

A Comprehensive Methodology for Creating and Evolving Reference Architectures

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Abstract

This paper presents a comprehensive methodology for creating, validating, and evolving reference architectures. We address key methodological gaps in the current literature and propose a structured approach that encompasses problem delineation, requirements specification, theory development, architectural design, validation, evaluation, implementation guidelines, and evolution strategies.

1 Introduction

Reference architectures play a crucial role in guiding the development of complex systems across various domains (?). However, methodological gaps persist in their creation and evolution...

2 Related Work

Existing methodologies for creating reference architectures, such as Galster and Avgeriou's empirically-grounded approach (?) and Nakagawa's process-based method (?), provide valuable insights but have limitations...

3 Research Methodology

3.1 Problem Delineation

The first step in our methodology is a clear delineation of the problem and justification for the reference architecture. This aligns with the problem relevance principle in Design Science Research (DSR) (?).

3.2 Requirements Specification

We adopt ISO/IEC/IEEE 29148:2018 (?) for requirements specification, focusing on Architecturally Significant Requirements (ASRs) (?). ASRs are particularly relevant for reference architectures as they...

4 Artefact Design

4.1 Theory Development

We propose a two-step theory development process, drawing on DSR principles (?):

4.1.1 Data Collection and Insight Gathering

This phase involves systematic literature reviews (?), multivocal literature reviews (?), and expert interviews (?). We propose a novel taxonomic approach for categorizing findings...

4.1.2 Theory Formulation

Using abductive inference (?), we develop kernel theories and design theories. This process is iterative and...

4.2 Translating Theories into Architectural Constructs

We propose a rigorous method for translating theories into architectural components, incorporating variability management techniques (?).

4.3 Architectural Representation

We advocate for the use of ISO/IEC/IEEE 42010:2011 (?) and ArchiMate (?) for standardized architectural representation. This choice is justified by...

4.4 Component Explanation and Views

We propose a comprehensive set of views including structural, behavioral, and deployment models (?). Each component should be explained in terms of...

5 Validation and Evaluation

We propose a multi-method approach to validation and evaluation, including case studies (?), expert evaluations (?), and simulation (?)...

6 Implementation Guidelines

To bridge the gap between abstract architecture and concrete implementation, we propose...

7 Evolution Strategies

Reference architectures must evolve to remain relevant. We propose strategies for continuous refinement and adaptation (?)...

8 Threats to Validity

We acknowledge potential threats to validity in our methodology, including...

9 Discussion

Our proposed methodology addresses several key limitations of existing approaches...

10 Conclusion

This paper has presented a comprehensive methodology for creating, validating, and evolving reference architectures...