

Coexistence and Collaboration: Agentic vs. Deterministic Control Paradigms for Industrial Automation to achieve reliable Agentic AI workflows

Masterthesis

You investigate the feasibility of an agentic or a rule-based actor within engineering processes and evaluate the reliability of ai made decisions in enterprise ressource planning (ERP).

Motivation

Agentic AI is increasingly used in engineering workflows, from PLC code generation to the orchestration and ERP. Agents can handle unstructured input flexible, but their non-deterministic behaviour can be a problem in industrial environment, where safety, quality and compliance with applicable rules are essential. Historically, automation in engineering relied on deterministic algorithms: precise, repeatable, and inherently predictable. While these systems excelled in reliability, their rigidity limited adaptability in complex, dynamic environments.

Recent work has proposed agentic Business Process Model and Notation (BPMN) concepts as a solution, wherein BPMN serves as a rule-based orchestrator. This approach integrates agentic tasks into a structured framework, allowing processes to remain machine-readable and deterministic at their core while enabling flexible execution where needed. However, integrating agentic decisions, particularly those originating from enterprise-level systems like ERP, into these rule-based workflows raises important questions about trust, reliability, and control. This thesis addresses these challenges by investigating whether agentic and deterministic elements can be combined within industrial automation.

Goals

- Conceptual design for usage of agentic and deterministic elements in industrial workflows including clear criteria for deciding which task is handled agentially, which deterministically or where hybrid architectures are sensible
- Prototypical implementation of the concepts on 2–3 industrial use cases
- Validation of the approach and compare hybrid, purely agentic, and purely deterministic variants regarding efficiency, reliability, and engineering effort.

Interessen und hilfreiche Vorkenntnisse

- 🔧 Interest in automation engineering workflows
- 🏢 Prior knowledge in mechanism of agentic AI
- 📖 Lectures IT/AT, MARO and CPM

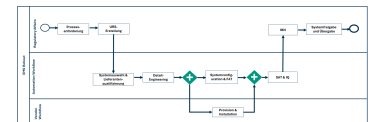


Abbildung 1: Example BPMN of a typical engineering process

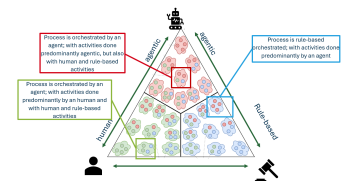


Abbildung 2: Spectrum of different actors for business process execution according to Dumas et. al



Supervisor

Ilona Bühlmann, M. Sc.
ilona.buehlmann@kit.edu
Marwin Madsen, M. Sc.
marwin.madsen@kit.edu

Thesis: Masterthesis

Datum der Ausschreibung: 12.10.2026

Tags: Agentic AI, Workflows, Automation Engineering