

Data-Driven Decision Making via LLM-Enhanced MCDA Copilots: Methods and Applications

Summary

Large organisations crave data-driven agility, yet AI assistants often trade transparency for speed. This PhD tackles that gap by developing LLM-enhanced MCDA copilots—hybrid decision-support methods where large language models assist in generating and explaining decision artefacts, while preserving human interpretability and methodological rigour. The project is part of TalTech's research grant TEM-TA141 "SMARTER USE OF DATA VIA MACHINE#LEARNING," which supports cross-disciplinary research in data-driven systems, machine learning, and decision-making. This position contributes by advancing the theory and practice of hybrid intelligence—integrating LLM capabilities with MCDA methodologies to support high-quality, explainable decisions in real-world settings. The research will deliver new algorithmic insights, experimental validation strategies, and conceptual models that improve both the effectiveness and explainability of AI-assisted decision making.

Research field:	Information and communication technology
Supervisor:	Dr. Innar Liiv
Availability:	This position is available.
Offered by:	School of Information Technologies Department of Software Science
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

Traditional decision-support tools either rely on black-box AI models or on manual MCDA processes. The goal of this PhD is two-fold:

- **Methodological innovation#**— Formalise algorithms and prompt-engineering patterns that let LLMs generate, justify and refine MCDA artefacts (criteria, weights, explanations) while preserving full audit trails.
- **Practical impact#**— Build a reference architecture and prototype "copilot" platform (web-based) to validate the methods in at least three real-world case studies;

Main research question

How can we integrate LLM assistance into MCDA workflows so that decision quality, transparency and stakeholder trust all improve concurrently?

Goals

- Design an LLM-MCDA integration method (incl. human-in-the-loop checkpoints and collective-intelligence extensions).
- Develop a modular reference architecture and web prototype implementing the method.
- Evaluate algorithmic correctness, usability, and impact on decision quality in simulated and live settings.
- Collaborate with real-world companies and public-sector partners to validate the method in applied decision-making contexts.
- Generalise findings into design principles and publish in top-tier IS & AI venues.

Responsibilities and (foreseen) tasks

- Develop, formalise, and evaluate LLM-enhanced MCDA methods.
- Implement prototypes combining decision-analysis algorithms and LLM-based prompting.
- Collaborate with companies, public-sector partners, and TEM-TA141 WP#2 & WP#4 researchers to validate solutions in applied contexts.
- Conduct experiments and publish findings in peer-reviewed venues.

- Participate in departmental activities and supervise MSc students.

Applicants should fulfil the following requirements:

- Master's degree (or equivalent) in Computer Science, Software Engineering, Data Science, Information Systems, or a related field.
- Solid understanding of multi-criteria decision analysis (MCDA) or decision theory, and foundational knowledge of machine learning and large language models.
- Proficiency in Python and experience with LLM APIs.
- Familiarity with decision-support tools or algorithms such as AHP, ELECTRE, PROMETHEE, or similar.
- Interest in explainable AI, human-AI interaction, and/or hybrid intelligence frameworks.
- Excellent command of English.
- Strong academic writing and analytical reasoning skills.
- Ability to work independently and in an international, interdisciplinary research environment.
- Interest in working on real-world problems with external partners, and a drive to integrate applied use cases into high-quality academic research.
- Willingness to assist in organisational and collaborative tasks related to the broader TEM-TA141 project.

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- A 4-year fully funded PhD position.
- Integration into the TEM-TA141 research team, offering cross-disciplinary mentorship in databases and analytics.
- Access to high-performance computing resources.
- Support for presenting at leading international conferences.
- Professional development courses, doctoral-school seminars, and support for research commercialization.

About the department

The ambition of the Department of Software Science is to be a leading actor in software science research in the Baltic Sea region and an intermediary of top level and scientifically relevant competence between students, enterprises, public sector and researchers.

Department of Software Science is part of School of Information Technologies, which prepares specialists with bachelor's, master's and doctoral degrees in one of the fastest developing fields of science and technology, which is information and communication technology. Research and development activities at a good international level and cooperation with companies create the basis for high-quality research-based learning activities.

(Additional information)

For further information, please contact Associate Professor Innar Liiv (innar.liiv@taltech.ee) <https://taltech.ee/en/department-of-software-science>



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