

Generative AI for Requirements Engineering: A Systematic Literature Review

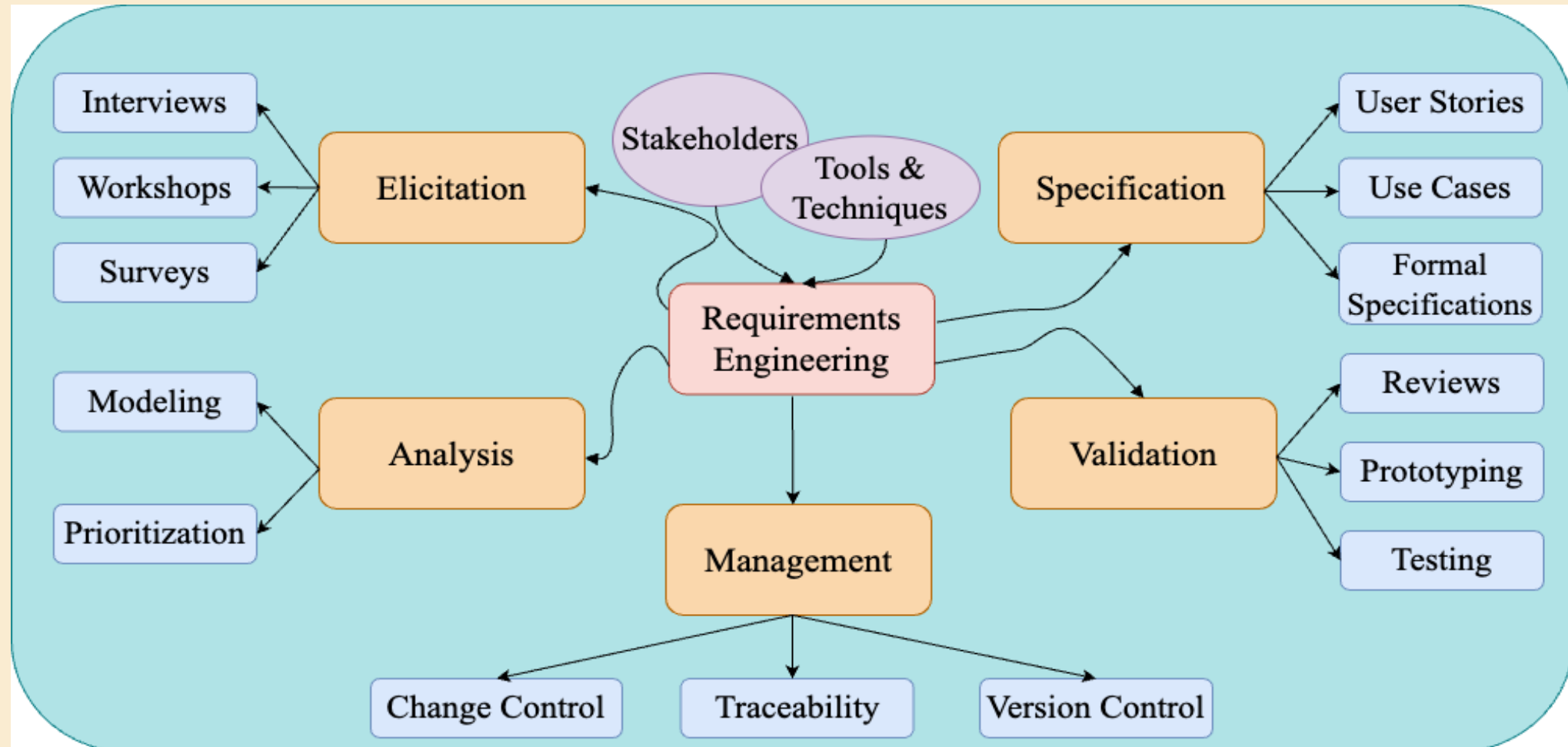
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01 INTRODUCTION

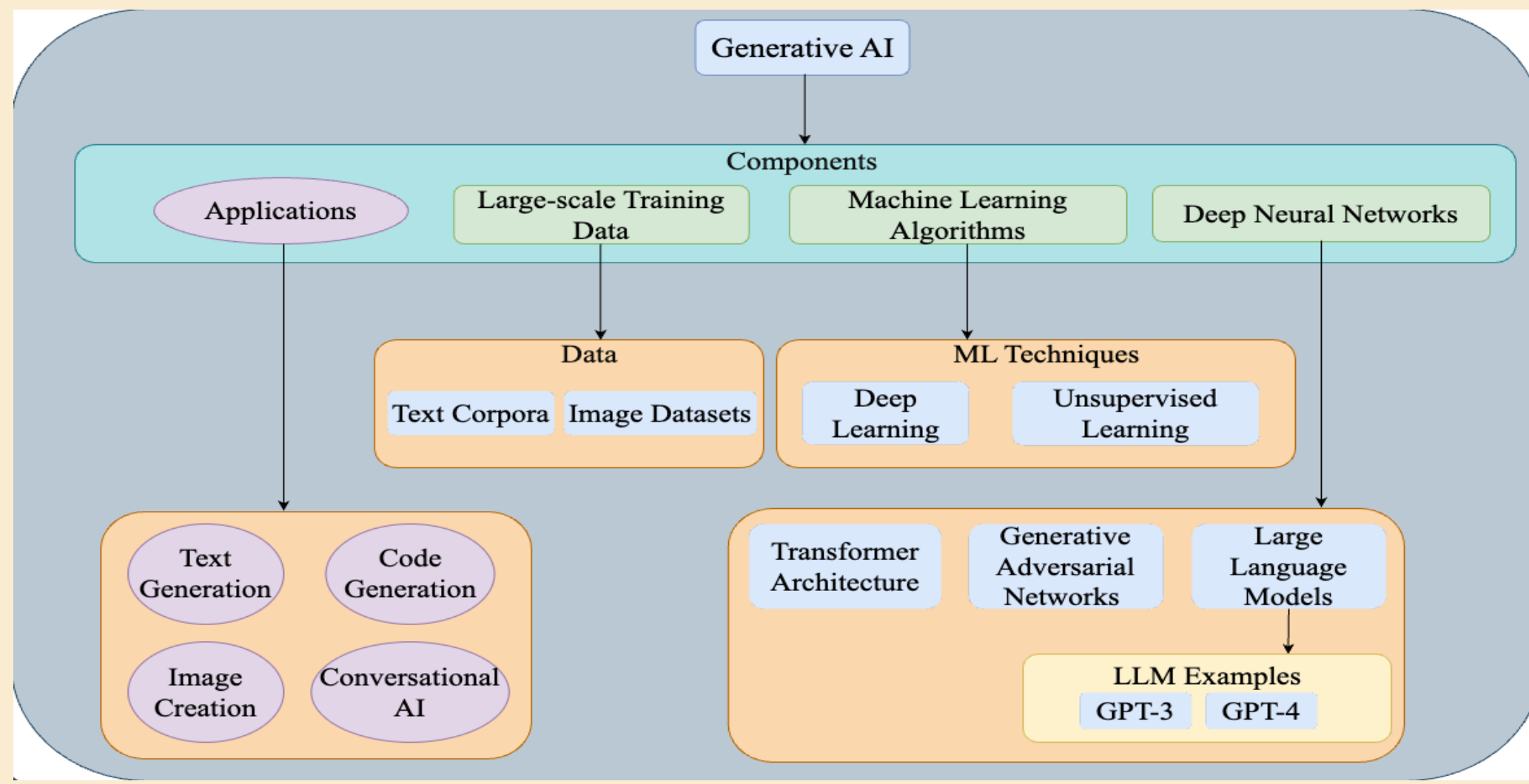
Software Engineering (SE) is a systematic software development and maintenance approach. It aims to improve the efficiency, quality, and reliability of software systems

Requirements Engineering (RE) is a critical phase in the software development lifecycle. It focuses on eliciting, analyzing, specifying, and validating software requirements.

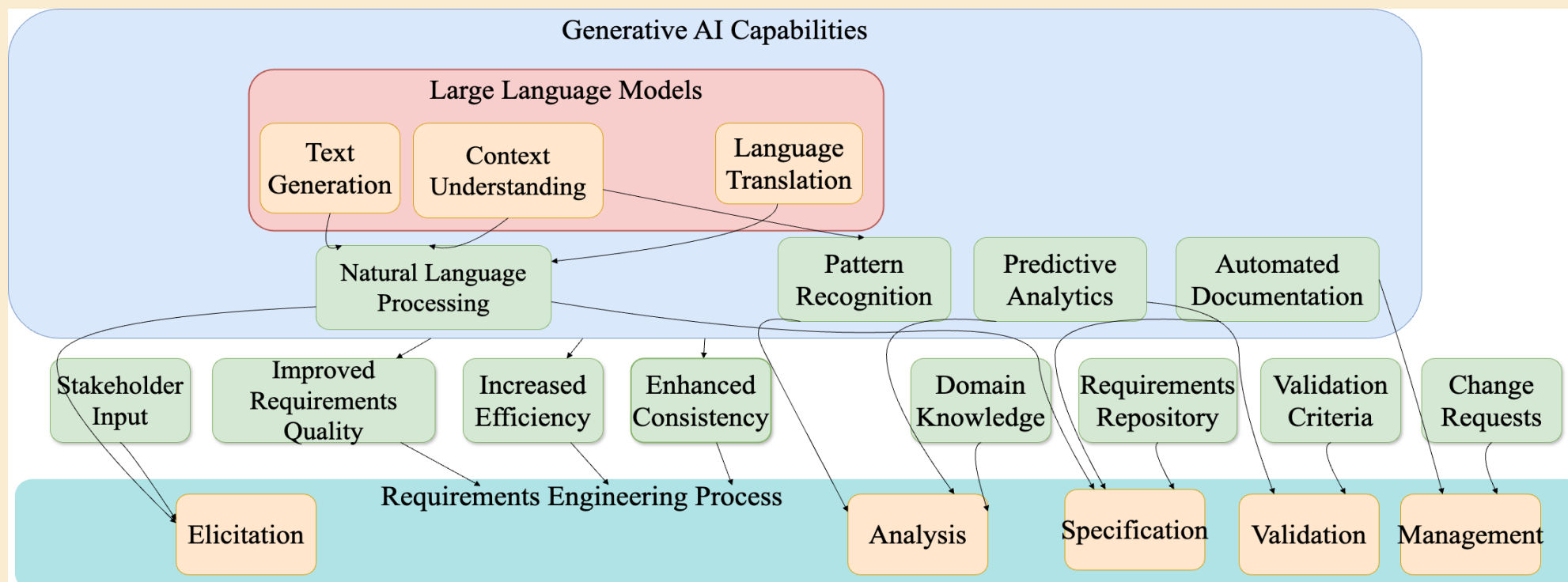
RE plays a crucial role in project success and stakeholder satisfaction. Current traditional RE methods struggle with efficiency and accuracy in complex projects



Generative AI (GenAI) refers to AI systems capable of generating new content (text, code, images), it powered by advanced deep learning techniques and large language models (LLMs)

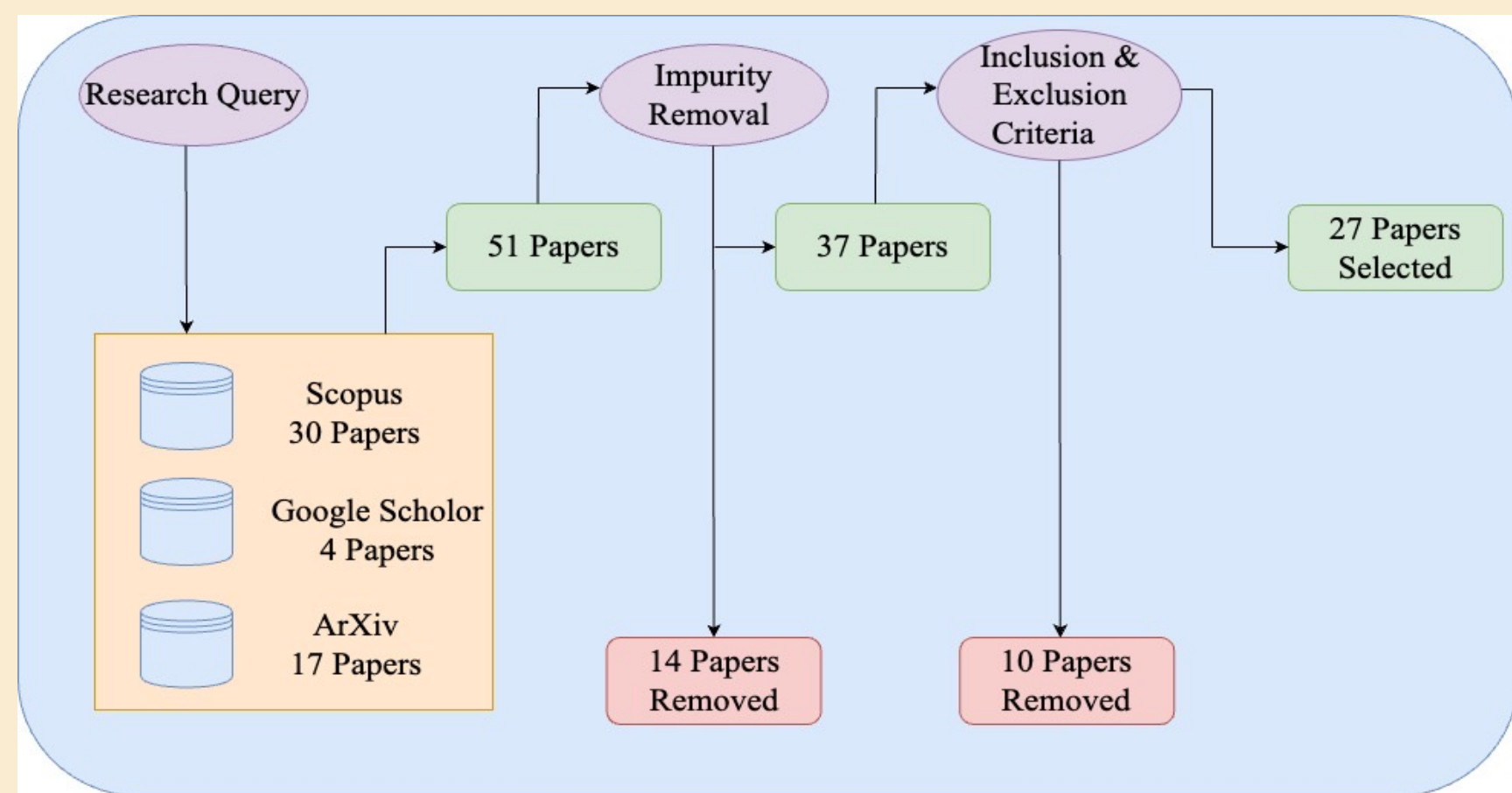


GenAI for RE is an emerging field that applies GenAI techniques to RE tasks.



03 Research Methodology

Search and Selection Process



Search Strategy: Scopus, ArXiv, Google Scholar (2019-2024)

Inclusion Criteria: Peer-reviewed articles, English language, high relevance to GenAI in RE

Exclusion Criteria: High relevance to GenAI in SE, Consider BERT as GenAI, Grey literature (book chapters, Ph.D. theses, etc)

Data Extraction: Standardized forms, collaborative review process

Final Selection: 27 papers selected

05 Threats to Validity

Internal Validity:

- Potential unintentional omission of relevant studies
- Possible subjective bias in data extraction and analysis

Mitigation: Comprehensive search strategy, rigorous screening criteria, and independent review by multiple researchers

External Validity:

- Time frame limitation (2019-2024) may not fully capture the latest developments
- The generalizability of findings may be limited by specific research contexts

Acknowledgment: Cautious interpretation of results, considering contextual factors

Construct Validity:

- Existing quality assessment criteria may not fully apply to this emerging field
- The proposed analysis framework may not cover all significant aspects

Approach: Continuous refinement of evaluation frameworks and openness to new influencing factors

06 Conclusion and Future Work

Conclusion:

- GenAI shows significant potential in RE, particularly in requirements **elicitation and validation**, with **GPT series** models being the primary tools used in current research.
- GenAI faces critical challenges including **integration of domain-specific knowledge** and **ethical and regulatory concerns**.
- The field is rapidly evolving, with an increasing focus on **early stages of the RE** lifecycle.

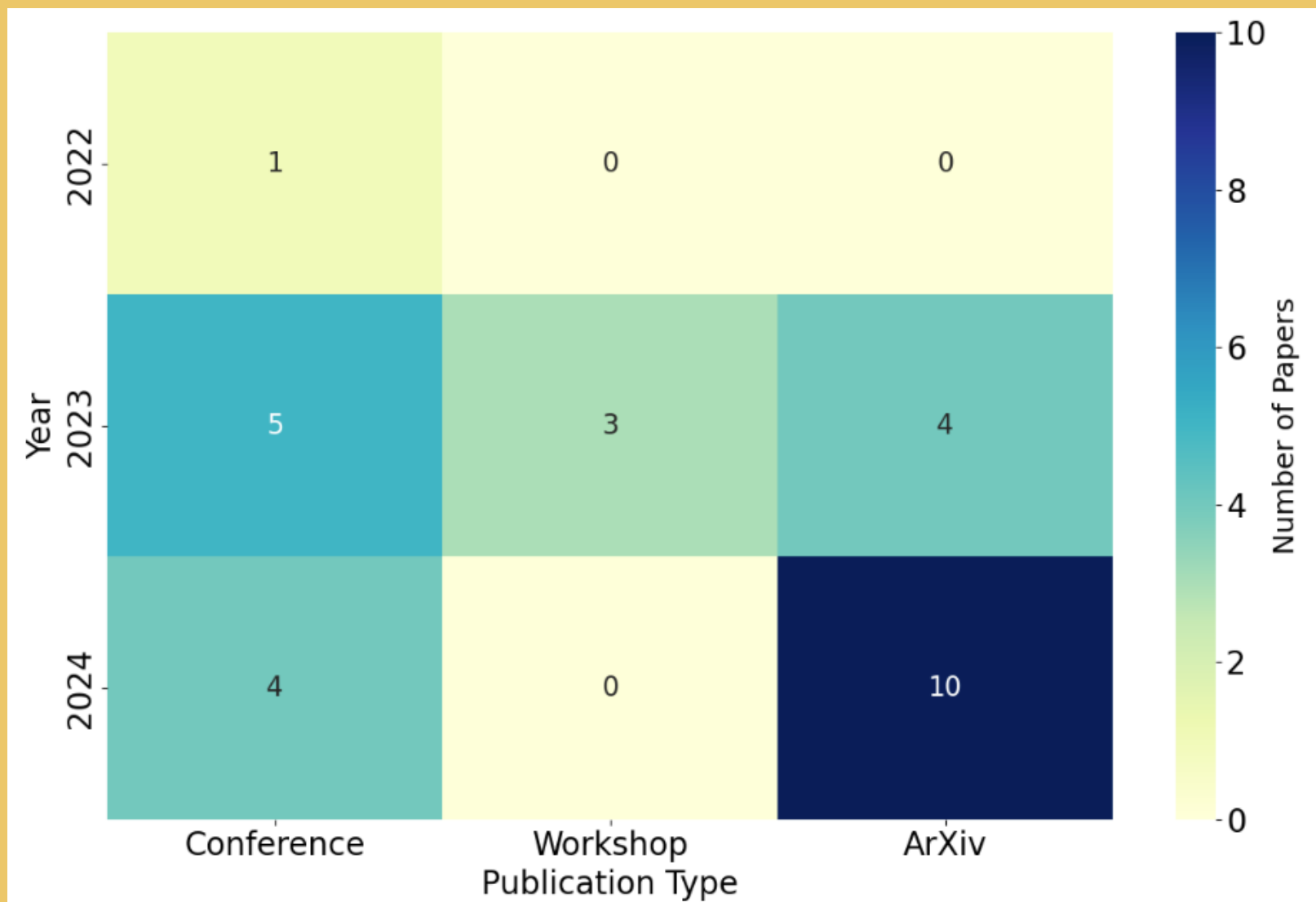
Future Work:

- Develop more sophisticated, domain-specific GenAI models and expand their application across the entire RE lifecycle, particularly in later stages.
- Establish robust **human-AI collaboration frameworks** and **comprehensive evaluation** to optimize and assess the long-term impacts of GenAI on RE processes and outcomes.
- Address **ethical, legal, and technical challenges**.

04 Analysis and Discussion

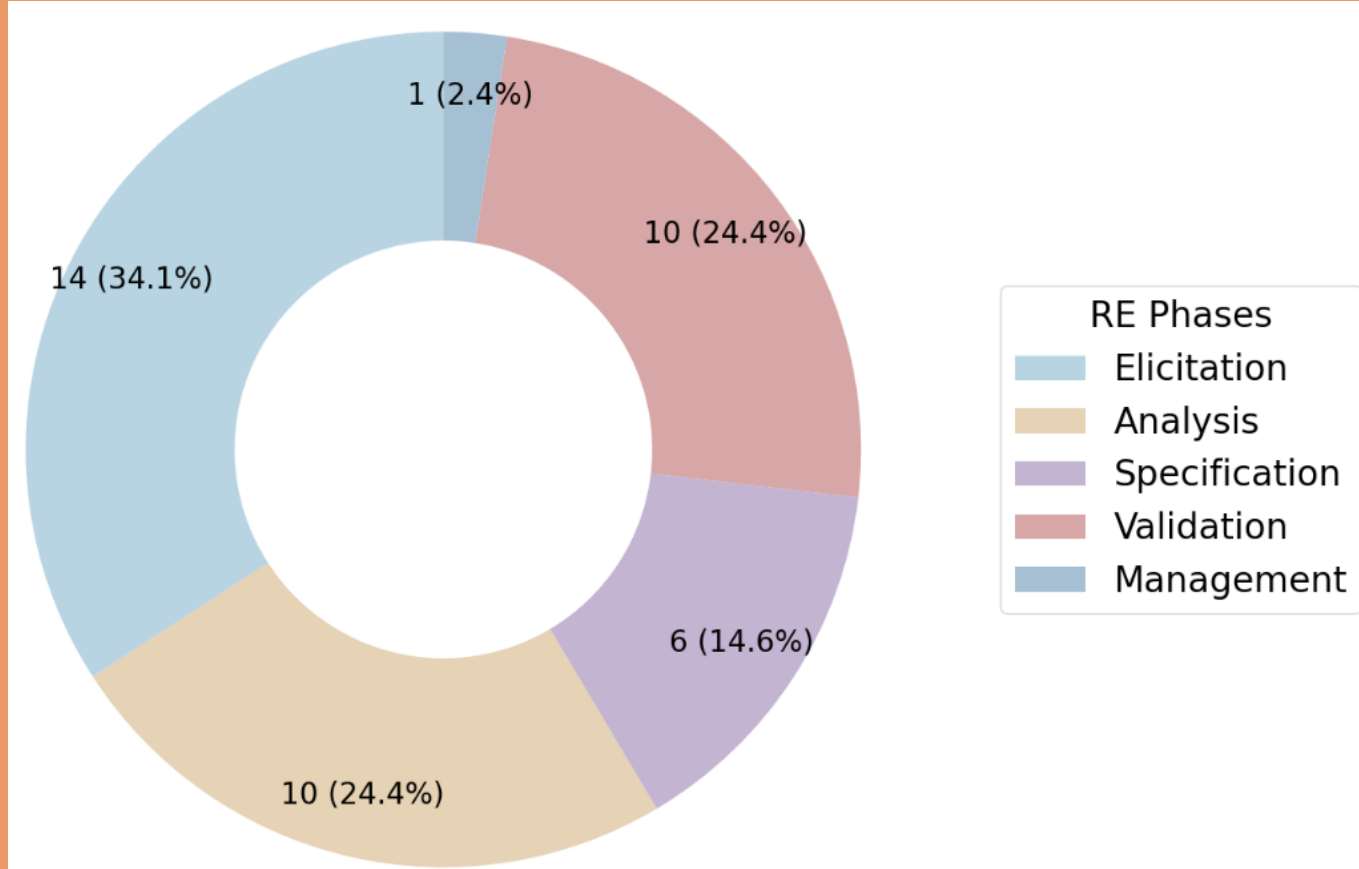
RQ1: Publication Trends in GenAI for RE

Significant growth in publications from 2023 to 2024.

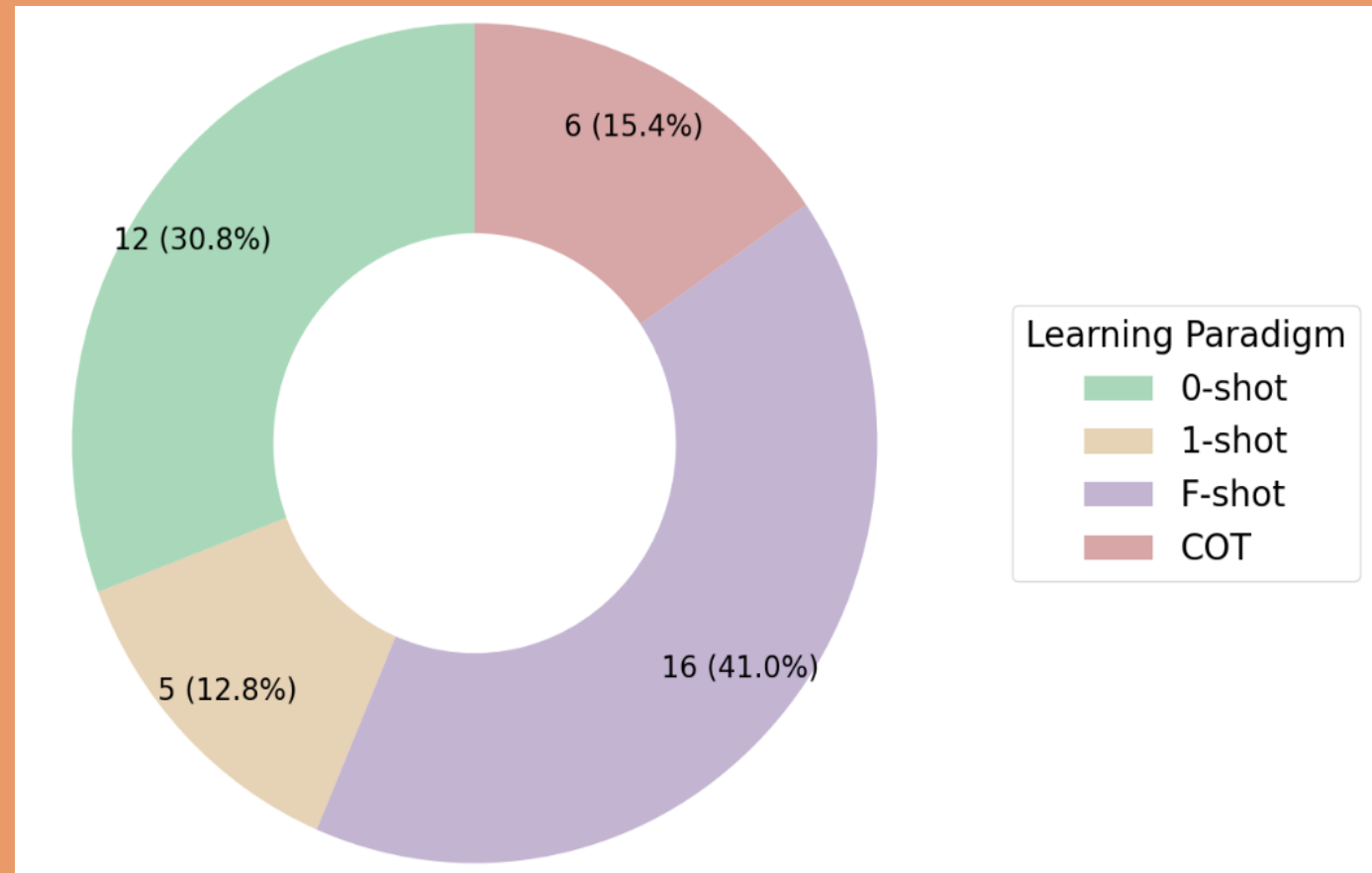


Distribution of papers by publication type and year

RQ2: Methodology Trends in GenAI for RE



Distribution of Requirements Engineering Phases



Distribution of Learning Paradigm

Most studies focus on **elicitation, and validation**. Researchers are interested in **how GenAI can assist in gathering and discovering initial requirements**.

This distribution reveals a strong preference for SOTA, general-purpose language models in RE research, particularly those from the **GPT family**.

Different approaches are being explored when GenAI is applied to RE tasks. F-shot may offer the **best balance of performance and flexibility** for RE tasks at the current stage.

Researchers and practitioners prefer to use **direct and explicit instructions** to guide GenAI models through RE tasks.

02 Research Questions

RQ1:

What are the current research trends in applying GenAI to RE?

RQ2:

What are the predominant approaches and techniques employed in current GenAI for RE research?

RQ3:

How is the quality of current research in GenAI for RE evaluated?

RQ4:

What are the main challenges in applying GenAI to RE, and what are the future research directions? How do these challenges and directions relate to the limitations of current research?

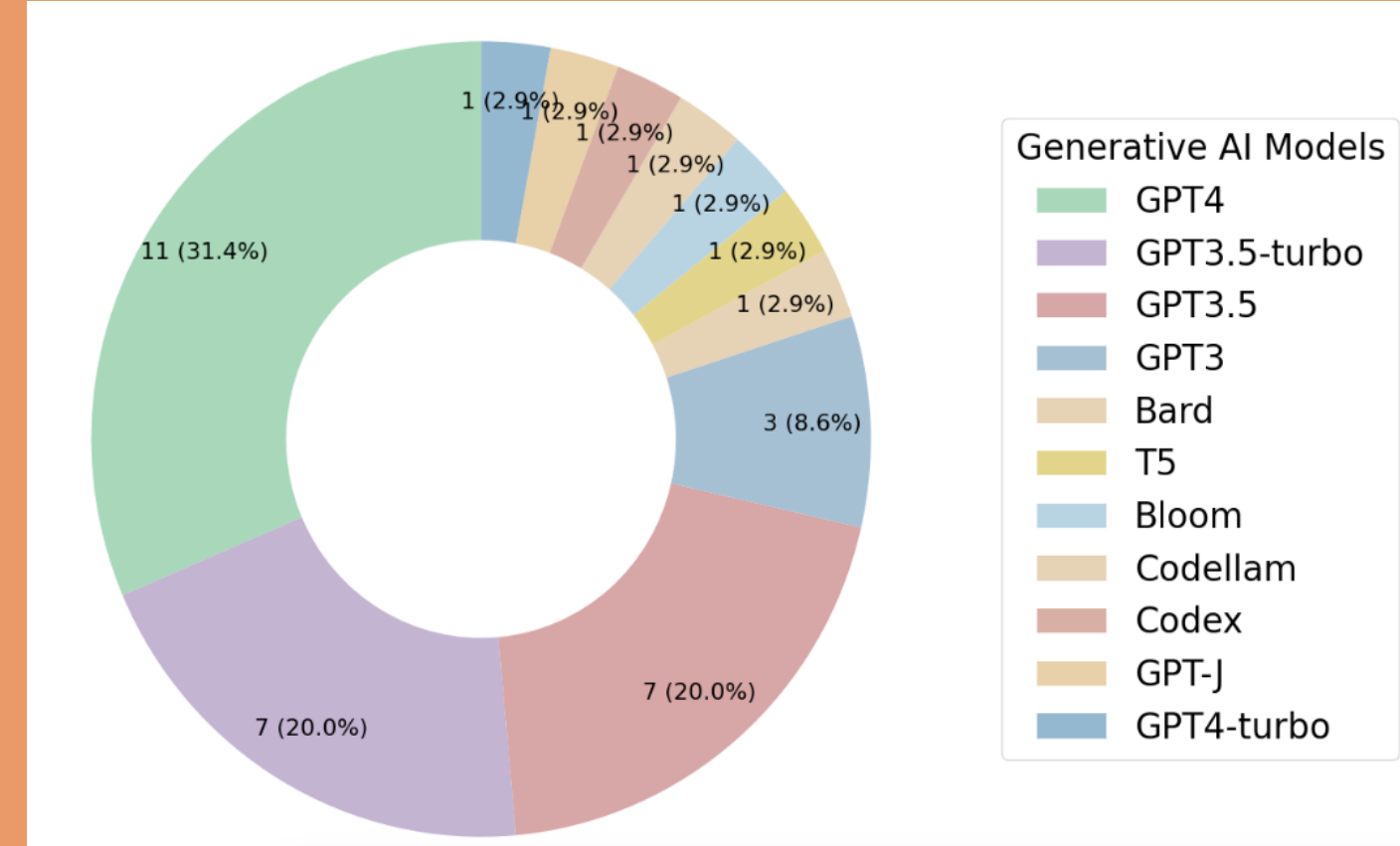
RQ3: Quality Assessment

Table 5: Quality Assessment of Reviewed Papers

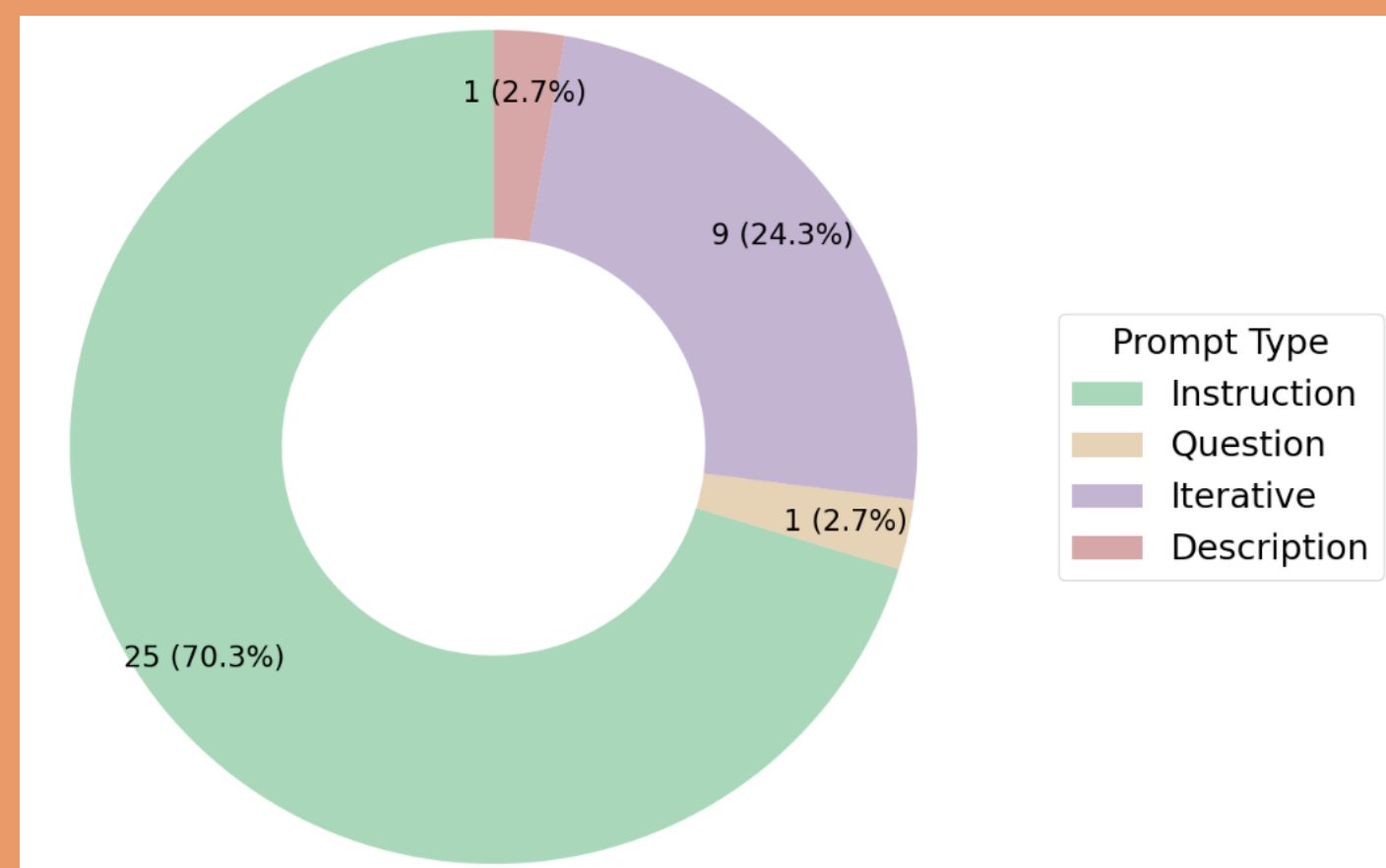
ID	Q11	Q12	Q13	Q14	Total
A1, W1, A2, C1, W3, A3, C6, C7	1	1.0	1.0	1.0	4.0
C8, A4, A8, A10, A11	1	1.0	1.0	1.0	4.0
A12, A13, A14	1	1.0	1.0	1.0	4.0
C2, C5, C9	1	0.5	1.0	1.0	3.5
C3, A5	1	1.0	1.0	0.5	3.5
A6	1	1.0	0.5	1.0	3.5
W2, A7	1	0.5	0.5	1.0	3.0
C4	1	1.0	1.0	1.0	4.0
C10	1	0.5	1.0	1.0	3.5
A9	1	1.0	1.0	1.0	4.0
Average					3.79

Note: Q11-Q14 represent quality indicators used in the assessment process. (1 = Yes, 0.5 = Partial)

High average quality score (3.79 out of 4) across reviewed papers
Rigorous evaluation methods and clear research objectives in most studies



Distribution of Generative AI Models



Distribution of Prompt Type

RQ4: Gaps and Future Directions

Research Limitations: The primary concern is an **overreliance on large language models**, which struggle with complex domain-specific requirements, especially in specialized or safety-critical domains. There's also an imbalanced research focus favoring early RE stages while **neglecting later phases of the RE lifecycle**.

Key Challenges: Persistent issues with the interpretability and traceability of GenAI outputs, coupled with a lack of comprehensive evaluation frameworks. Critical challenges include **bias and fairness concerns**, **ethical and regulatory issues**, **security and privacy risks**, **high computational costs**, **real-time processing difficulties**, **potential for hallucinations in AI-generated content**, **reproducibility issues**, **limited model controllability**, and unresolved questions about **authorship and copyright**.

Future Directions: Future efforts should address the full lifecycle of RE, improve the **handling of specialized domain knowledge**, and **ensure transparency and accountability** in AI-generated outputs. Tackling these multifaceted challenges is crucial for realizing the true potential of GenAI in revolutionizing RE practices.