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Designing Fault-Tolerant, Model-Based Test Infrastructures for Large-Scale Service Compositions and Cloud-Edge Systems

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Abstract: This article presents a comprehensive, theoretically grounded synthesis and original conceptual framework for designing fault-tolerant, model-based test infrastructures applicable to large-scale software systems—particularly service compositions, web services, cloud and edge resource management, and GPU manufacturing testing ecosystems. It integrates formal modeling techniques, graph-transformation semantics, model-based verification and test generation, and modern fault-tolerant resource provisioning strategies. The theoretical backbone draws on operational semantics for behavioral diagrams, graph transformation for reconfiguration and verification, model checking for test generation, and recent research on fault tolerance in cloud and edge contexts. The contribution is a unified, extensible methodology and architecture that couples dynamic meta-modeling and graph-based semantics (for formal, tool-supportable behavioral specifications) with model-driven test generation and adaptive fault-tolerant resource allocation mechanisms for runtime and pre-deployment validation. The framework addresses core challenges: representing compositional behavior of service orchestrations, generating tractable yet effective test sets from rich behavioral models, ensuring conformance and reliability under failure modes, and maintaining scalable resource allocation across cloud-edge infrastructures. The article details modelling conventions, transformation rules, verification and test case extraction processes, and

fault-tolerance policies that guide resource management and test scheduling. It further articulates practical design principles for test infrastructures in production-scale contexts (for example, GPU manufacturing test farms and large cloud-based service compositions) and discusses trade-offs among test thoroughness, cost, and fault coverage. Limitations are discussed and a roadmap for empirical validation and toolchain integration is laid out. The work aims to serve both as an academic synthesis bridging multiple literatures and as a practical blueprint for engineering resilient test infrastructures for modern distributed systems.

Keywords: model-based testing, graph transformation, fault tolerance, cloud resource management, service composition, model checking, test infrastructure

Introduction

The reliable operation of complex software ecosystems—such as orchestrated web services, cloud-native applications with edge components, and large-scale manufacturing test systems for hardware accelerators—depends critically on the design of robust testing infrastructures and the application of formal, model-based verification and validation technologies. Over the last quarter century the software engineering and distributed systems communities have developed formal methods for describing behavioral semantics (e.g., UML behavioral diagrams) and for using those semantics to drive verification and test generation (Engels, 2000; Wermelinger & Fiadeiro, 2002). Simultaneously, the rise of service composition languages (such as BPEL) and wide adoption of web services necessitated new approaches to model-based conformance testing (Foster et al., 2003; Heckel & Mariani, 2005). These traditions have matured in parallel with advances in cloud and edge resource management and fault-tolerance strategies (Alomari & Islam, 2021; Gani et al., 2020; Quamar et al., 2020), creating the opportunity to synthesize formal-model-driven verification with adaptive resource provisioning to create test infrastructures that are both rigorous and operationally scalable.

This article responds to clear gaps in the literature and in practice. First, while formal semantics and graph-transformation approaches provide precise foundations for representing and reasoning about behavior (Engels, 2000; Wermelinger & Fiadeiro, 2002; Gönczy et al., 2006), there is limited integrated guidance on how to convert these formal artifacts directly into scalable test infrastructures that operate in fault-prone cloud-edge environments. Second, model checking and graph-transformation-based verification techniques can generate sound test cases (Hamon et al., 2004; García-Fanjul et al., 2006), but the integration of such generated test sets with dynamic resource allocation and fault-tolerant execution—required for large-scale, resource-constrained test farms—remains under-specified. Finally, domain-specific needs—such as those arising from GPU manufacturing test infrastructures (recent industry reports) and high-throughput web-service composition testing—require architectural blueprints that explicitly combine formal model-driven test generation with fault-tolerant scheduling, monitoring, and reconfiguration capabilities (Panwar & Supriya, 2022; Alhaddad & Islam, 2020).

To address these gaps, this article develops a rigorous conceptual architecture and method: dynamic meta-modelling and graph-transformational semantics are used to encode behavioral models; model checking and symbolic exploration produce minimal yet effective test suites; resource-aware fault-tolerance policies coordinate test execution across cloud and edge resources; and feedback loops from runtime monitoring inform adaptive reconfiguration and test selection. The methodology is designed to be domain-agnostic yet parameterizable so it can be applied to service compositions, web service conformance testing, and large-scale hardware test infrastructures alike (Hausmann et al., 2004; Heckel & Mariani, 2005; Quamar et al., 2020).

This introduction continues by elaborating the problem statement and positioning the present contribution within the extant literature. The subsequent sections present, in order, a detailed methodology grounded in formal semantics and graph transformations; an account of test generation and resource-aware scheduling for fault tolerance; a descriptive synthesis of expected results when deploying the framework; a deep interpretation of implications, limits, and potential future work; and a concise conclusion.

Methodology

The methodology integrates formal modeling, graph-transformation semantics, model-checking based test generation, and fault-tolerant resource provisioning. It is organized into five interlocking components: (1) dynamic meta-modeling and representation of behavioral semantics; (2) graph-transformation based operational semantics and reconfiguration rules; (3) model checking and test extraction to produce efficient, evidence-rich test sets; (4) resource-aware scheduling and fault-tolerant execution policies; and (5) monitoring-driven adaptive reconfiguration and feedback. Each component is described in depth below, including theoretical motivations, concrete constructs, and specification conventions.

Dynamic meta-modeling and behavioral representation

Model-based approaches to system behavior rely on precise meta-models that define the abstract syntax and static constraints of modeling notations, and operational semantics that define runtime behavior. Dynamic meta-modeling extends static meta-models by enabling meta-level constructs to evolve, supporting the representation of dynamic reconfiguration and adaptive behaviors (Engels, 2000). The approach advocated here begins by defining a set of meta-model layers: a core behavioral meta-model capturing states, events, transitions, message exchanges, and data flow; a composition meta-model capturing orchestration constructs (sequence, parallel, choice, loops) as typically used in service composition languages; and an execution context meta-model capturing deployment topology, resource constraints, and fault models.

The core behavioral meta-model is intentionally granular. It distinguishes between internal control states (representing control-flow points), observable events (inputs/outputs between actors and services), and internal data stores. Transitions are labeled with guard predicates and action expressions; action expressions may include message-passing operations, resource acquisition calls, and test or assertion operations. This explicit separation of observable and internal artifacts is critical for deriving test cases that are conformance-focused: tests should exercise observable behaviors and validate outputs against specified expectations (Foster et al., 2003; Heckel & Mariani, 2005).

The composition meta-model formalizes constructs often found in BPEL and other orchestrators: sequence, parallel composition, choice (non-deterministic and deterministic), event handlers, compensation handlers, and transactional scopes. By embedding these constructs in a meta-model that is compatible with graph-transformation semantics, one achieves a representation that is both human-readable (supporting UML-style diagrams) and formally tractable for automated transformation and verification (Wermelinger & Fiadeiro, 2002; Hausmann et al., 2004).

The execution context meta-model captures resources (compute nodes, test harness instances, GPU test benches), connectivity, latency and bandwidth characteristics, and fault models (node crash, communication loss, transient failures, resource overload). Resource descriptors include quantitative cost metrics (e.g., execution time, monetary cost, energy consumption) and reliability metrics (historical failure rates, mean time between failures). These descriptors enable the downstream scheduling engine to make cost-reliability trade-offs that align with organizational priorities (Panwar & Supriya, 2022; Alomari & Islam, 2021).

Graph-transformation based operational semantics and reconfiguration

Operational semantics specify how models execute. Graph transformation systems (GTS) provide a natural mechanism for representing both the static structure of models and their dynamic evolution via rule-based rewriting (Wermelinger & Fiadeiro, 2002; Gönczy et al., 2006). In this framework, models are represented as typed graphs where nodes denote entities (states, components, resources) and edges denote relations (control-flow, message links, deployment mappings). Transformation rules map graph patterns (left-hand side) to replacement patterns (right-hand side), representing state transitions and reconfiguration actions.

A core insight is to separate two families of transformation rules: behavioral rules (which model normal execution semantics—state transitions,

message passing, intra-orchestration control flow) and fault-handling / reconfiguration rules (which model recovery, redundancy activation, rerouting, and resource reprovisioning). By representing both families within the same GTS formalism, the system can be simulated and analyzed uniformly, and verification tools can reason about properties that span normal execution and exceptional scenarios (Engels, 2000; Gönczy et al., 2006).

Behavioral transformation rules must preserve important invariants, such as message ordering constraints and transactional consistency properties of scopes. Formally, applying a behavioral rule consumes a pattern that typically includes a source control state and possibly guard conditions, and generates a graph reflecting the post-state plus any emitted messages or resource interactions. Reconfiguration rules usually match on patterns that signal anomalous conditions—for example, a resource node flagged as failed or a message queue exceeding a latency threshold—and replace or augment the graph to reflect corrective actions (e.g., spawning a replacement test harness instance, switching to a backup communication path).

The meta-theory of GTS provides for proving properties about reachability, confluence, and termination in many cases. Crucially for test infrastructures, GTS permits the extraction of execution traces that reflect both nominal and exceptional behaviors: each application of a transformation rule corresponds to an execution step, and traces can be represented as sequences of rule applications. These traces are the raw material for test generation and for defining test oracles (what outputs or observable events should be expected at each step) (Wermelinger & Fiadeiro, 2002; Gönczy et al., 2006).

Model checking and test extraction

Model checking complements graph transformations by providing exhaustive or bounded exploration of state space subject to property specifications and constraint bounds (Hamon et al., 2004). The approach proposed here maps the typed-graph model and its transformation rules into a representation suitable for a model checker (for example, translating to labelled transition systems or to input languages of existing model checkers). Verification targets include safety properties (e.g., "no message is lost without a compensating handler being invoked") and liveness properties (e.g., "a request eventually receives a reply or compensating failure notification").

From the state-space exploration, test extraction proceeds in two coordinated stages: (1) selection of meaningful traces and (2) reduction or minimization of test sets while preserving coverage criteria. Hamon et al. (2004) demonstrated how model checking could be used to generate efficient test sets. Building on this, the present method uses property-guided trace selection: for each property deemed critical (e.g., conformance of response sequences, transactional integrity, explicit fault-handling behaviors) the model checker is asked to produce counterexamples or witness traces. These traces are converted into executable test cases by mapping model events to concrete service calls, inputs, and expected outputs. This translation requires a mapping table between abstract model actions and concrete API calls or message formats.

Test minimization applies techniques to reduce redundancy and focus on coverage metrics that matter operationally. Coverage can be multi-dimensional: state coverage (how many control states are visited), transition coverage (how many transformation rules are exercised), path coverage (coverage of distinct control-flow paths), and fault-mode coverage (coverage across distinct fault-handling branches). Minimization may use heuristics such as greedy set cover (choose traces that cover maximal uncovered elements), or more sophisticated optimization that balances cost and coverage. The result is a test suite that is small enough to be economically executable yet comprehensive regarding targeted properties (Hamon et al., 2004; García-Fanjul et al., 2006).

A key practical step is instrumentation: when mapping traces to executable tests, the test harness must be able to monitor observable events and evaluate oracles. Oracles can be specified declaratively alongside models (e.g., assertions attached to control states or message patterns). By generating oracles as part of the test extraction process, one ensures traceability from model property to test expectation—a crucial aspect for conformance testing (Foster et al., 2003; Heckel & Mariani, 2005).

Resource-aware scheduling and fault-tolerant execution policies

Executing tests at scale requires careful resource management. Resource-aware scheduling coordinates test execution with available compute and physical resources under cost, latency, and reliability constraints (Panwar & Supriya, 2022; Alomari & Islam, 2021). The architecture splits scheduling into two layers: a global scheduler that decides which tests to run and where, and a local execution manager that executes tests, monitors for failures, and triggers local recovery actions.

The global scheduler takes as input: (a) the generated test suite annotated with resource requirements and priority, (b) the execution context meta-model describing current resource availability and performance, and (c) organizational policies (e.g., prioritize safety-critical tests, minimize monetary cost, maximize fault coverage). The scheduler solves a constrained optimization problem to assign tests to resources over time. Because complete optimization is intractable in large-scale settings, pragmatic heuristics are advocated: deadline-aware prioritized queuing for urgent tests, cost-rational allocation for non-critical tests, and redundancy-aware allocation for tests exercising fault-handling paths (Panwar & Supriya, 2022; Quamar et al., 2020).

Fault-tolerant execution policies are critical at the local manager level. They specify how the test harness responds to resource failures or environmental perturbations. Policies include immediate restart strategies (retry the test on the same resource), failover strategies (reassign the test to a backup resource), checkpoint-and-resume strategies (if supported by the test/application), and isolation strategies (run suspected flaky tests in dedicated sandboxed environments). Each policy has cost-reliability trade-offs; for example, aggressive failover increases reliability but consumes backup resources. Policies can be encoded declaratively as part of the execution context meta-model and enforced by the local manager (Gani et al., 2020; Alhaddad & Islam, 2020).

A further dimension is adaptive redundancy: for tests exercising known brittle components (derived from historical failure data), the scheduler may elect to run multiple redundant instances in parallel to obtain consensus on expected outputs. This is particularly important in hardware testbeds (e.g., GPU wafer/fab test benches) where nondeterministic hardware anomalies may cause flakiness; redundancy reduces false-positive fail reports though at increased cost (recent industry case studies).

Monitoring-driven adaptive reconfiguration and feedback

To maintain resilience in dynamic environments, the infrastructure must continuously monitor execution and adapt. Monitoring data includes resource health metrics, test execution traces, oracle pass/fail outcomes, error logs, and external signals (e.g., network anomalies). This telemetry feeds two main adaptive loops: (1) short-term corrective actions (triggering reconfiguration rules in the GTS to recover or reallocate resources) and (2) longer-term learning for scheduling policy refinement (updating resource reliability estimates and test prioritization weights).

Short-term corrective actions map observed anomalies to pre-defined reconfiguration rules. For instance, if the monitor detects that a compute node executing an important test has become unresponsive, a reconfiguration rule matching the "node-failed-during-test" pattern is fired; the right-hand side of the rule may spawn a replacement instance and apply the required state transfer logic (e.g., re-injecting necessary preconditions or checkpointed state). The advantages of representing such corrective logic in the same formalism as the behavioral semantics are twofold: (a) one can prove that corrective actions preserve modeling invariants, and (b) one can reason about the interplay of recovery and normal operation within unified verification tasks (Gönczy et al., 2006; Engels, 2000).

For longer-term adaptation, historical monitoring data informs probabilistic models used by the scheduler. Bayesian updating of resource reliability metrics (as suggested in dynamic provisioning literatures) allows the scheduler to adjust risk models and improve allocation decisions over time (Panwar & Supriya, 2022). Integration of machine learning methods for predicting service availability or resource failure probabilities can further improve allocation; however, such models must be used with caution and validated continuously to

avoid misallocation due to model drift (Alhaddad & Islam, 2020).

Security and Conformance Considerations

While the focus of the present methodology is reliability and fault tolerance, practical test infrastructures must simultaneously enforce security and conformance. Models should encode security-relevant constraints (e.g., access control checks, authentication tokens) and test generation should include negative tests for security violations (e.g., malformed inputs, unauthorized actions). Additionally, ensuring that test harnesses and monitoring channels cannot be used as attack vectors requires standard secure engineering practices: compartmentalization, least-privilege execution contexts, encrypted telemetry, and audit logging. Integration with existing conformance testing approaches for web services ensures that security-related conformance requirements are also addressed (Foster et al., 2003; Heckel & Mariani, 2005).

Results

This section presents, in descriptive form, the expected outcomes and qualitative benefits of applying the proposed methodology. Rather than presenting empirical measurements (which require experimental deployment beyond the scope of this conceptual article), the analysis details the types of improvements one should expect, explains the mechanisms driving those improvements, and outlines how to interpret outcomes when the framework is deployed.

Improved fault coverage with model-driven test suites

By deriving test cases from behavioral models and model-checker-generated traces, the test infrastructure produces test suites that explicitly target both nominal and exceptional behaviors designed into the model. Compared to ad-hoc or manually crafted tests, these model-driven suites achieve superior coverage of rare control-flow combinations and fault-handling branches because the model checker explores corner cases systematically (Hamon et al., 2004). For example, complex interaction patterns in service orchestrations—nested compensations or interleaved parallel compositions—are often under-tested in practice; model-derived traces deliberately exercise those constructs. As a result, organizations deploying the proposed method should expect higher detection rates for errors in fault-handling logic and for subtle orchestration bugs that only surface under unusual sequences of events (Foster et al., 2003; García-Fanjul et al., 2006).

Traceable linkage between requirements, models, and tests

A practical benefit is that each test case has a direct provenance to a model element and to the property it exercises. This traceability simplifies regulatory compliance and auditing where evidence of testing against specified behavior is required. For safety-critical systems or high-assurance services, being able to point to a model and a model-checker witness trace as the origin of a test increases confidence that tests are not merely opportunistic but systematically derived from requirements (Engels, 2000; Hausmann et al., 2004).

Adaptive resource utilization and cost-reliability trade-offs

Resource-aware scheduling, informed by an execution-context meta-model and historical telemetry, allows test orchestration to balance monetary cost and reliability. In practice, this manifests as prioritized assignment of critical tests to highly reliable nodes and low-priority tests to cheaper, possibly less reliable resources. The governance of redundant execution for brittle tests enables an organization to control false-positive rates in hardware testbeds: redundant runs reduce spurious failure reports at an organizationally acceptable cost (Panwar & Supriya, 2022; Gani et al., 2020).

Reduced mean time to recovery (MTTR) and resilient test execution

Encoding reconfiguration rules and recovery logic within the same graph-transformational framework as behavioral semantics reduces the complexity of recovery logic and shortens the path from failure detection to corrective action. The short-term corrective loop (detection → apply reconfiguration rule → resume execution) is formal, predictable, and verifiable. Consequently, operational MTTR for tests interrupted by resource anomalies is expected to decrease when compared with manual or poorly integrated recovery approaches. This applies equally to cloud-hosted test

harnesses and to on-premises hardware test benches where automated failover reduces manual intervention (Gönczy et al., 2006; Alomari & Islam, 2021).

Limitations of the conceptual results and sources of uncertainty

Several limitations qualify the descriptive findings. First, the scalability of model checking is a perennial concern. Unbounded exhaustive exploration of large behavioral models is infeasible, and the method therefore relies on bounded exploration, heuristics, and property-focused generation. While these techniques are effective in practice for targeted coverage, they cannot guarantee absolute completeness across unbounded state spaces (Hamon et al., 2004). Second, the efficacy of resource-aware scheduling depends on the accuracy of reliability and cost models. If resource reliability metrics are inaccurate or subject to significant nonstationarity, allocation decisions may be suboptimal; continuous monitoring and model updating mitigate but do not eliminate this risk (Panwar & Supriya, 2022; Alhaddad & Islam, 2020). Third, integrating formal GTS semantics into existing organizational toolchains requires engineering effort and may face cultural resistance; organizations with mature DevOps practices are likely to adapt more readily than those with rigid legacy processes.

Discussion

This discussion situates the framework within broader research agendas, identifies nuanced trade-offs and counter-arguments, and outlines an actionable research and engineering roadmap for empirical evaluation and toolchain adoption.

Theoretical implications: unifying semantics and operational resilience

At the theoretical level, the primary contribution is conceptual unification: dynamic meta-modelling and graph-transformation semantics are not merely academic formalisms but become first-class artifacts that drive operational resilience. By encoding reconfiguration and recovery within the same formalism used to specify nominal behavior, the framework enables reasoning about system correctness across both normal and exceptional modes. This has implications for verification: safety and liveness properties can be specified to span across recovery actions, enabling proofs or counterexamples that consider the whole lifecycle of service operations (Engels, 2000; Wermelinger & Fiadeiro, 2002). Such a unified approach mitigates a common disconnect in industry, where recovery logic is often ad-hoc and verified separately—if at all.

Trade-offs: expressiveness versus tractability

A counter-argument is that the expressiveness required to model realistic orchestration and resource contexts could make verification and test generation intractable. Indeed, modeling complex data manipulations, parameterized loops, and infinite-state data structures push model checkers beyond their practical limits. The response advocated here is pragmatic: use abstraction and parameterization. Abstract away inessential data details where possible; use bounded or symbolic variable representations for repeating constructs; and rely on compositional verification techniques to break models into tractable components (Hamon et al., 2004). Additionally, hybrid approaches that combine automatic test generation for control-flow behavior with selective manual tests for complex data-dependent behavior provide a balance between expressiveness and tractability.

Operational counter-arguments: cost and inertia

From an operations perspective, implementing a model-based fault-tolerant test infrastructure requires investment. Some organizations may favor cheaper ad-hoc testing due to short-term constraints. However, in high-stakes domains—cloud service providers, hardware manufacturers, financial services, and safety-critical industries—the long-term savings from reduced field failures, faster recovery, and more targeted testing can justify the initial cost. A useful mitigation is incremental adoption: start with modeling and model-driven testing for the most critical service compositions or hardware test sequences, demonstrate measurable value (defect detection, reduced MTTR), and expand progressively.

Integration with machine learning approaches for prediction

The framework benefits from predictive models for resource reliability and service availability (Alhaddad &

Islam, 2020). Machine learning models (e.g., time-series forecasting, survival analysis) can supply probabilistic estimates to the scheduler. However, purely ML-driven allocation without formal guarantees risks misallocation when models drift. Therefore, the recommended integration is hybrid: use ML predictions as soft inputs in allocation heuristics, but preserve formal constraints and fallback conservative policies when uncertainty is high (Panwar & Supriya, 2022). Research on safe and explainable ML in operational decision-making is therefore particularly relevant to future work.

Applicability to GPU and hardware test infrastructures

Large-scale GPU manufacturing test infrastructures present distinctive challenges: physical test benches have throughput constraints, tests may require precise hardware states, and hardware-induced nondeterminism can cause flakiness. The presented framework is well-suited to such contexts because models can represent fine-grained test sequences and reconfiguration rules can encode precise recovery actions (e.g., rerun with adjusted voltage settings, re-seat components). Redundant execution for flaky tests and consensus-based oracles can reduce false positives (industry test reports). However, the practical adoption requires careful modeling of hardware-specific operations and collaboration with chip/test engineers to encode relevant invariants and acceptance criteria.

Roadmap for empirical validation and toolchain integration

The following steps are recommended for empirical validation:

1. **Pilot deployment in a constrained domain:** Select a bounded domain (e.g., one service composition hosting critical APIs or a subset of GPU test sequences) and implement the full pipeline—meta-modeling, graph-transformational semantics, model checking, test extraction, and resource-aware scheduling. Measure defect detection rates, execution cost, and MTTR before and after.

2. **Tool integration:** Integrate with existing CI/CD pipelines and test harnesses. Adapter components map abstract test traces to concrete test scripts (e.g., BPEL to HTTP calls or hardware testbench APIs). Monitoring and telemetry agents must be connected to the execution context meta-model.

3. **Evaluate scalability and optimization:** Stress-test scheduler heuristics under realistic load and resource churn. Evaluate the impact of bounded model checking parameters on test quality.

4. **Iterate policy tuning with feedback loops:** Use historical telemetry to refine reliability models, test prioritization weights, and redundancy policies.

5. **Publicly report findings and artifacts:** Share lessons learned, tooling adapters, and empirical metrics to advance community knowledge and encourage standardization.

Limitations and ethical considerations

A thorough application of the framework must recognize additional limitations. Modeling requires accurate specifications; poor models yield poor tests. Ensuring models are maintained alongside evolving code and infrastructures requires organizational practices for model governance. Ethical considerations include responsible handling of telemetry and adherence to privacy regulations when monitoring test executions that involve real user data; synthetic or anonymized datasets should be preferred for test inputs where possible.

Conclusion

This article has articulated a unified methodology for designing fault-tolerant model-based test infrastructures that integrate dynamic meta-modeling, graph-transformation operational semantics, model-checking-driven test generation, and resource-aware fault-tolerant scheduling. The proposed architecture connects formal semantics and verification artifacts directly to operational testing and resource management, enabling organizations to generate targeted, traceable, and resilient test suites for large-scale service compositions, cloud-edge deployments, and hardware test infrastructures such as GPU manufacturing test farms.

The theoretical integration affords several practical advantages: improved fault coverage, traceability from requirements to tests, adaptive resource usage balancing cost and reliability, and reduced MTTR via

formalized recovery rules. Limitations include inherent scalability challenges in exhaustive model checking, the dependency of allocation decisions on the accuracy of predictive models, and organizational overhead for modeling and tool integration. The article outlines an empirically driven roadmap to validate and refine the approach, emphasizing incremental adoption, pragmatic abstractions, and hybrid integration of predictive analytics.

In sum, by bridging formal modeling and operational resilience, the proposed framework offers a pathway toward more dependable testing practices in complex, fault-prone environments. It invites both rigorous empirical validation and toolchain development so that the theoretical benefits may be realized in industrial and research settings.

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