

# The Method Framework for Engineering System Architectures (MFESA): A Practical Way to Generate Effective and Efficient Project-Specific System Architecture Engineering Methods

Donald G. Firesmith  
Software Engineering Institute  
dgf@sei.cmu.edu

## Abstract

*This 1/2 day tutorial presents a new proposed method framework and associated repository of reusable method components for creating appropriate project-specific methods for engineering system architectures. Several MFESA tasks directly involve component-based software-intensive systems in that they involve the identification and analysis of potential reusable architectural work products including patterns, models, and architectural components.*

## 1. Introduction

Historically, most projects that have an architecture engineering method have used a previously existing architecture engineering method. This method is often (1) an organizational standard method, (2) a method largely based on an international or military standard, (3) an industry domain specific method, (4) a method drawn from a book, article, or conference paper or tutorial on architecture engineering, or (5) a method that the chief architect was familiar with because he or she had used it on one or more previous projects.

However, each project is unique. Systems vary widely in terms of size, complexity, requirements, and application domains, while development organizations vary widely in terms of size, expertise, experience, and geographical distribution. Differences in contracts also affect the system architecture.

Therefore, no single method or standard for engineering system architectures is sufficiently flexible to effectively and efficiently engineer all system architectures. Most architecture teams have had to tailor the previously existing method to meet the needs of the endeavor. Unfortunately, the variability of architecture engineering efforts has been so great that it has often been very difficult to choose the reusable architecture engineering methods and properly tailor it to meet the specific needs of the endeavor. This

difficulty is one of many reasons why the architecture engineering method intended to be used and the actual architecture engineering process performed in practice have often differed greatly and have both had limited success in effectively and efficiently developing and maintaining a optimal system architecture and associated architectural representations.

## 2. MFESA Overview

MFESA takes a different approach. Because of the vast potential variability of system engineering projects, MFESA assumes that no previously existing architectural engineering method will optimally meet the specific needs of the project. Because the necessary amount of tailoring is often so large, MFESA also assumes that tailoring an existing method is not always the optimal way to achieve the necessary flexibility while retaining the benefits of standardization. MFESA therefore embraces the idea of situational method engineering, which is the generation of an appropriate project-specific method by:

- Selecting suitable method components from a repository containing a consistent class library of pre-existing reusable method components,
- Tailoring these selected method components (if necessary), and
- Integrating the selected tailored method components to create the actual method to be used.

This is the reason why this quick reference guide does not document and recommend any one method for engineering system architectures. As illustrated in Figure 1 below, the quick reference guide instead describes a method framework – Method Framework for Engineering System Architecture (MFESA)<sup>1</sup>, which consists of the following four parts:

---

<sup>1</sup> MFESA is pronounced as you-mesa.

- **MFESA Ontology of Concepts and Terminology**  
An information model defining a consistent set of interrelated concepts and terms underlying system architecture engineering
- **MFESA Metamodel**  
A model of the types of method components (see Figure 1) in the repository of reusable method components (i.e., architectural work products, architectural work units, and architectural workers)
- **MFESA Repository of Reusable Method Components**  
A repository containing a consistent class library of reusable components for creating project-specific methods for engineering system architectures
- **MFESA Metamethod**  
A method for creating effective and efficient project-specific methods for engineering system architectures (i.e., a method for creating methods)

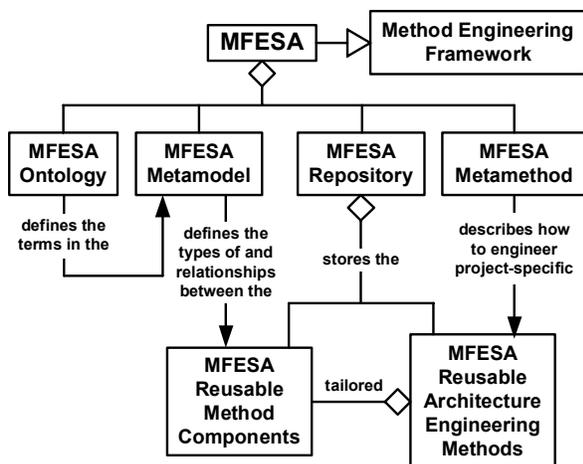


Figure 1: The components of MFESA

#### 4. MFESA Tasks

As illustrated in Figure 2, the MFESA method consists of the following tasks, typically performed in a highly iterative, incremental, parallel, and time-boxed manner. Members of the architecture team(s):

1. **Plan and Resource Architecture Engineering Effort**  
Plan the overall architecture engineering effort and obtain the necessary resources to engineer the system architecture.
2. **Identify the Architectural Drivers**  
Identify the architecturally significant product and process requirements that have been derived for

and/or allocated to their system or subsystem and categorize them into a set of architectural concerns.

3. **Create Initial Architectural Models**  
Create a consistent set of initial partial draft logical and physical static and dynamic models of the system or subsystem based on the architectural drivers, the associated architectural concerns, and the opportunities for reuse.
4. **Identify Opportunities for the Reuse of Architectural Elements**  
Identify and initially analyze potential opportunities for the reuse architectural decisions and inventions such as styles, patterns, and relevant parts of existing architectural structures.
5. **Create Candidate Architectural Visions**  
Use the initial architectural models to create a set of competing candidate architectural visions for their system or subsystem that support meeting the derived and allocated architectural drivers and associated architectural concerns.
6. **Analyze Reusable Components and their Sources**  
Identify and evaluate potentially reusable physical architectural components and their sources for reuse within candidate architectural visions.
7. **Select or Create Most Suitable Architectural Vision**  
Select the most suitable architectural vision for the system or subsystem from the competing candidate architectural visions. If combining consistent components from multiple competing candidate architectural visions would yield an even more suitable architectural vision, then do so to obtain the single new architectural vision.
8. **Complete and Maintain the Architecture**  
Complete and maintain the architectural models and other architectural descriptions of their system or subsystem architecture based upon the architectural vision selected.
9. **Evaluate and Accept the Architecture**  
Evaluate the quality of the system or subsystem architecture so that architectural risks can be managed, compliance with architecturally significant requirements can be determined, and the architecture can be accepted by its authoritative stakeholders.
10. **Ensure Architectural Integrity**  
Ensure that the integrity of the system architecture does not degrade over time.

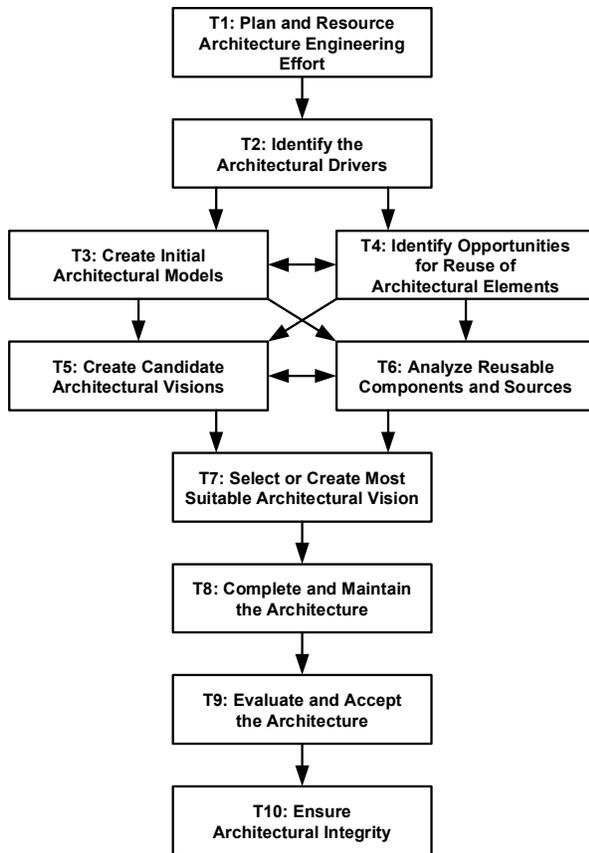


Figure 2: MFESA Tasks

As illustrated in Figure 3, the work products produced by the MFESA tasks are typically used as inputs to logically subsequent tasks.

## 5. Tutorial Agenda

This ½ day tutorial introduces the attendee to both system architecture engineering and the MFESA method framework by covering the following topics:

- An ontology of system architecture engineering concepts and terminology
- Current challenges facing system architecture engineering
- The foundational principles underlying MFESA
- An overview of the MFESA method framework including the primary goals, inputs, tasks, outputs, and assumptions
- An overview of architects and architecture teams

- The 10 tasks of system architecture engineering

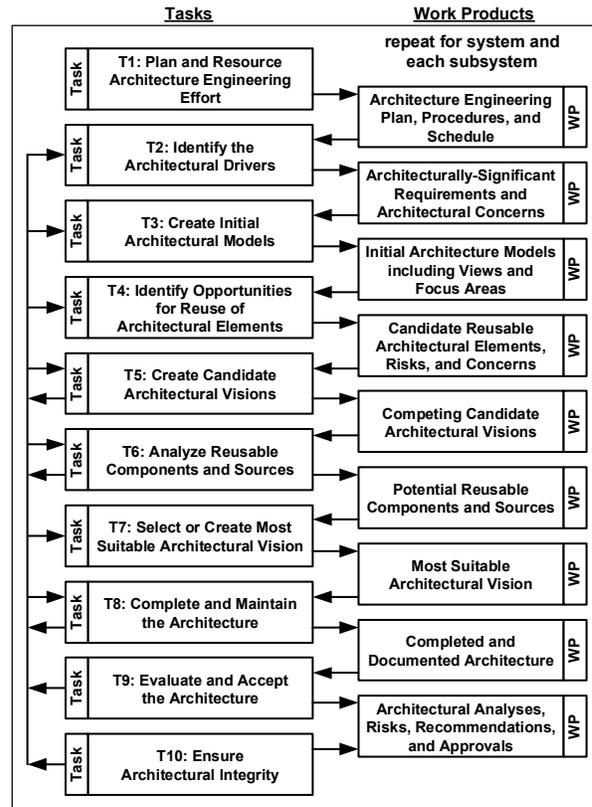


Figure 3: MFESA Tasks and Work Products

## 5. Conclusion

The tutorial is from the draft manuscript of *The Method Framework for Engineering System Architectures (MFESA)* [1] to be published by Auerbach Publications in 2008.

## 6. References

- [1] Donald, D.G., et al., *The Method Framework for Engineering System Architectures (MFESA): A Practical Way to Generate Effective and Efficient Project-Specific System Architecture Engineering Methods*, Auerbach Publications, New York, New York, 2008.