MAPS-AI: Model-Based Approach for IT Project Scope Using Artificial Intelligence*

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Abstract
The research project "Model-Based Methodology for Development of IT Project Management Plan and Scope Using Artificial Intelligence Algorithms", shortly called MAPS-AI (Model-based Approach for IT Project Scope using Artificial Intelligence), aims to elaborate an approach to the development of IT Project Management Plan and Scope using model-driven engineering concepts integration with generative artificial intelligence. The project focuses on developing a structured methodology to automate the generation of IT project scope elements, agile backlog user stories and standards-based project management plan. Key project activities include analysis of existing software engineering standards and project management frameworks, definition of transformation rules for source and target elements used in project initiation, integration of AI-driven algorithms for project artifacts refinement, and validation of the methodology through prototype development and case studies.

Keywords
IT project management plan, IT project scope, model-driven engineering, artificial intelligence, documentation generation

1. Introduction and Research Background

The initiation phase of information technology (IT) projects establishes the basis for scope definition, planning, resource allocation, and stakeholder alignment. Artifacts produced during this phase, including scope descriptions, requirements, backlogs, and project management plans, function as reference points for subsequent development and governance activities. Problems in these artifacts propagate across the project life-cycle and result in misunderstandings, uncontrolled scope changes, and increased rework [1].

Established standards and frameworks, including PMBOK [2], ISO [3-5], and SWEBOK [6], define the structure and content of project management and engineering artifacts. These standards promote consistency, traceability, and alignment with organizational objectives [2-6]. However, the development of initiation-phase artifacts remains largely manual and dependent on individual expertise. Empirical evidence indicates inconsistencies between artifacts, incomplete documentation, and weak traceability between business objectives, requirements, and planning elements [7]. In agile and hybrid environments, this problem is not eliminated but reconfigured, as iterative development practices require both flexibility and structured artifact management to maintain governance and coordination [8].

Model-Driven Engineering provides a formal basis for improving artifact consistency by treating models as primary development entities and applying transformation rules to derive

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related artifacts [9; 10]. In the context of IT project initiation, model transformations support the derivation of structured artifacts, such as use case models and backlog elements, from conceptual representations of the problem domain [11]. Nevertheless, model-driven approaches alone do not fully address the generation of artifacts that require narrative content and contextual interpretation, as such elements remain difficult to derive from models and typically require manual effort and domain-specific reasoning [12].

Recent advances in generative artificial intelligence, particularly large language models, provide mechanisms for automating documentation tasks, including requirements formulation and project planning support [13]. Tools such as ChatGPT, Copilot, and Gemini demonstrate the applicability of AI-assisted text generation in software engineering contexts [14-16]. At the same time, unconstrained use of these models leads to outputs that may lack structural consistency, deviate from predefined templates, and contain semantic inaccuracies [17]. These limitations indicate the need for controlled and context-aware integration of generative techniques, as current applications of AI in project management highlight challenges related to context understanding, output reliability, and alignment with domain requirements [18].

These observations reveal a methodological gap. Model-driven approaches ensure structural consistency but lack flexibility in narrative generation. Generative approaches provide expressive capabilities but require constraints to ensure traceability, consistency, and standards compliance. An integrated approach is required that combines formal transformation logic with controlled generative mechanisms across different levels of abstraction.

This paper addresses the identified gap by proposing MAPS-AI (Model-Based Approach for Project Scope using Artificial Intelligence), a model-driven and AI-assisted methodology for generating IT project scope and management plan artifacts. The methodology is based on a hybrid architecture that separates deterministic model transformations from controlled generative processes. Structured artifacts are derived from a conceptual process model through predefined transformation rules, while narrative elements are generated using constrained generative techniques guided by project-specific data and standards-aligned templates [19]. The approach ensures traceability between artifacts, alignment with standards, and reduction of manual effort in early project phases.

The methodology is instantiated in a prototype tool that supports the generation of key initiation artifacts, including UML use case models, backlog elements, scope components, and draft project management plans. The research follows the Design Science Research paradigm [20], focusing on the construction and evaluation of a methodological artifact. The approach is validated through case-based evaluation, demonstrating feasibility and improvements in artifact consistency, traceability, and standards alignment.

The main contributions of this paper are as follows:

(1) a model-driven and AI-assisted methodology for the automated generation of IT project initiation artifacts;

(2) a hybrid transformation and generation framework that integrates deterministic model transformations with controlled generative AI;

(3) an instantiation of the methodology in the MAPS-AI prototype;

(4) an empirical validation demonstrating the applicability of the approach in a realistic project context.

The remainder of the paper is structured as follows. Section 2 presents the research methodology. Section 3 describes the project results and the conceptual workflow of the proposed MAPS-AI methodology. Section 4 concludes the paper and outlines directions for future work.

2. Research Methodology

The research presented in this paper follows the Design Science Research (DSR) paradigm, which is appropriate for the development and evaluation of artifacts intended to address identified practical problems in information systems [20]. In contrast to purely empirical or theoretical studies, DSR emphasizes the construction of innovative artifacts and the systematic evaluation of their utility, rigor, and relevance. In the context of this research, the primary artifact is a methodology for the automated generation of IT project initiation artifacts, supported by a prototype implementation. The research process is structured into three interrelated phases: relevance, design, and rigor, following established DSR guidelines.

During the **Relevance phase** the problem domain was identified through systematic literature review and mapping studies focusing on IT project initiation artifacts and model transformation approaches. These studies revealed limitations in existing practices, including fragmented artifact structures, insufficient traceability, and lack of integrated automation mechanisms [7]. Additionally, an analysis of software engineering and project management standards [2-6] was conducted to define the expected structure and content of initiation-phase artifacts. Based on the identified problem, a model-driven and AI-assisted methodology was developed during **Design phase**. This phase involved:

(1) definition of a unified artifact meta-model capturing relationships between initiation artifacts;

(2) specification of a deterministic transformation chain linking source and target artifacts;

(3) integration of controlled generative AI mechanisms for narrative artifact generation.

The resulting methodology combines formal model transformations with constrained generative techniques, ensuring that structured artifacts are derived through reproducible rules, while narrative elements are generated in a controlled and context-aware manner [19].

During **Rigor phase** the methodology was instantiated as a prototype tool (MAPS-AI) and evaluated through a case-based approach. The evaluation focuses on assessing artifact consistency, traceability, and alignment with standards, as well as the feasibility of the approach in a realistic project context.

3. Project Results

The project began with a systematic literature review of model transformations applied in early IT project phases [7]. The review demonstrated that while model-driven engineering is widely used in later development stages, automation of initiation-phase artifacts remains insufficiently supported.

A complementary systematic mapping study identified the key artifacts used in IT project initiation and planning. Based on the identified artifacts, the approach defines a unified conceptual artifact pool containing the project elements metamodel shown in Figure 1.

The core outcome of the research is a methodology that defines how IT project initiation artifacts can be systematically generated from problem domain models. The methodology is based on a hybrid architecture consisting of two complementary components:

1. Transformation component, responsible for deterministic model-to-model transformations;
2. Generation component, responsible for controlled generative AI-based enrichment of artifacts.

The transformation component operates on structured inputs, primarily business process models, which serve as the representation of the problem domain. Through defined transformation rules, these models are mapped to UML use case diagrams and user stories as product backlog elements. This transformation chain ensures that all generated artifacts are traceable to the original source model [11].

The generation component complements this process by producing narrative elements that cannot be derived through deterministic transformations alone. These include refinement of user story descriptions and generation of acceptance criteria and project scope elements. To ensure consistency and standards alignment, generative AI is applied in a controlled manner using structured inputs, predefined templates, and context-aware prompting strategies.

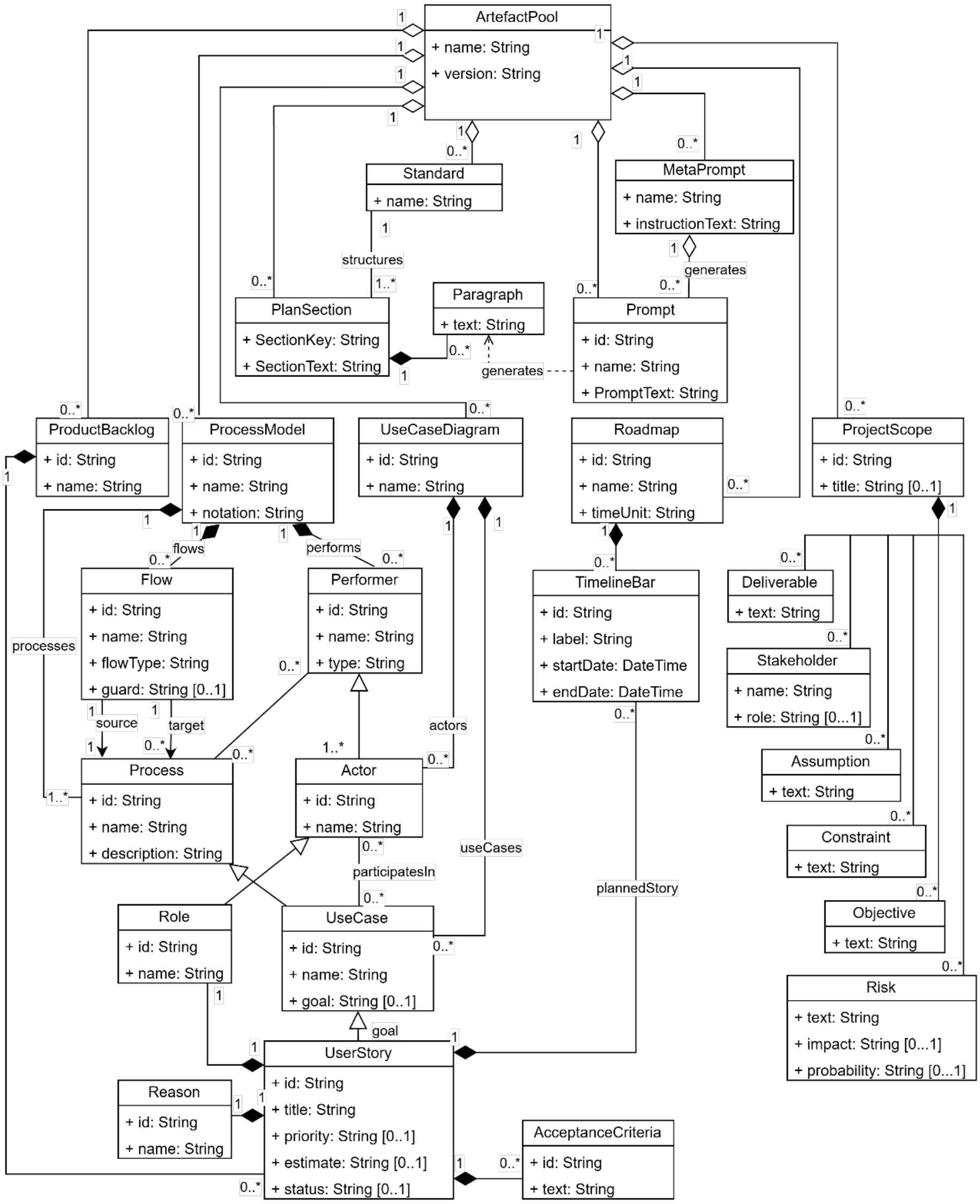

Figure 1: Artifact pool meta-model defined by MAPS-AI.

The methodological integration of meta-prompting and structured semantic retrieval is applied to generation of textual sections of the project management plan and is presented in [21]. The main idea of IT project management plan generation is to employ a meta-prompting strategy, where prompt construction itself is treated as a systematic, model-driven activity rather than an ad-hoc interaction with the language model. In this approach, a higher-level meta-prompt is used to generate precise, task-specific prompts for the execution LLM, ensuring that each generation step is aligned with predefined templates, project management standards, and the structure of the target artifact. This "Generative AI for Generative AI" principle enables the decomposition of complex documentation tasks into smaller, controlled generation units, each governed by explicit instructions and constraints [22].

Furthermore, meta-prompting is tightly coupled with structured semantic retrieval, where relevant information from the artifact pool (e.g., process model elements, use cases, user stories, and scope data) is dynamically injected into prompts at generation time. This ensures that generated textual content remains grounded in the underlying business semantics and maintains traceability to source artifacts. The approach follows a “generation fountain” workflow, in which prompts are iteratively refined and enriched with contextual data, reducing hallucination risks and improving structural consistency across document sections. As a result, meta-prompting enables controlled variability in text generation while preserving compliance with IT standards, ensuring that narrative elements of the IT project management plan are both semantically accurate and structurally consistent with the artifact-driven transformation backbone.

The workflow in Figure 2 illustrates how structured project knowledge is progressively refined and enriched, starting from initial inputs and resulting in a coherent set of IT project initiation artifacts. As illustrated in Figure 2, the workflow is organized around two core elements: artifact repositories, and processing engines, which supports the key methodological principle of the explicit separation between deterministic and generative processes enabling reproducibility of structural artifacts while maintaining flexibility in generating context-dependent content.

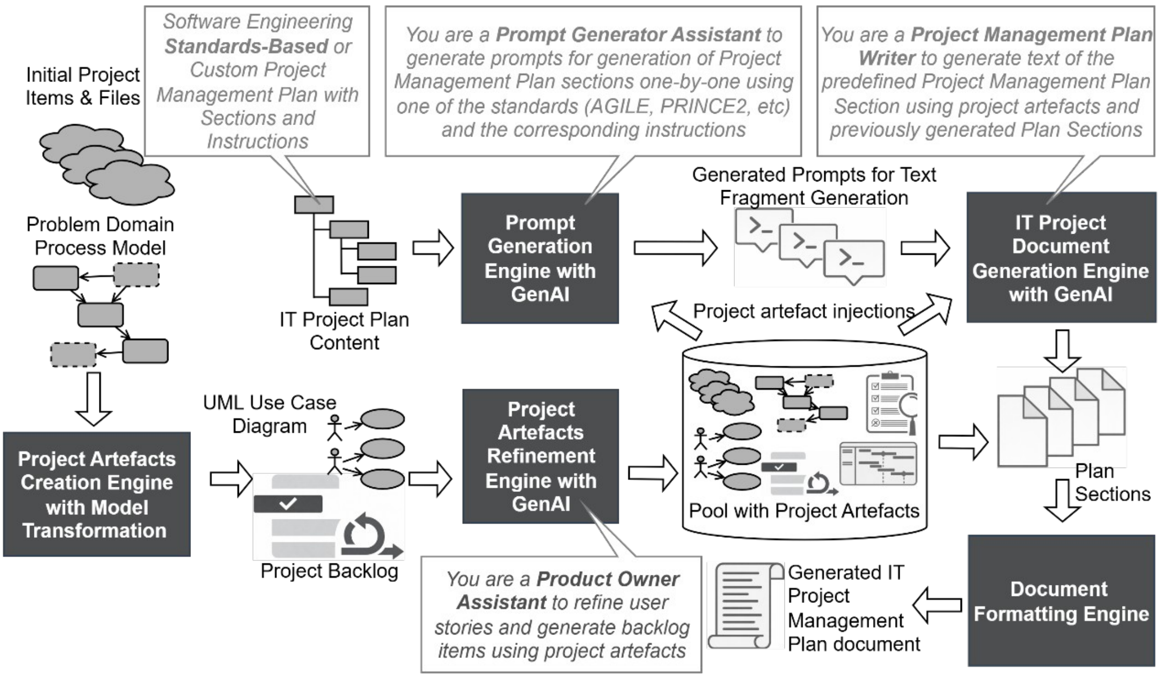

Figure 2: Conceptual workflow of the proposed methodology

The MAPS-AI methodology is implemented as a prototype [19] and evaluated using a case-based validation approach, which is suitable for investigating complex artifacts in real-world or realistic contexts [23]. The evaluation examined structural consistency between generated artifacts; traceability from business process models to backlog items and planning documents; completeness of initiation-phase artifact coverage; reproducibility of deterministic transformations.

The case study validation was conducted using three complementary approaches, schematically presented in Figure 3. First, a complete IT project artifact set generated by the methodology was submitted for expert evaluation in order to assess structural consistency, traceability, and content adequacy. Second, the IT Project Management Plan generated by MAPS-AI was systematically compared with a manually developed plan from a real project to evaluate coverage, alignment with standards, and practical usability. Third, the functionality of MAPS-AI itself was modeled as input to the tool, enabling the generation of a new IT project artifact set, which was then compared with the artifacts originally produced during the development of MAPS-AI. The generated artifact set for the last validation case is available at [24].

Taken together, these validation activities demonstrate the feasibility of the proposed approach within the defined scope of initiation-phase planning artifacts and confirm its ability to produce structurally coherent and traceable artifact set. However, it is important to note that the validation of AI-assisted artifact generation introduces a fundamentally different challenge compared to traditional model-driven approaches. In the case of deterministic model transformations, correctness can be ensured through formally defined transformation rules. If these rules are specified correctly, the transformation process is fully reproducible, and the same input will always produce the same output, allowing for verification based on formal properties and rule completeness.

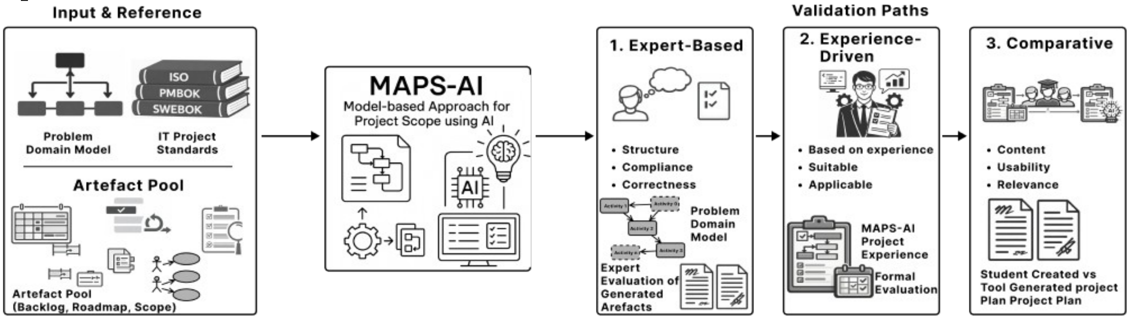

Figure 3: Validation schema underlying three complementary evaluation strategies.

In contrast, when generative AI is applied, the generation process becomes inherently non-deterministic. Even with identical inputs and prompts, large language models may produce variations in output, and there is no strict guarantee of correctness, completeness, or compliance with domain-specific constraints. As a result, traditional validation approaches based on formal verification are not directly applicable. Instead, validation must rely on a combination of indirect methods, such as expert evaluation, comparison with reference artifacts, and consistency checks across generated outputs.

This reflects a broader research challenge currently discussed in the field: identifying reliable and systematic validation methods for AI-generated artifacts. Existing studies highlight issues such as structural inconsistency, semantic drift, and hallucinations when using unstructured or weakly controlled prompting. Consequently, there is an ongoing shift towards hybrid validation strategies that combine model-driven guarantees (for structural artifacts) with controlled generation techniques and multi-perspective evaluation (for narrative artifacts).

In this context, the MAPS-AI validation approach can be interpreted as a step towards such hybrid validation, where deterministic transformations ensure a stable and verifiable backbone, while AI-generated components are validated through combination of expert judgment, artifact comparison, and traceability analysis.

4. Conclusion and Ongoing Work

This paper presents MAPS-AI as a model-driven and AI-assisted methodology for the automated generation of IT project initiation artifacts, with emphasis on project scope and project management plan elements. The research is grounded in the Design Science Research paradigm and addresses limitations of current practices, where artifact creation remains manual, inconsistent, and weakly traceable.

The proposed methodology is defined as a hybrid framework that combines deterministic model transformations with controlled generative mechanisms. The transformation component ensures systematic derivation of structured artifacts from conceptual source models, while the generative component supports the production of narrative elements that cannot be derived through formal rules alone. The explicit separation between transformation and generation processes constitutes a central design principle of the approach, enabling reproducibility of structural artifacts and controlled variability of textual content.

The methodological contribution lies in the specification of an integrated artifact generation process. The framework introduces a unified artifact meta-model, a deterministic transformation chain, and a constrained generative layer governed by templates, contextual inputs, and meta-prompting strategies. This structure supports traceability across artifacts, alignment with standards, and consistency between different levels of abstraction.

The evaluation, conducted through case-based validation, indicates that the methodology is capable of producing a coherent and structurally consistent set of initiation-phase artifacts. The results demonstrate traceability between source models and generated outputs, completeness of artifact coverage within the defined scope, and reproducibility of deterministic transformations. At the same time, the evaluation highlights the limitations of generative components, where correctness and completeness cannot be guaranteed solely through formal verification and require complementary validation mechanisms.

The conducted research led to the following findings:

1. The development of initiation-phase artifacts remains insufficiently automated and consistent, while approaches based solely on model-driven techniques or generative artificial intelligence do not ensure both structural consistency and contextually adequate content.
2. Model-driven transformations provide determinism, reproducibility, and traceability, but are insufficient for narrative generation, whereas generative techniques require controlled usage due to their variability.
3. The use of a unified artifact meta-model, transformation chain, and explicit separation of transformation and generation processes ensures traceability, structural consistency, and controlled variability of generated outputs.

Several limitations must be mentioned. The evaluation is based on a limited number of case scenarios and does not fully address scalability across different domains and project types. The reliance on controlled generative mechanisms reduces, but does not eliminate, risks related to semantic inaccuracies and variability in generated content. Consequently, human validation remains necessary, particularly for artifacts requiring domain-specific interpretation.

Future work will extend the methodology along three directions. First, the artifact model and transformation rules will be expanded to cover additional project management domains and artifact types. Second, the integration of generative mechanisms will be refined through improved prompt design, domain-specific knowledge incorporation, and enhanced control strategies. Third, further empirical validation will be conducted to assess scalability, robustness, and applicability in diverse organizational contexts.

Overall, the results indicate that a structured integration of model-driven engineering with controlled generative techniques provides a viable methodological basis for improving the consistency, traceability, and efficiency of IT project initiation artifact generation.

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Declaration on Generative AI

Web-based AI image generation tool NanoBanana (Google, Gemini 3.1 Flash Image, 2026) was used for creating Figure 3 based on an author-defined prompt without adding new content. ChatGPT (OpenAI, GPT-5.3, 2026) was used for minor linguistic refinement of the text. Generative AI was not used to generate scientific content, analysis, or conclusions. The authors take full responsibility for all content, analysis, and conclusions.

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