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Prioritizing and Testing Non-Functional Requirements: A Practical Guide

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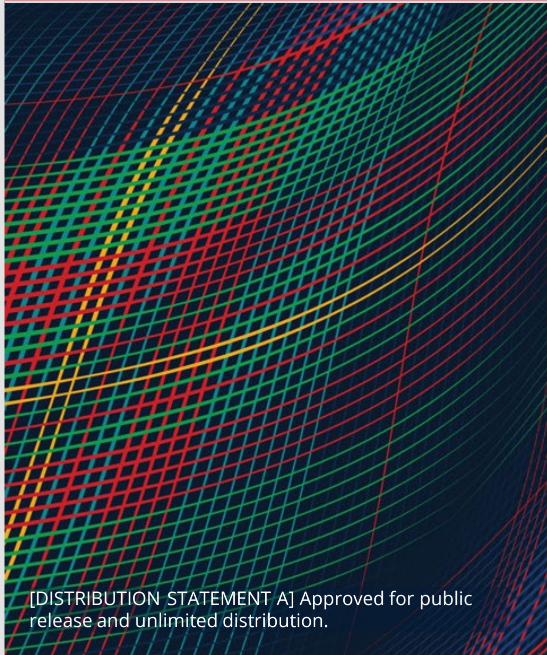

Agenda

- Background
- Technique #1 – Requirements Analysis
- Technique #2 – Creative Testing
- Conclusions

Software Engineering is Hard

But we adapt to improve software quality

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Software Quality is "the degree to which software possesses a desired combination of attributes." [1]

Technique #1

Well-Reasoned Requirements Analysis

Technique #2

Modern Software Engineering Practices

1: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=237006

Where do we start reasoning about requirements?

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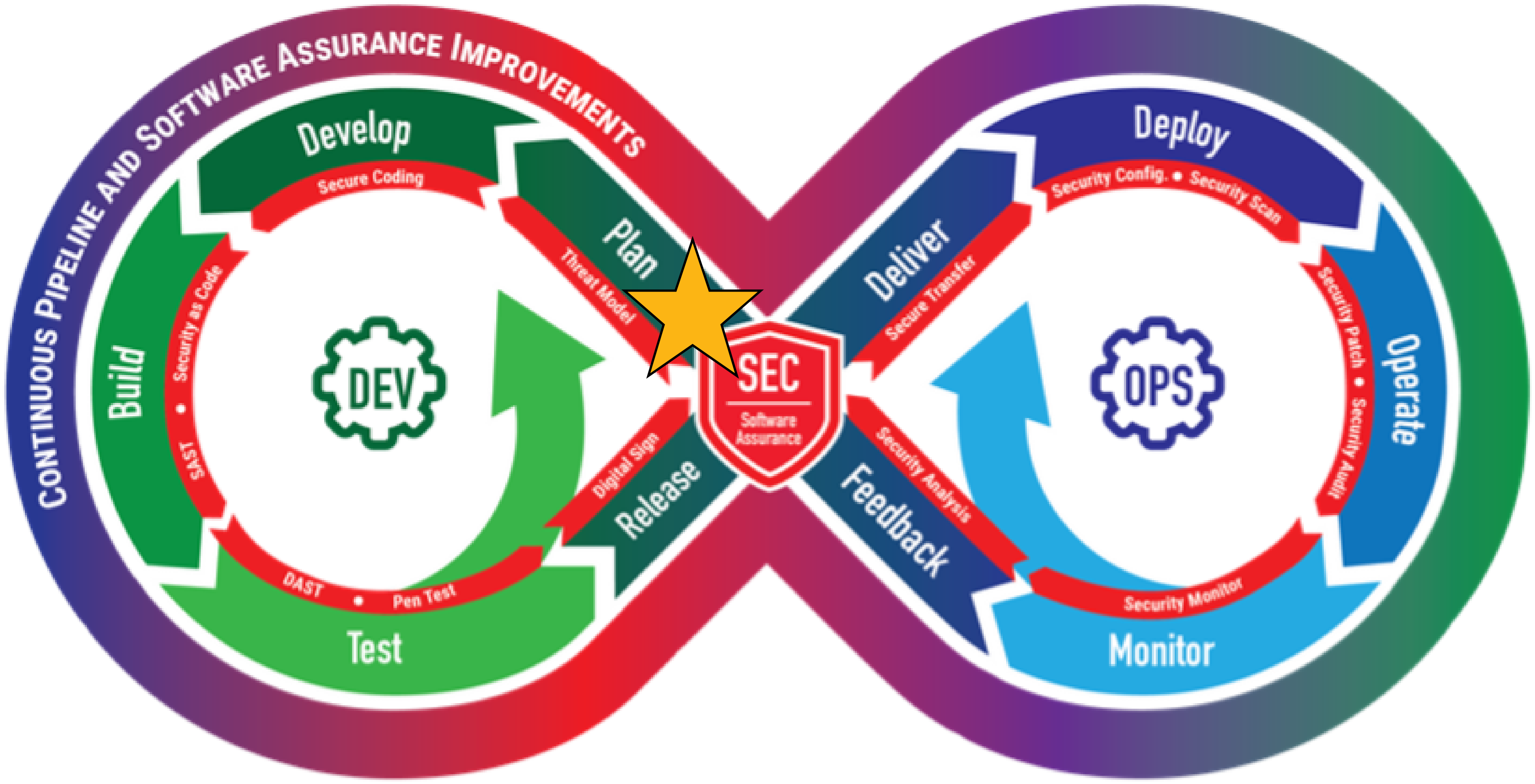
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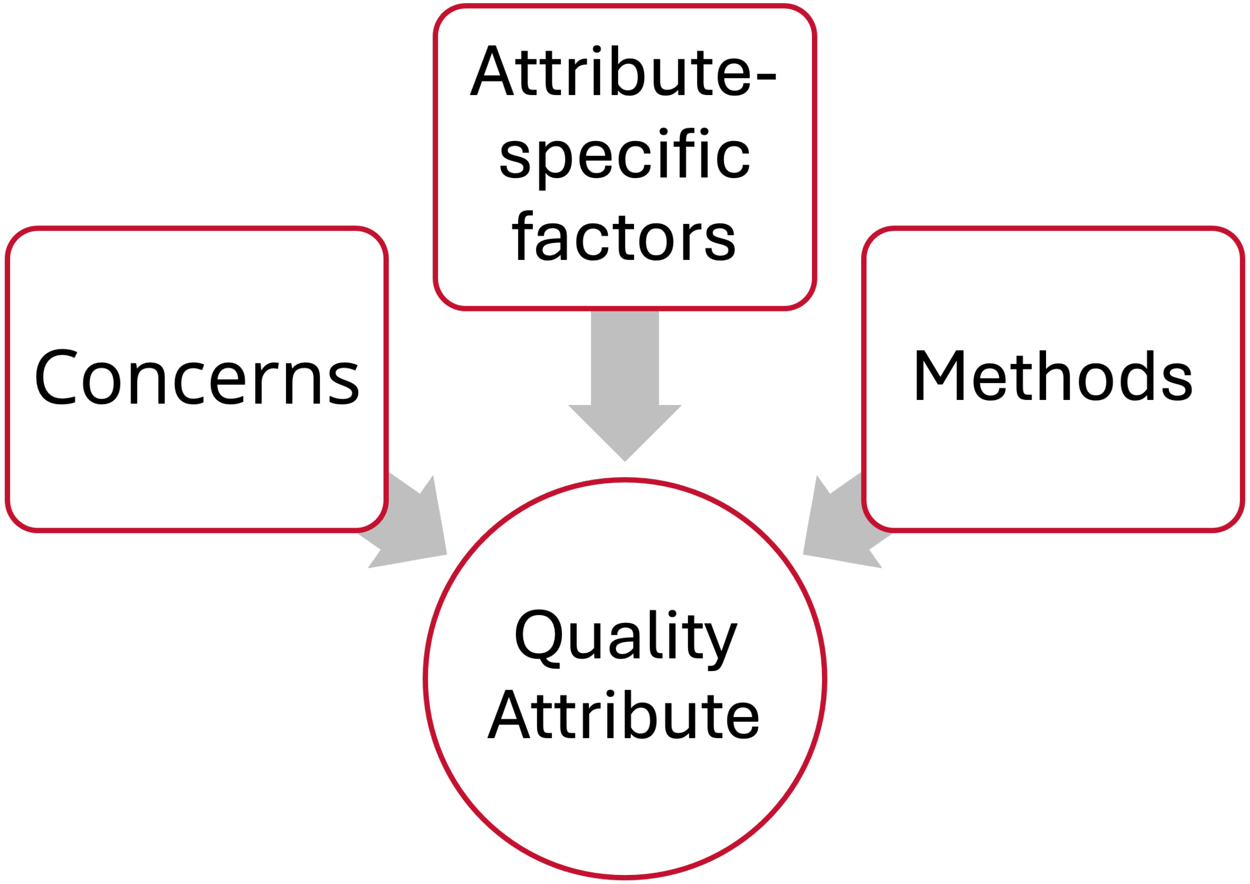
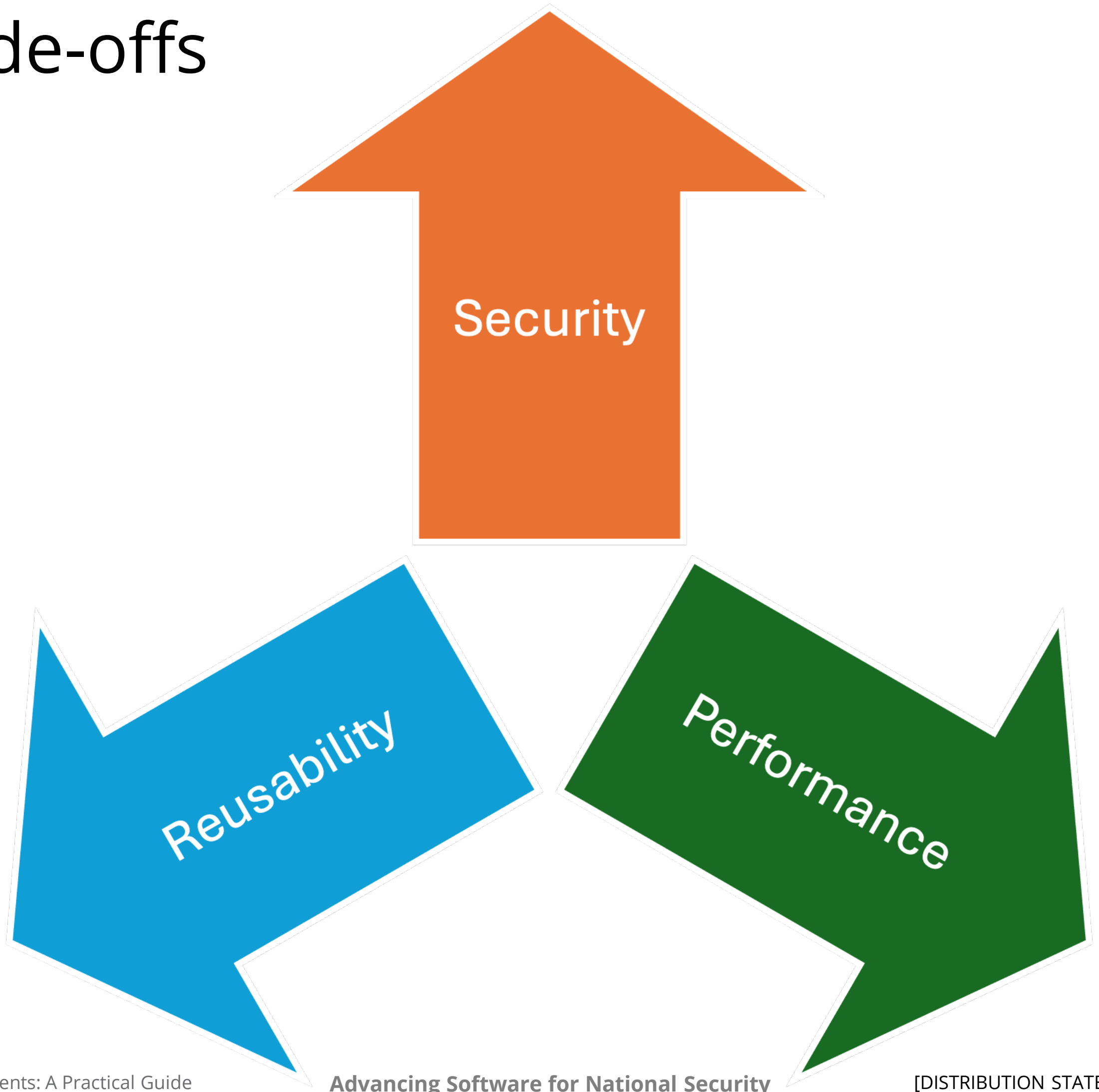
Deploy
Security Config. • Security Scan
OPS
Operate
Security Patch • Security Audit
Monitor
Security Monitor
Feedback
Security Analysis

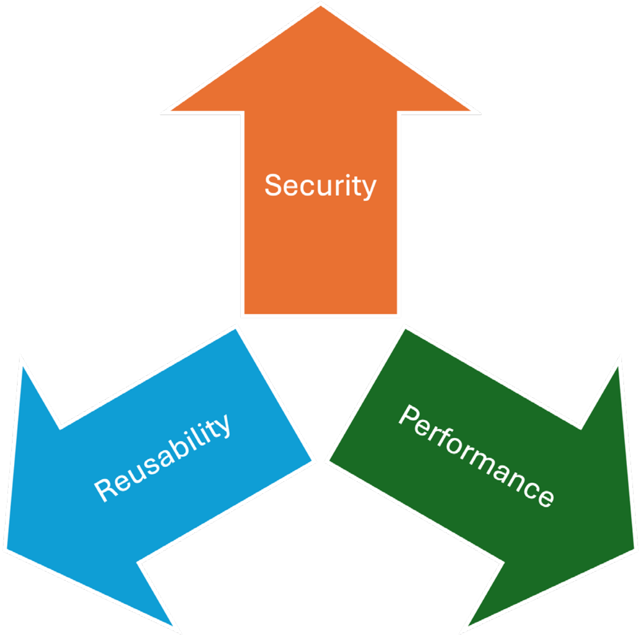
Building Blocks of Software Quality Attributes



Attribute Trade-offs



Prioritization Process



Methodology: Architecture Tradeoff Analysis Method (ATAM) [2]

Purpose: “To assess the consequences of architectural decisions in light of quality attribute requirements.”

Goals: To elicit, concretize, and prioritize the driving quality attribute requirements.

In Practice: Provides structure for decision making about trade-offs.

2: https://insights.sei.cmu.edu/library/atam-method-for-architecture-evaluation/

Security Quality Attribute Sub-factors

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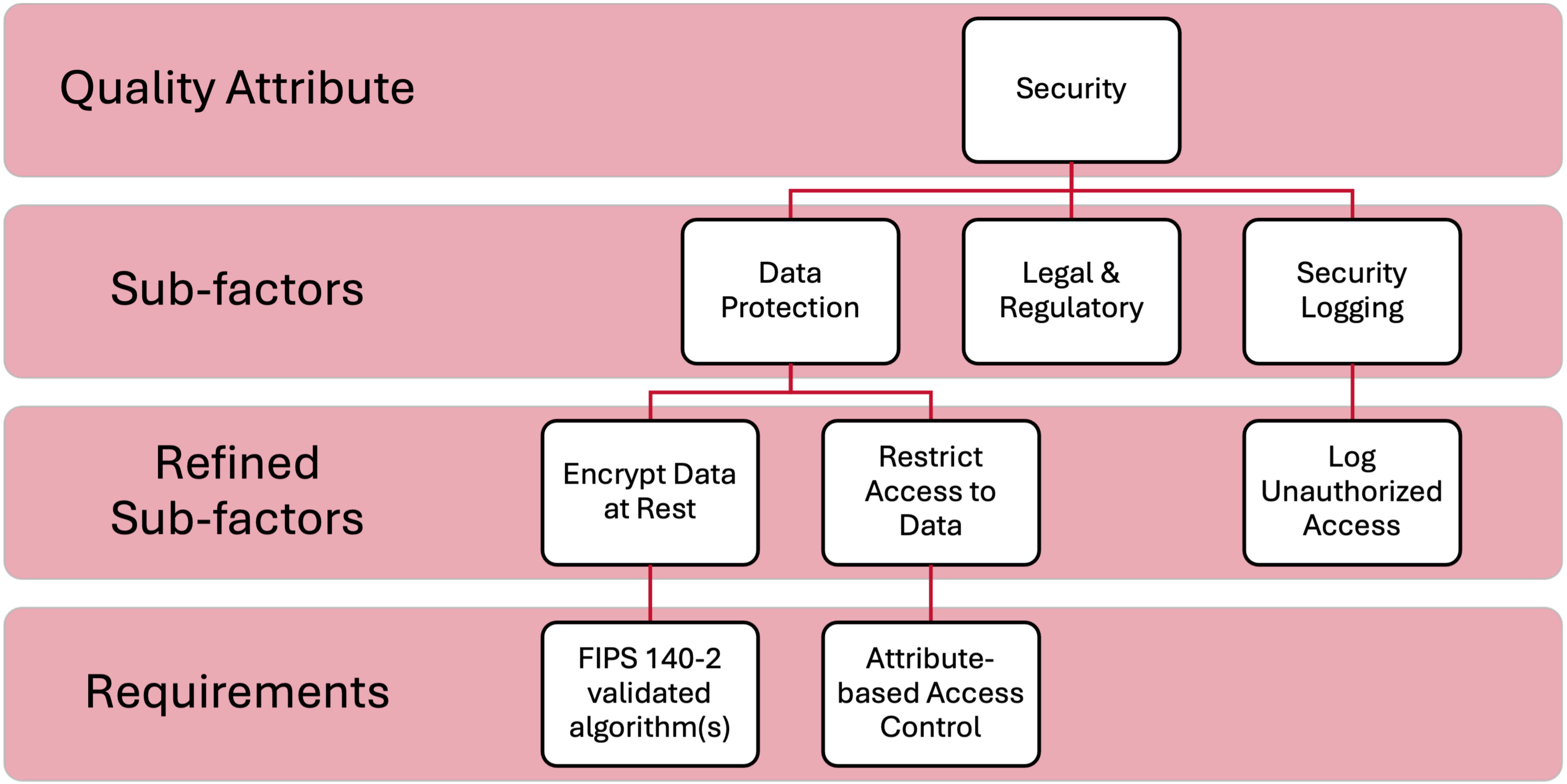
- Authentication & Authorization
- Disaster Recovery
- Third-party Dependencies
- Security Logging
- Legal & Regulatory
- Data Protection
- Encryption

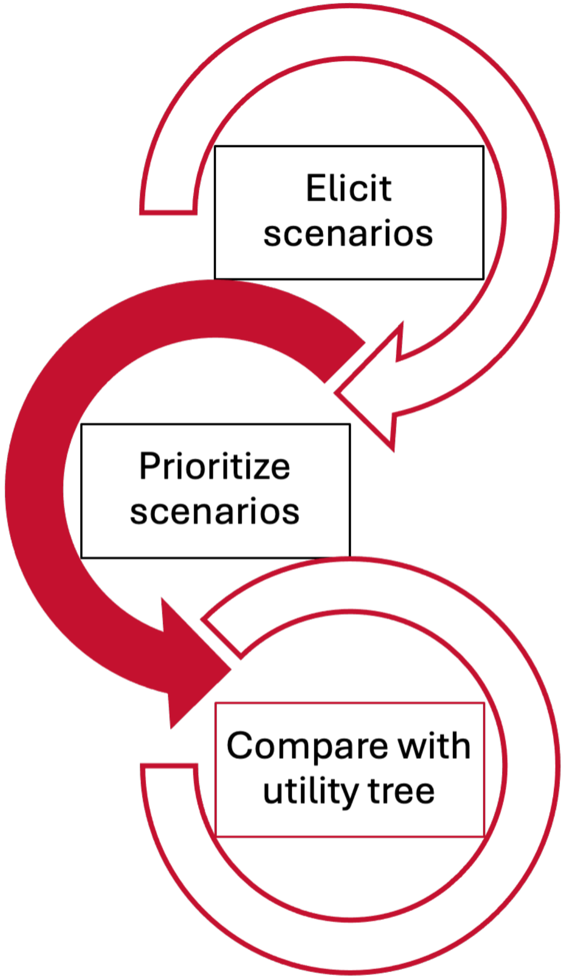
Building a Utility Tree



Brainstorming Scenarios

Goals:

- Represent stakeholders' interests
- Understand quality attribute requirements



Planning Process Accomplishments

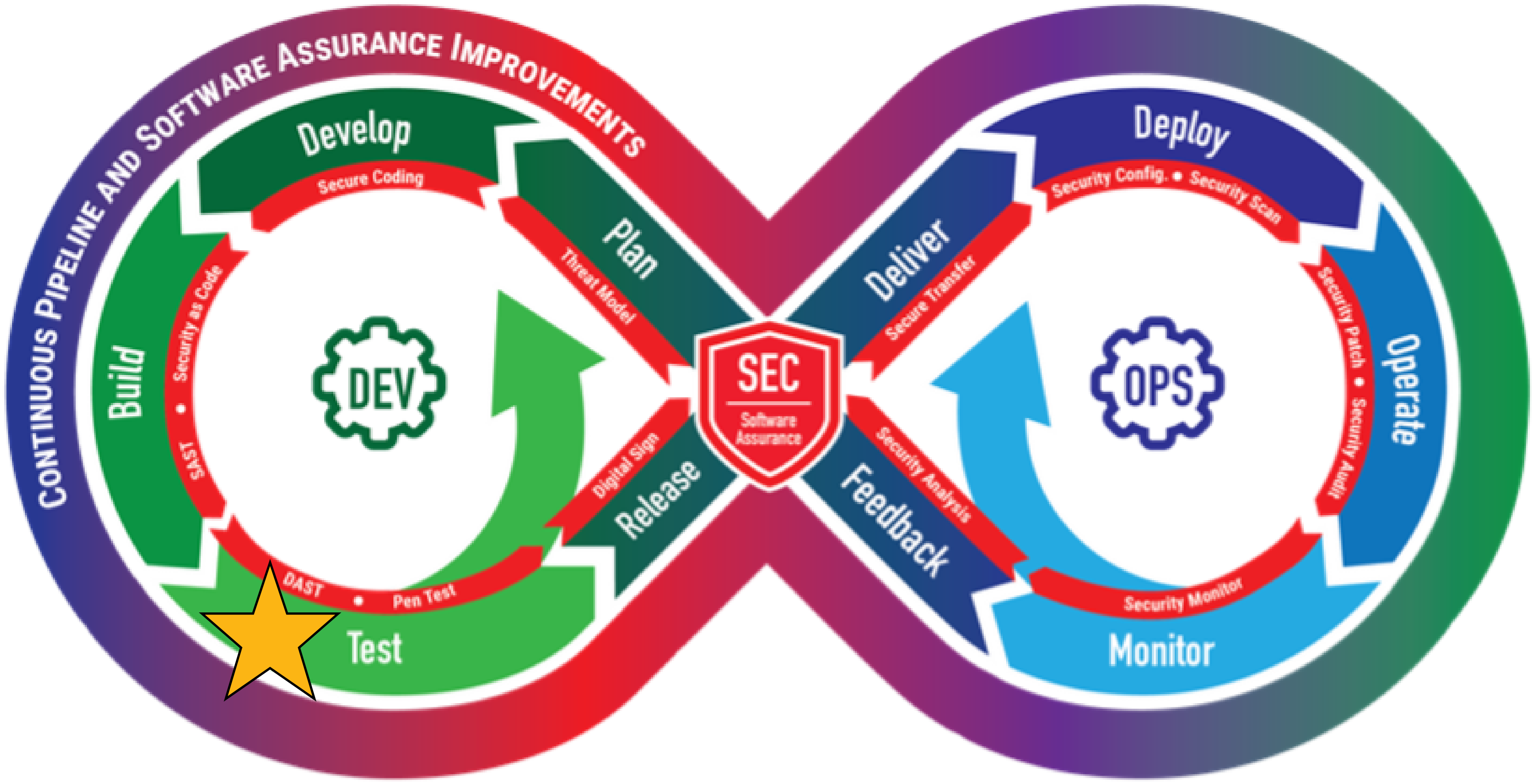
Requirements are:

- Precisely defined
- Measurable
- Prioritized

Software design is:

- Well understood
- Aligned with requirements

How do we measure success?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Security Scan
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Security Patch
Security Audit
OPS
Monitor
Security Monitor
Feedback
Security Analysis

Traditional Goals of Software Testing

- Unit testing verifies that individual functions in the code produce the expected output
- Regression testing validates that recent code changes won't break existing functionality
- Performance testing ensures that the application can handle higher loads and stress
- Static Analysis Security Testing (SAST) scans software for known security vulnerabilities

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Threats to Testing Success

Unaddressed challenges:

- Inadequate testing tools
- Manual testing procedures
- Incomplete testing procedures

Negative Outcomes:

- Inconsistent test results can negatively impact software quality
- Poor software quality can negatively impact business success

Designing Your Test Plan

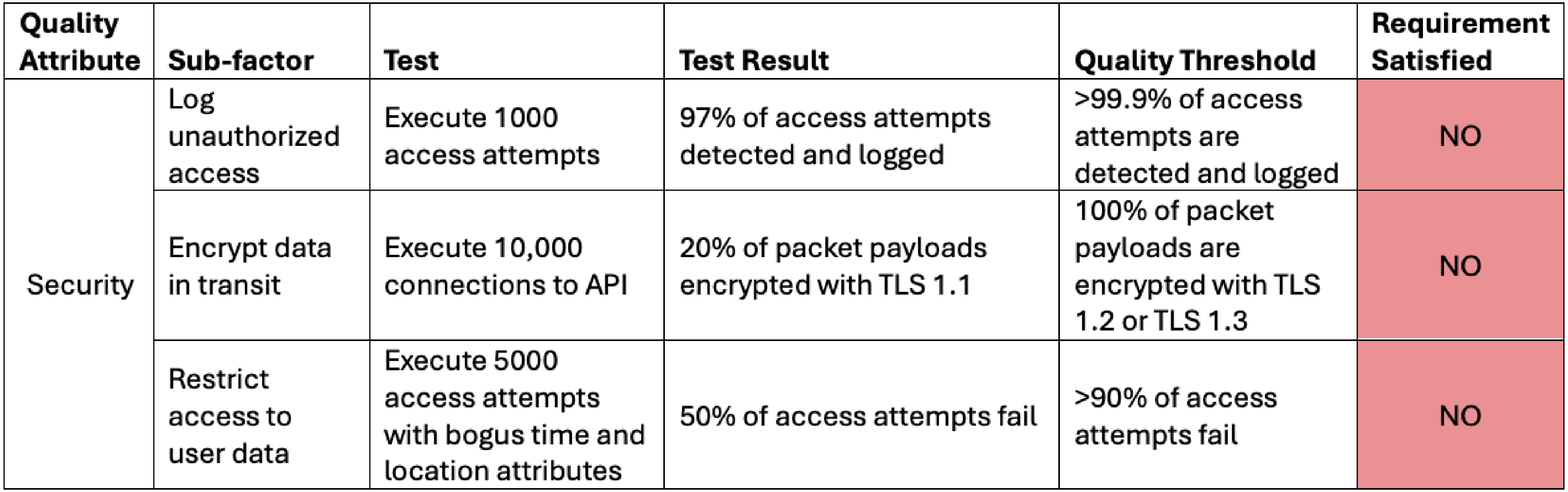
Test what you care about: **Your Requirements!**

When designing your tests:

- Get automated
- Get objective
- Get creative

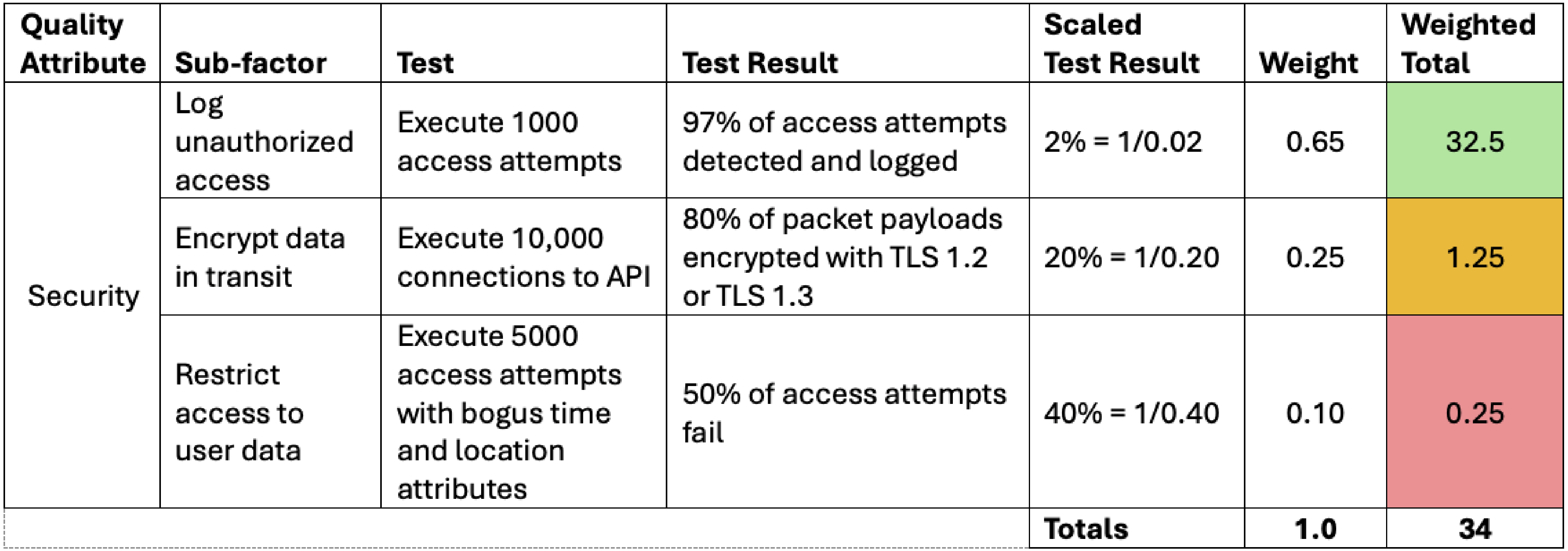
The metrics you collect will provide decision support

Decision Matrix



Quality Attribute	Sub-factor	Test	Test Result	Quality Threshold	Requirement Satisfied
Security	Log unauthorized access	Execute 1000 access attempts	97% of access attempts detected and logged	>99.9% of access attempts are detected and logged	NO
	Encrypt data in transit	Execute 10,000 connections to API	20% of packet payloads encrypted with TLS 1.1	100% of packet payloads are encrypted with TLS 1.2 or TLS 1.3	NO
	Restrict access to user data	Execute 5000 access attempts with bogus time and location attributes	50% of access attempts fail	>90% of access attempts fail	NO

Weighted Decision Matrix



Quality Attribute	Sub-factor	Test	Test Result	Scaled Test Result	Weight	Weighted Total
Security	Log unauthorized access	Execute 1000 access attempts	97% of access attempts detected and logged	2% = 1/0.02	0.65	32.5
	Encrypt data in transit	Execute 10,000 connections to API	80% of packet payloads encrypted with TLS 1.2 or TLS 1.3	20% = 1/0.20	0.25	1.25
	Restrict access to user data	Execute 5000 access attempts with bogus time and location attributes	50% of access attempts fail	40% = 1/0.40	0.10	0.25
				Totals	**1.0**	**34**

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Conclusions

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Conclusions

There will be tradeoffs

- Understand all your requirements
- ATAM provides scaffolding for reasoning about the tradeoffs between requirements
- Scaffolding materials can be prepared in advance

There must be measurements

- Metrics relate directly to requirements
- Objective metrics support sound design decisions

Questions

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