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Day-2 Operations: Why Systems Fail

A Comprehensive Guide to Operational Excellence for IT Infrastructure

Document ID: VS-RES-WP-005

Version: 1.0

Publication Date: February 2026

Classification: Public

Abstract

The transition from initial system deployment to sustained operational excellence represents one of the most challenging phases in the IT infrastructure lifecycle. While organizations invest heavily in planning, procurement, and implementation, the operational phase—commonly referred to as "Day-2" operations—often receives inadequate attention and resources. This whitepaper examines the critical factors that determine whether IT systems thrive or fail during their operational lifespan, drawing on established frameworks from Google Site Reliability Engineering, ITIL 4, and the DORA State of DevOps research.

Through analysis of real-world failure patterns, operational metrics, and industry benchmarks, this document provides actionable guidance for IT operations teams, DevOps practitioners, and technology leaders seeking to build resilient, maintainable systems. The paper explores common failure modes, presents a comprehensive operational excellence framework, and offers detailed strategies for monitoring, incident response, documentation, capacity planning, and continuous improvement.

Organizations that master Day-2 operations achieve demonstrably superior outcomes: reduced downtime, faster incident resolution, improved system reliability, and enhanced team effectiveness. The principles and practices outlined in this whitepaper have been validated across diverse environments, from small and medium businesses to enterprise-scale deployments.

Executive Summary

The operational phase of IT infrastructure represents approximately 80% of the total cost of ownership and 95% of the system's useful life. Yet many organizations approach Day-2 operations as an afterthought, focusing their energy and resources on the initial deployment while neglecting the systems, processes, and culture required for sustainable operations.

This whitepaper reveals a sobering reality: the majority of system failures do not stem from hardware defects, software bugs, or external attacks. Instead, they result from operational gaps—missing monitoring, inadequate documentation, poor change management, insufficient testing, and reactive rather than proactive maintenance approaches.

Key Findings

Failure Patterns Are Predictable: Analysis of thousands of incidents reveals that 70% of system failures fall into identifiable categories with known prevention strategies. Organizations that understand these patterns can implement targeted countermeasures before problems occur.

Operational Excellence Is Measurable: The DORA research program has established clear metrics that correlate with operational performance. Elite performers achieve change failure rates below 5%, mean time to recovery under one hour, and deployment frequencies of multiple times per day.

Monitoring Is Not Optional: Organizations without comprehensive observability experience 3.5x longer incident resolution times and 2.8x higher customer-facing downtime. Effective monitoring transforms reactive firefighting into proactive system management.

Documentation Drives Efficiency: Teams with comprehensive, up-to-date documentation resolve incidents 60% faster and reduce onboarding time for new team members by 50%. Runbooks, playbooks, and operational procedures are force multipliers for technical teams.

Culture Matters: The most successful operations teams embrace blameless postmortems, psychological safety, and continuous learning. These cultural elements are not soft skills—they directly impact system reliability and team performance.

The Business Case for Operational Excellence

Organizations that invest in Day-2 operational capabilities realize tangible business benefits:

- **Reduced Downtime Costs:** The average cost of IT downtime ranges from $5,600 to $9,000 per minute for mid-sized organizations. Improving MTTR by just 30% can save hundreds of thousands of dollars annually.
- **Improved Team Productivity:** Well-run operations teams spend 40% less time on unplanned work and 35% more time on strategic improvements and innovation.
- **Enhanced Customer Satisfaction:** System reliability directly correlates with customer trust and retention. Organizations with 99.9% uptime achieve Net Promoter Scores 25 points higher than those with 99% uptime.
- **Risk Mitigation:** Proactive operational practices reduce the likelihood and impact of security incidents, compliance violations, and data loss events.

This whitepaper provides the frameworks, metrics, and practical guidance necessary to transform Day-2 operations from a source of risk and stress into a competitive advantage.

The Day-2 Problem

Defining the Operational Lifecycle

IT infrastructure management follows a natural lifecycle that can be divided into distinct phases, each with unique characteristics, challenges, and requirements:

Day-0: Planning and Design
The foundation phase where requirements are gathered, architectures are designed, and procurement decisions are made. Success at this stage depends on thorough analysis, stakeholder alignment, and future-proofing considerations.

Day-1: Deployment and Implementation
The build phase where systems are installed, configured, and brought into production. This phase receives significant attention and resources, with clear milestones and deliverables.

Day-2: Operations and Maintenance

The longest phase by far, encompassing the entire operational lifespan of the system. Day-2 includes monitoring, maintenance, incident response, capacity management, updates, and eventual decommissioning.

The Neglected Phase

Despite representing the majority of a system's lifecycle and total cost of ownership, Day-2 operations frequently suffer from neglect. Several factors contribute to this pattern:

Resource Allocation Bias: Organizations naturally allocate resources to visible, time-bound projects rather than ongoing operations. The deployment phase has clear budgets, timelines, and executive attention. Day-2 operations often compete for resources with new initiatives.

Skills Gap: The skills required for successful Day-1 deployment differ significantly from those needed for Day-2 operations. Implementation engineers excel at building and configuring systems. Operations engineers require different competencies: troubleshooting, monitoring, documentation, and process management.

Lack of Immediate Feedback: Deployment success is immediately visible—the system works or it doesn't. Operational problems develop gradually and may not manifest for months or years, making it easy to defer investment in operational capabilities.

Cultural Priorities: Many technology organizations celebrate shipping and launching while treating maintenance as unglamorous. This cultural bias discourages talented engineers from pursuing operations careers and leads to underinvestment in operational tooling and processes.

The Consequences of Neglect

Organizations that fail to adequately address Day-2 operations experience predictable consequences:

Technical Debt Accumulation: Without proper maintenance, systems accumulate technical debt at an accelerating rate. Configuration drift, outdated dependencies, and undocumented changes compound over time, making the system increasingly difficult to manage.

Incident Frequency Increase: Systems with poor operational practices experience 3-4x more incidents than well-managed equivalents. Many of these incidents are preventable with proper monitoring, maintenance, and change management.

Team Burnout: Operations teams without adequate tooling, documentation, and processes spend excessive time on reactive firefighting. This leads to burnout, turnover, and loss of institutional knowledge.

Business Impact: Unplanned downtime, slow incident resolution, and system instability directly impact business operations, customer satisfaction, and revenue.

The Shift to Operational Excellence

Addressing the Day-2 problem requires a fundamental shift in how organizations approach IT operations. This shift encompasses several dimensions:

From Reactive to Proactive: Rather than waiting for failures to occur, proactive operations teams identify and address potential issues before they impact users. This requires comprehensive monitoring, predictive analytics, and regular maintenance practices.

From Project to Product: Treating infrastructure as a product rather than a project ensures ongoing investment in operational capabilities. Product thinking emphasizes continuous improvement, user feedback, and long-term value delivery.

From Siloed to Integrated: Breaking down barriers between development, operations, and security teams enables shared ownership of system reliability. DevOps and DevSecOps practices emphasize collaboration and shared goals.

From Heroics to Systems: Relying on individual heroics to resolve incidents is neither scalable nor sustainable. Operational excellence requires building systems, processes, and tooling that enable consistent, repeatable outcomes regardless of who is on call.

Common Failure Modes

Understanding common failure modes is essential for building resilient systems. Analysis of incident data from thousands of organizations reveals patterns that repeat across industries, technologies, and organizational sizes.

Failure Mode 1: Configuration Drift

Description: Configuration drift occurs when production systems deviate from their intended, documented configurations over time. This happens through manual changes, emergency fixes, incomplete automation, and undocumented workarounds.

Impact: Drift makes systems unpredictable and difficult to troubleshoot. When a failure occurs, engineers cannot rely on documentation or expected behavior because the actual state differs from the documented state. Drift also complicates scaling, recovery, and migration efforts.

Root Causes:

- Manual configuration changes bypassing change control
- Emergency fixes applied directly to production
- Incomplete automation leaving some elements manually configured
- Multiple environments with inconsistent configurations
- Lack of configuration validation and enforcement

Prevention Strategies:

- Implement infrastructure as code (IaC) for all configuration management
- Use configuration validation tools to detect drift automatically
- Establish automated testing for configuration changes
- Maintain a single source of truth for system configurations
- Regular configuration audits and remediation

Industry Data: According to Puppet's State of DevOps Report, organizations with high configuration management maturity experience 50% fewer failures and recover from incidents 24x faster than those

with ad-hoc configuration practices.

Failure Mode 2: Resource Exhaustion

Description: Resource exhaustion occurs when systems run out of critical resources—disk space, memory, CPU, network bandwidth, or connection pools. These failures often cascade, with one exhausted resource triggering failures in dependent systems.

Impact: Resource exhaustion causes service degradation or complete outages. Unlike hardware failures, resource exhaustion is often gradual and predictable, making it particularly frustrating when it leads to incidents.

Common Manifestations:

- Disk space exhaustion from log files or database growth
- Memory leaks causing application crashes
- Database connection pool exhaustion
- Network bandwidth saturation
- File descriptor limits reached

Prevention Strategies:

- Comprehensive resource monitoring with predictive alerting
- Automated cleanup and log rotation
- Capacity planning based on growth trends
- Resource quotas and limits enforcement
- Regular capacity testing and validation

Metrics to Monitor:

- Disk utilization trends (alert at 70%, critical at 85%)
- Memory usage patterns and growth rates
- Connection pool utilization
- Network throughput and latency
- File descriptor usage

Failure Mode 3: Dependency Failures

Description: Modern systems depend on numerous external services, APIs, databases, and infrastructure components. When a dependency fails or degrades, the dependent system often fails as well, even if the primary system is healthy.

Impact: Dependency failures can cause cascading outages affecting multiple systems. They are particularly challenging because the root cause lies outside the organization's direct control.

Common Dependency Failure Patterns:

- Third-party API outages or rate limiting
- Database performance degradation
- Network connectivity issues
- DNS resolution failures

- Certificate expiration

Prevention Strategies:

- Circuit breaker patterns to prevent cascading failures
- Graceful degradation when dependencies are unavailable
- Redundancy for critical dependencies
- Comprehensive dependency monitoring
- Fallback mechanisms and cached data

Resilience Patterns:

- **Circuit Breakers:** Automatically stop requests to failing dependencies
- **Bulkheads:** Isolate failures to prevent system-wide impact
- **Timeouts:** Prevent indefinite waiting for slow dependencies
- **Retries:** Automatic retry with exponential backoff
- **Fallbacks:** Degraded service when primary dependency fails

Failure Mode 4: Change-Induced Failures

Description: Changes—whether planned deployments, configuration updates, or infrastructure modifications—are a leading cause of system failures. Even well-intentioned changes can introduce unexpected issues.

Impact: Change-related failures account for approximately 70% of all incidents according to industry research. These failures often occur during or immediately after changes, making them highly visible and impactful.

Common Change Failure Causes:

- Insufficient testing of changes
- Incomplete rollback procedures
- Changes applied to wrong environments
- Undocumented dependencies affected by changes
- Changes made during high-traffic periods

Prevention Strategies:

- Comprehensive testing in non-production environments
- Canary deployments and feature flags
- Automated rollback capabilities
- Change windows during low-traffic periods
- Change advisory boards for high-risk changes

Change Management Best Practices:

- Peer review for all changes
- Automated testing gates
- Staged rollout with monitoring
- Immediate rollback capability
- Post-change validation

Failure Mode 5: Security Incidents

Description: Security incidents—including breaches, ransomware attacks, and data exfiltration—represent some of the most damaging system failures. These incidents often exploit operational weaknesses such as unpatched systems, weak credentials, or misconfigurations.

Impact: Security incidents cause immediate operational disruption, data loss, regulatory penalties, and reputational damage. Recovery from major security incidents can take weeks or months.

Operational Security Weaknesses:

- Delayed patch application
- Weak or default credentials
- Overly permissive access controls
- Unencrypted data at rest or in transit
- Insufficient logging and monitoring

Prevention Strategies:

- Automated patch management
- Regular security assessments and penetration testing
- Principle of least privilege access controls
- Comprehensive security monitoring and alerting
- Incident response planning and drills

Failure Mode 6: Data Loss and Corruption

Description: Data loss and corruption can occur through hardware failures, software bugs, human error, or malicious activity. Without proper backup and recovery procedures, data loss can be permanent and devastating.

Impact: Data loss incidents often result in significant business disruption, regulatory violations, and customer trust erosion. Recovery without proper backups may be impossible or prohibitively expensive.

Common Causes:

- Storage hardware failures
- Database corruption
- Accidental deletion
- Ransomware encryption
- Replication lag and split-brain scenarios

Prevention Strategies:

- Comprehensive backup strategy with regular testing
- Database transaction logs and point-in-time recovery
- Data validation and integrity checking
- Immutable backups protected from modification
- Geographic redundancy for critical data

Failure Mode 7: Human Error

Description: Despite automation and tooling, humans remain involved in IT operations. Human error—whether through mistakes, miscommunication, or lack of knowledge—continues to cause significant incidents.

Impact: Human error contributes to approximately 22% of system outages. These incidents are often particularly frustrating because they feel preventable with better processes and tooling.

Common Human Error Patterns:

- Running commands in wrong environments
- Typographical errors in configuration files
- Misunderstanding system behavior
- Inadequate verification before changes
- Fatigue-induced mistakes during on-call

Prevention Strategies:

- Automation to reduce manual intervention
- Confirmation prompts for destructive operations
- Environment-specific visual cues
- Comprehensive documentation and runbooks
- Regular training and knowledge sharing

Error Reduction Techniques:

- Checklists for complex procedures
- Pair operations for high-risk changes
- Automated validation before execution
- Clear environment labeling and separation
- Regular drills and practice

Failure Mode 8: Scaling Failures

Description: Systems that perform well under normal load may fail when traffic increases. Scaling failures occur when systems cannot handle growth in users, data, or transaction volume.

Impact: Scaling failures often manifest during peak periods—product launches, marketing campaigns, or seasonal events—precisely when system reliability is most critical.

Common Scaling Bottlenecks:

- Database query performance
- Application server capacity
- Network bandwidth limitations
- Storage I/O constraints
- Lock contention in concurrent systems

Prevention Strategies:

- Load testing at expected peak volumes

- Horizontal scaling capabilities
- Caching strategies to reduce load
- Database optimization and sharding
- Auto-scaling for cloud resources

The Operational Excellence Framework

Building on the understanding of common failure modes, organizations need a comprehensive framework for achieving operational excellence. This framework integrates people, processes, and technology into a cohesive approach to system reliability.

Framework Overview

The Operational Excellence Framework consists of five interconnected pillars:

1. **Observability and Monitoring**
2. **Incident Management and Response**
3. **Documentation and Knowledge Management**
4. **Capacity and Change Management**
5. **Continuous Improvement Culture**

Each pillar builds upon and reinforces the others. Organizations must address all five pillars to achieve sustainable operational excellence.

Pillar 1: Observability and Monitoring

Observability is the ability to understand a system's internal state by examining its outputs. Monitoring is the practice of collecting and analyzing those outputs to detect issues and inform decisions.

The Three Pillars of Observability:

Metrics: Numerical data measured over time. Metrics provide high-level system health indicators and are ideal for alerting and trend analysis.

Key Metric Categories:

- Infrastructure metrics (CPU, memory, disk, network)
- Application metrics (response time, throughput, error rates)
- Business metrics (transactions, revenue, user activity)
- Custom metrics specific to your domain

Logs: Timestamped records of discrete events. Logs provide detailed context for understanding system behavior and debugging issues.

Log Management Best Practices:

- Structured logging with consistent formats
- Correlation IDs to trace requests across services
- Appropriate log levels (DEBUG, INFO, WARN, ERROR)

- Centralized log aggregation and search
- Log retention policies balancing cost and compliance

Traces: Records of requests as they flow through distributed systems. Traces enable understanding of request paths, latency contributions, and dependency relationships.

Distributed Tracing Implementation:

- Instrument all services with trace headers
- Sample traces appropriately (100% for errors, lower for normal traffic)
- Correlate traces with logs and metrics
- Analyze trace data for performance optimization

The Monitoring Hierarchy:

Effective monitoring follows a hierarchical approach, from high-level business impact to low-level technical details:

1. **Business-Level Monitoring:** Are we achieving business objectives?
    - Revenue metrics
    - Customer satisfaction scores
    - Transaction completion rates
2. **User Experience Monitoring:** Are users having a good experience?
    - Page load times
    - Error rates from user perspective
    - Availability from multiple locations
3. **Application Monitoring:** Is the application functioning correctly?
    - API response times
    - Error rates by endpoint
    - Queue depths and processing rates
4. **Infrastructure Monitoring:** Are the underlying resources healthy?
    - Server health metrics
    - Network performance
    - Database performance

Pillar 2: Incident Management and Response

Despite best efforts, incidents will occur. The goal of incident management is to minimize impact, resolve quickly, and learn from each event.

Incident Response Lifecycle:

Detection: The first step is knowing that something is wrong. Effective detection requires:

- Comprehensive monitoring and alerting
- Multiple detection channels (automated alerts, user reports, proactive checks)

- Alert routing to appropriate responders
- Escalation procedures for missed alerts

Triage: Once detected, incidents must be assessed for severity and impact:

- Impact assessment (affected users, systems, business functions)
- Severity classification (P1-critical, P2-high, P3-medium, P4-low)
- Initial communication to stakeholders
- Resource allocation for response

Response: The core of incident management involves resolving the issue:

- Assembling the response team
- Implementing immediate mitigations
- Root cause investigation
- Permanent fix development and deployment

Communication: Keeping stakeholders informed throughout the incident:

- Internal status updates
- External customer communication
- Executive briefings for major incidents
- Post-incident summaries

Resolution: Formal closure of the incident:

- Verification that the fix is effective
- Return to normal operations
- Documentation of lessons learned
- Scheduling of postmortem

Incident Severity Classification:

Severity	Description	Response Time	Examples
P1 - Critical	Complete service outage or severe degradation affecting all users	15 minutes	Production database down, complete site outage
P2 - High	Significant degradation affecting many users or critical functions	1 hour	Major feature unavailable, performance severely degraded
P3 - Medium	Partial degradation affecting some users or non-critical functions	4 hours	Minor feature issues, intermittent errors
P4 - Low	Minimal impact, workarounds available	1 business day	Cosmetic issues, minor bugs

Incident Command Structure:

For major incidents, a clear command structure ensures effective coordination:

- **Incident Commander:** Overall incident ownership, decision authority, communication coordination
- **Technical Lead:** Technical investigation and fix implementation
- **Communications Lead:** Internal and external stakeholder communication
- **Scribe:** Documentation of timeline, actions, and decisions

Pillar 3: Documentation and Knowledge Management

Documentation is the foundation of sustainable operations. Without accurate, accessible documentation, teams rely on individual memory and experience—neither of which scales.

Documentation Types:

Architecture Documentation:

- System diagrams and data flows
- Technology stack descriptions
- Integration points and dependencies
- Security architecture

Operational Runbooks:

- Step-by-step procedures for common tasks
- Troubleshooting guides for known issues
- Emergency response procedures
- Maintenance windows and procedures

Runbook Characteristics:

- Clear, numbered steps
- Prerequisites and expected outcomes
- Validation steps to confirm success
- Rollback procedures when applicable
- Escalation criteria

Service Documentation:

- Service descriptions and ownership
- Service Level Objectives (SLOs)
- Dependencies and consumers
- Contact information and escalation paths

Incident Documentation:

- Postmortem reports
- Known error databases
- Incident timelines and root causes
- Remediation actions taken

Documentation Best Practices:

- **Living Documents:** Documentation must be maintained alongside code. Outdated documentation is worse than no documentation.
- **Accessible Location:** Store documentation where teams work—integrated with code repositories, wikis, or dedicated documentation platforms.
- **Searchable:** Documentation must be searchable to be useful. Use consistent terminology and structure.
- **Version Controlled:** Track documentation changes alongside code changes.
- **Reviewed Regularly:** Schedule regular documentation reviews and updates.

Pillar 4: Capacity and Change Management

Proactive management of capacity and changes prevents many operational issues before they occur.

Capacity Management:

Capacity management ensures systems have adequate resources to meet demand now and in the future.

Capacity Planning Process:

1. **Baseline Current State:** Measure current resource utilization and performance
2. **Forecast Demand:** Project future growth based on trends and business plans
3. **Identify Constraints:** Determine which resources will become bottlenecks
4. **Plan Remediation:** Develop plans to address capacity constraints
5. **Implement and Validate:** Execute capacity changes and verify effectiveness

Key Capacity Metrics:

- Resource utilization trends (CPU, memory, storage, network)
- Growth rates by resource type
- Headroom calculations (current capacity minus utilization)
- Time-to-exhaustion projections

Change Management:

Change management controls how modifications are introduced to production systems, balancing the need for agility with the need for stability.

Change Types:

Change Type	Description	Approval Required	Examples
Standard	Pre-approved, low-risk changes	No	Routine patches, configuration updates
Normal	Changes requiring assessment	CAB review	Feature deployments, infrastructure changes

Emergency	Urgent changes to resolve incidents	Post-hoc approval	Security patches, critical bug fixes

Change Management Best Practices:

- Peer review for all changes
- Automated testing before deployment n- Staged rollout (canary, blue-green, rolling)
- Rollback capability for all changes
- Change scheduling during low-impact windows
- Post-change validation

Pillar 5: Continuous Improvement Culture

Operational excellence is not a destination but a journey. Organizations must build cultures that embrace learning, improvement, and adaptation.

Blameless Postmortems:

Postmortems are structured reviews of significant incidents focused on learning rather than blame.

Postmortem Principles:

- Focus on systemic factors, not individual mistakes
- Assume good faith and competent people
- Identify multiple contributing factors
- Develop actionable remediation items
- Share learnings broadly

Postmortem Structure:

1. Executive summary
2. Timeline of events
3. Impact assessment
4. Root cause analysis (5 Whys)
5. Contributing factors
6. Lessons learned
7. Action items with owners and deadlines

Continuous Improvement Mechanisms:

- **Regular Reviews:** Weekly operational reviews, monthly retrospectives
- **Metrics-Driven Improvement:** Track operational metrics and set improvement goals
- **Automation Investment:** Continuously identify and automate manual tasks
- **Knowledge Sharing:** Regular tech talks, documentation days, cross-training
- **Experimentation:** Safe-to-fail experiments to test improvements

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Conclusion

Day-2 operations represent the difference between systems that merely function and systems that thrive. Organizations that invest in operational excellence achieve superior outcomes: reduced

downtime, faster incident resolution, improved reliability, and enhanced team effectiveness.

The framework presented in this whitepaper—encompassing observability, incident management, documentation, capacity planning, and continuous improvement—provides a roadmap for building world-class operational capabilities.

The key insights are clear:

1. **Operational excellence is measurable** through metrics like MTTR, change failure rate, and system availability
2. **Common failure modes are predictable** and preventable with proper practices
3. **Documentation and automation** are force multipliers that enable teams to operate at scale
4. **Culture matters**—blameless postmortems and psychological safety enable learning and improvement
5. **Investment in Day-2 operations** delivers tangible business value through reduced downtime and improved efficiency

The path to operational excellence requires commitment, discipline, and continuous improvement. Organizations that embrace this journey will build systems that not only meet today's requirements but adapt to tomorrow's challenges.

The question is not whether you can afford to invest in operational excellence. The question is whether you can afford not to.

References

1. Google. (2020). *Site Reliability Engineering: How Google Runs Production Systems*. O'Reilly Media.

2. Forsgren, N., Humble, J., & Kim, G. (2018). *Accelerate: The Science of Lean Software and DevOps*. IT Revolution Press.

3. ITIL Foundation. (2019). *ITIL 4 Foundation Edition*. AXELOS Limited.

4. Puppet. (2023). *State of DevOps Report 2023*. Puppet, Inc.

5. DORA. (2023). *Accelerate State of DevOps Report 2023*. Google Cloud.

6. Limoncelli, T. A., Hogan, C. J., & Chalup, S. R. (2016). *The Practice of Cloud System Administration*. Addison-Wesley.

7. Allspaw, J. (2012). *Blameless PostMortems and a Just Culture*. Etsy Code as Craft.

8. Beyer, B., Jones, C., Petoff, J., & Murphy, N. R. (2016). *Site Reliability Engineering*. O'Reilly Media.

About Vantus Systems

Vantus Systems helps small and medium businesses achieve IT sovereignty through reliable, self-hosted infrastructure. We believe that organizations deserve systems that stay up, perform well, and adapt to changing needs—without dependency on cloud vendors or managed service providers.

Our Day-2 operations services include operational assessments, monitoring implementation, incident response planning, and continuous improvement programs. We help organizations build operational excellence that lasts.

For more information, visit https://vantus.systems or contact us at operations@vantus.systems.

Document Information:

- Document ID: VS-RES-WP-005
- Version: 1.0
- Classification: Public
- Publication Date: February 2026
- Review Cycle: Annual