisted estimation platform.

The first research layer introduces and empirically validates a conceptual framework for evaluating organizational readiness for AI adoption. Grounded in an extensive literature review and informed by theories of decision-making, digital transformation, and organizational behavior, the framework identifies six critical dimensions—Strategic, IT, Resource, Cognitive, Cultural, and Partnership Readiness—that collectively shape an organization's preparedness for AI implementation. This framework is substantiated through a combination of quantitative (survey-based) and qualitative (expert interviews and brainstorming) methods. Findings indicate that perceptions of readiness differ notably by managerial role and professional experience, with Strategic Readiness - defined as the alignment of AI initiatives with business objectives and executive leadership support - emerging as the most influential factor across diverse contexts. By bridging theoretical constructs with practical organizational insights, and by highlighting how readiness dimensions intersect with industry-specific challenges, the study delivers a foundational diagnostic model for assessing AI adoption maturity within organizations.

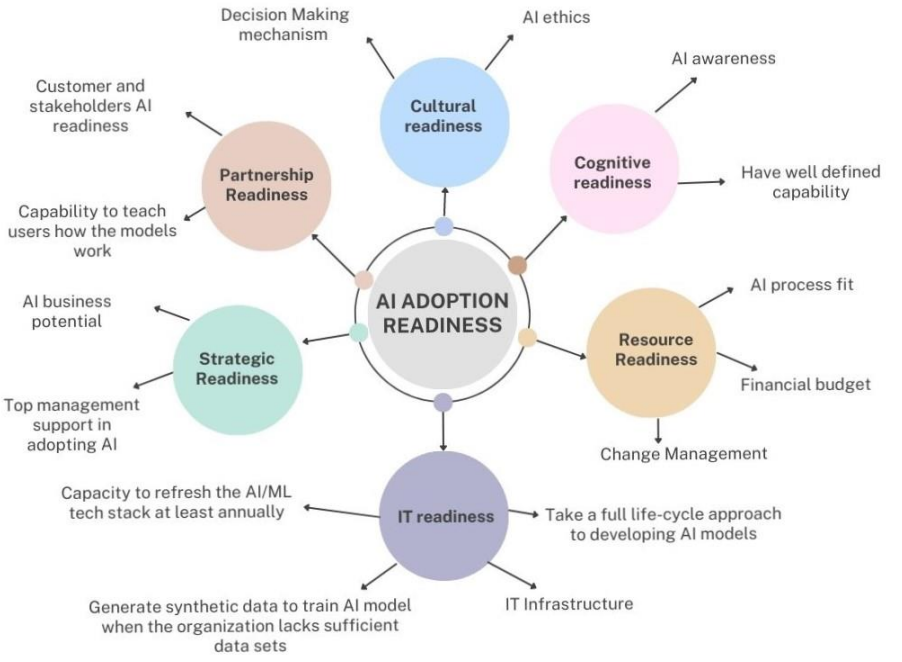

Figure 1. Organization`s readiness for AI adoption factors

The next layer of this research examined the extent to which Generative AI (GenAI) tools can effectively support core software engineering tasks, such as algorithmic problem solving and test case generation. This phase contributes original empirical evidence on the performance, applicability, and human-in-the-loop interactions of GenAI in software development. Focusing on two key tasks - algorithmic code generation and unit test creation - the study offers a comprehensive, large-scale evaluation of GenAI models, stratified by problem difficulty. This assessment benchmarks model performance across dimensions such as solution accuracy, response latency, explanation clarity, and iterative refinement behavior.

Additionally, the research introduces a novel use case involving the application of GenAI for unit test generation within a simulated real-world software environment. This case study yields practical insights into integration challenges, highlighting issues such as hallucinated outputs, the lack of service mocking capabilities, and the critical need for developer oversight to convert generated outputs into viable test assets. Complementing the technical evaluation, the study incorporates both qualitative and quantitative methods - including a survey of 99 software professionals and expert interviews - to situate the findings within current industry perspectives. This analysis reveals emerging practices, perceived advantages, and ongoing barriers to GenAI adoption in software engineering contexts.

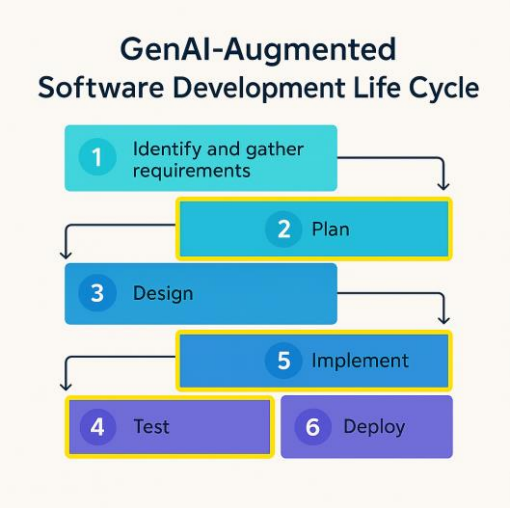

Figure 2. Explored phases of Software Engineering within this thesis

The final component of this thesis explores the integration of Generative AI tools into agile software development, with a particular focus on enhancing the effort estimation process for user stories through an AI-driven estimation platform. This research presents a comparative evaluation of two Large Language Models (LLMs) across datasets of varying sizes, revealing performance patterns relative to data volume. It also details the design and implementation of a prototype platform which employs Generative AI to assist product owners and developers in producing consistent, data-informed estimates. The platform adopts a dual-architecture approach, offering both a cloud-based GenAI model to ensure scalability and an on-premises machine learning alternative to provide resilience in the event of service disruptions. This hybrid design represents a forward-looking contribution, balancing innovation with operational reliability, and supporting the practical adoption of AI-enhanced tools within Agile workflows.

Among all the research layers it is stressed that AI should be adopted with a human-centric approach and be used as a support in the decision-making process and not as the decision maker.

The PhD thesis consists of six chapters with a total length of 151 pages (including the references list). In addition, 9 Annexes were defined to support the debates and explanations with supplementary details. In total, the PhD thesis consists of 12 Tables and 64 Figures. The **primary objective** of this doctoral research is to critically investigate and empirically evaluate the transformative impact of Generative Artificial Intelligence on contemporary software development process, within the evolving paradigm of Industry 5.0, which emphasizes human-centric, intelligent, and sustainable innovation.

Operational objectives pursued during the thesis are:

Objective 1: Contextualize the role of Artificial Intelligence within the broader transition toward Industry 5.0.

A) Synthesize literature on Artificial Intelligence (definition, classification, industrial use cases, ethical aspect).

B) Synthesize literature on decision-making systems and processes in organizations, and the role of technology in the evolution of decision-making systems.

Objective 2: Conceptualize and validate multi-dimensional framework for assessing organizational AI adoption readiness.

A) Define a multi-framework for determining an organization AI adoption readiness based on literature review.
B) Validate the multi-framework through qualitative and quantitative study.

Objective 3: Evaluate the performance, strength, and limitations of state-of-the-art Generative AI models in performing core software engineering tasks.

A) Investigates the practical capabilities of Generative AI in supporting software development tasks, with a focus on code generation and test automation.
B) Conduct quantitative and qualitative to incorporate feedback from practitioners to contextualize technical findings within actual development workflows.

Objective 4: Design, implement and empirically test an AI augmented decision-support system prototype which can be used as part of the practices within software engineering.

A) Synthetize the different methods for user story estimation and factors which impact the estimation of user stories.
B) Empirically test two LLMs on secondary to investigate the differences in their capacity to estimate user stories.
C) Design and implement a machine -learning model which can be used as a fallback for the Generative AI model.
D) Design and implement a proof of concept in the form of decision-support platform that operationalizes GenAI for agile use story estimation.
E) Validate the platform within a quantitative study

The general objective achievement and the operational objectives have been realized systematically and gradually, demonstrated by the scientific research described in each chapter of the PhD thesis.

Chapter 1, “Introduction into the Research Context” outlines the context of the research, the primary objective of the thesis and presents the motivations and objectives that led the author to select this research topic.

In Chapter 2, “Literature Review on Artificial Intelligence and Decision-Making” – offers a structured overview of the evolution, classifications, and applications of Artificial Intelligence (AI) and Decision-Making systems, with a focus on their synergy under the decision intelligence umbrella.

Chapter 3, “Exploratory Study on Organizational Readiness for Artificial Intelligence Adoption” – presents a conceptual and empirical exploration of the factors influencing an organization’s preparedness to integrate AI technologies.

Chapter 4, Applied Research on Artificial Intelligence in Decision-Making for Software Engineering” – investigates the capabilities and limitations of GenAI models in practical software engineering contexts through both experimental analysis and practitioner feedback. Collectively, the chapter offers a comprehensive empirical perspective on the role of GenAI in code generation

and testing, while laying the groundwork for tool-specific innovation in the next chapter.

Chapter 5, Applied Research on the Integration of Artificial Intelligence Within the Scrum Methodology" – presents the design, development, and validation of a decision-support system that leverages Generative AI to assist Agile teams in estimating software development tasks. This chapter demonstrates the practical application of GenAI in operational Agile settings, while contributing a validated prototype that embodies the principles of human-AI collaboration and decision augmentation.

Chapter 6. "Conclusions. Original Contributions. Limitations of the Study and Future Research – synthesizes the theoretical, empirical, and applied findings of the thesis, highlighting its original contributions, limitations, and broader implications. In summary, the original contributions made by doctoral research are:

- Synthesis of AI models with decision support systems (DSS) and the emerging field of decision intelligence, emphasizing the role of AI not only as a data processor but as a co-actor in human-centered decision-making frameworks.
- Forward bringing practical concerns including ethical risks, regulatory gaps, and challenges in AI auditing, positioning itself as a pragmatic resource for scholars and practitioners navigating the complexities of AI adoption and governance in Industry 5.0 contexts.
- Developing and empirically testing a conceptual framework for assessing organizational readiness for Artificial Intelligence (AI) adoption.
- Aligning the AI readiness framework with the principles of Industry 5.0, including human-centricity, trustworthiness, sustainability, and augmented intelligence. Rather than treating AI readiness as a purely technical or strategic concern, the framework reflects the philosophical shift toward human-AI collaboration, ethical decision-making, and organizational resilience.
- Empirical insights into the performance, practical application, and human-in-the-loop dynamics of Generative AI in software development, with a focus on two core engineering tasks: algorithmic code generation and unit test creation
- Through qualitative and quantitative inquiry-including a 99-respondent survey and expert interviews-the thesis contextualizes the technical findings within current professional sentiment, identifying emerging norms, perceived benefits, and persistent obstacles in Generative AI adoption.
- Design and implementation of a platform prototype-Estimy which leverages Artificial Intelligence to support product owners and developers in generating consistent and data-driven estimations.
- By conducting qualitative validation through industry practitioners brainstorming sessions, the study also contributes practical insights on the different stakeholders' view in terms of using AI based tools in their daily tasks.

The research carried out within the doctoral program has been valorized through the publication of five scientific papers, of which: 3 articles indexed in the Web of Science (WoS) database, and the other articles being indexed in other databases.

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