



**RI.
SE**

AI-augmented Requirements Engineering for Industrial Systems

Sarmad Bashir

Licentiate Thesis Defence

Time: 16 October 2025 13:15(CET)

Location: Mälardalen University, Västerås, Room:Case and digital participation



Sarmad Bashir

AI-augmented Requirements Engineering for Industrial Systems

Abstract

Engineering large-scale industrial systems requires an efficient Requirements Engineering (RE) process to manage the complexity resulting from continuous technological advancements. In manufacturing domains such as railways, the complexity of software-intensive systems is growing due to evolving standards, infrastructure specifications, and increasing customer expectations. Typically, the RE process begins with analyzing extensive tender documents from external customers to assess project feasibility. This analysis is critical, as the tender documents define the scope and the standards to which the system-to-be must comply. Once validated and agreed upon, the requirements are distributed among various subsystem teams for development and testing. During implementation, the evolving requirements are cross-referenced with existing technical documents to ensure consistency across project artifacts and prevent integration issues within subsystems. However, the reliance on manual efforts in performing these RE tasks makes the process labor-intensive and time-consuming, often leading to project scope creep in industrial settings.

This thesis empirically investigates Artificial Intelligence (AI), particularly Large Language Models (LLMs)-based solutions, to augment the RE process for realizing complex industrial systems. The proposed solutions aim to provide decision support to reduce the manual efforts typically required for (i) identifying requirements from other supporting information in tender documents, (ii) detecting ambiguous requirements and explaining them, (iii) allocating validated requirements to appropriate subsystem teams for development and (iv) addressing requirement-related queries during the development and release phases of the project. Consequently, this research contributes to enhancing requirements management in complex industrial systems by enabling more efficient and informed decision-making.

Faculty Examiner



Mattias Nyberg
Adjunct Professor

KTH Royal Institute of Technology and Scania
Sweden

Committee Members



Mattias Nyberg
Adjunct Professor

KTH Royal Institute of Technology and Scania
Sweden



Jennifer Horkoff
Associate Professor

Chalmers University of Technology,
Sweden



Sasikumar Punnekkat
Professor

Mälardalen University
Sweden



Eva Thorin
Professor
(Reserve Committee member)

Mälardalen University
Sweden

Supervisors



Main-Supervisor

Markus Bohlin
Professor

Mälardalen University
Sweden



Supervisor

Mehrdad Saadatmand
Senior Researcher

RISE
Sweden



Supervisor

Eduard Paul Enoiu
Associate Professor

Mälardalen University
Sweden

List of publications in the thesis

Paper A

Bashir, S., Abbas, M., Saadatmand, M., & Enou, E. P. (2023). Requirement or not, that is the question: A case from the railway industry. In Lecture notes in computer science (pp. 105–121). Springer Science and Business Media Deutschland GmbH.

Paper B

Bashir, S., Ferrari, A., Abbas, M., & Strandberg, P. E. (2025, September 7–12). Requirements ambiguity detection and explanation with LLMs: An industrial study. In Proceedings of the 41st International Conference on Software Maintenance and Evolution (ICSME 2025). Auckland, New Zealand. IEEE.

Paper C

Bashir, S., Abbas, M., Ferrari, A., & Saadatmand, M. (2023). Requirements classification for smart allocation: A case study in the railway industry. In Proceedings of the 2023 IEEE 31st International Requirements Engineering Conference (RE) (pp. 201–211).

Paper D

Ibtasham, M. S., Bashir, S., Abbas, M., & Haider, Z. (2025). ReqRAG: Enhancing software release management through retrieval-augmented LLMs: An industrial study. In Lecture notes in computer science (Vol. 15588, pp. 277–292). Springer Science and Business Media Deutschland GmbH.

Biography

Sarmad Bashir is an Industrial Ph.D. student at RISE, Västerås, Sweden. He has a Master's degree in Information Technology, with a thesis focused on language models for text generation. Before joining RISE, he worked as a Senior Machine learning Engineer, applying data-driven solutions to address industrial challenges. His research revolves around leveraging Artificial Intelligence techniques to optimize requirements engineering and software testing processes.

Contact



sarmad.bashir@mdu.se

IndTech Graduate School and its continuation IndTech Plus, is an industrial Ph.D. school at MDU offering advanced training in the field of industrial digitization, a new and emerging field of technology that revolutionizes all aspects of the manufacturing and process industry. A total of 21 doctoral students will, within the framework of the program, combine employment at companies with pursuing postgraduate studies at MDU from 2021-2030.



KK-stiftelsen



<https://indtech-graduateschool.se/>