Systems, Boundaries, and Re-Identifiability

A Structural Account

Abstract

This paper develops a structural account of systems, boundaries, and identity persistence within the framework of Informational Ontology (Rev5). It rejects substance-based individuation, intrinsic boundaries, and essentialist identity conditions, while preserving the reality of systems and the legitimacy of re-identification practices used in science, engineering, and everyday reasoning.

Systems are treated as regions of relational organization stabilized by internal constraint coherence rather than as sharply bounded objects or metaphysical unities. Boundaries are analyzed as emergent zones of constraint transition, where internal organization selectively filters perturbation, rather than as intrinsic or observer-imposed demarcations. Identity persistence is grounded in the continuity of structural invariants across change, not in material sameness, essential properties, or naming conventions.

The account is explicitly non-relativistic and non-nihilistic. Non-sharp boundaries are shown to be compatible with real system individuation, and context sensitivity is distinguished from arbitrariness. Re-identifiability is characterized as a structural achievement rather than a pragmatic convenience, enabling stable reference to systems without appealing to substance ontology.

The paper operates strictly downstream of Informational Ontology and does not introduce new primitives or revise existing definitions. Its aim is clarificatory: to articulate how systems can exist, persist, and be re-identified under conditions of change without presupposing sharp borders, intrinsic essences, or absolute individuation.

1. Scope, Commitments, and Method

1.1 Downstream Position

This paper operates strictly downstream of Informational Ontology (Rev5). The ontological regime sequence
Δ → R → I → A → V → M → P
is assumed as authoritative and is not revised, repaired, or re-argued. No new primitives are introduced, and no foundational gaps are implied.

The present work concerns implications of that ontology for system individuation, boundary formation, and identity persistence. It does not propose an independent metaphysics of objects, nor does it offer a competing account of existence or fundamentality.

1.2 Structural Orientation

All claims in this paper are structural rather than substantive. Systems are characterized by patterns of relation, constraint, and organization, not by intrinsic properties or underlying substances. Where exclusion occurs, it is exclusion by regime order or structural incompatibility, not by dismissal or rhetorical negation.

The paper avoids treating systems as observer-dependent constructions while also rejecting intrinsic or absolute individuation. Structural dependence is not equated with subjective projection.

1.3 Targeted Misreadings

The account is designed to block several predictable collapse routes:

- that non-sharp boundaries imply non-existent systems
- that identity without essence collapses into convention
- that context sensitivity implies relativism
- that structural individuation reduces to mereological nihilism

These are addressed through constraint-based reasoning rather than reassurance or stipulation.

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2. Systems as Constraint-Bound Organizations

2.1 Minimal System Characterization

Within Informational Ontology, a system is treated as a region of relational organization whose internal constraints cohere sufficiently to maintain distinguishability under perturbation.

A system is not:

- a substance
- a container
- a sharply bounded object

Systemhood does not require material uniformity, fixed composition, or intrinsic properties. It requires only that relational structure remains sufficiently organized to persist across ordered change.

2.2 Constraint Coherence and Persistence

What distinguishes a system from its surroundings is not absolute separation, but differential constraint coherence. Internal relations within a system constrain one another more strongly than they are constrained by external relations. This asymmetry allows organization to persist.

Persistence here does not imply stasis. Systems may undergo transformation, adaptation, or internal reconfiguration while remaining identifiable. What must persist is not a particular state, but an organizational pattern capable of absorbing perturbation without dissolution.

2.3 Systemhood Without Substance

Because systemhood is defined structurally, no appeal to substance ontology is required. The account does not deny that material descriptions may apply to many systems; it denies only that material sameness is what grounds system identity.

This allows biological, artificial, and social systems to be treated under a common structural framework without forcing reduction to any single domain.

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3. Boundaries as Emergent Constraint Transitions

3.1 Boundaries Are Not Intrinsic

Boundaries are not intrinsic features of systems. They are not metaphysical edges or sharply defined borders. Instead, boundaries arise as zones where patterns of constraint transition.

A boundary exists where internal organization selectively filters interaction with its surroundings. Perturbations are neither fully excluded nor freely admitted; they are regulated by the system's structure.

3.2 Non-Sharpness Without Arbitrariness

Boundaries may be fuzzy, layered, or context-sensitive without being arbitrary. Many structurally real phenomena exhibit gradual transitions rather than precise demarcations. The absence of sharpness does not undermine reality; it reflects the nature of constraint gradients.

This blocks the inference that if boundaries are not sharp, systems do not exist. On the contrary, systems exist because constraint transitions are graded rather than absolute.

3.3 Boundary Persistence

Boundary persistence depends on the persistence of organizational constraint. Boundaries may shift or deform while the system remains re-identifiable. Boundary failure occurs only when constraint coherence collapses to the point that organizational identity cannot be maintained.

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4. Identity Without Essence

4.1 Structural Identity

Identity in this framework is not metaphysical sameness. It is structural continuity across change. A system remains the same system insofar as its defining organizational invariants persist.

These invariants may include constraint patterns, functional organization, or relational topology, depending on the system type. No appeal to essential properties or intrinsic natures is required.

4.2 Change and Tolerance

Identity does not require exact preservation. Systems tolerate variation. Material components may be replaced, internal configurations may shift, and interactions may change while identity persists.

Identity fails only when organizational continuity is disrupted beyond recovery. This failure is structural, not semantic.

4.3 Blocking Conventionalism

Because identity persistence is tracked by structural invariants, re-identification is not merely a naming practice or pragmatic convenience. Linguistic reference tracks structural stability; it does not create it.

This blocks collapse into conventionalism without reverting to essence.

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5. Re-Identifiability as Structural Stability

5.1 Re-Identifiability Defined

Re-identifiability is the capacity of a system to remain available for reference across time and change. It is not metaphysical sameness, but structural availability.

A system is re-identifiable when its organization constrains future states in a way that remains continuous with its prior organization.

5.2 Scientific and Practical Re-Identification

Scientific and everyday practices of re-identification rely on structural continuity, not intrinsic identity. Instruments, organisms, institutions, and persons are re-identified by tracking invariants, not by verifying essence.

This account explains why such practices succeed without requiring metaphysical substances.

5.3 Failure Modes

Re-identification fails when organizational continuity fails. This failure is neither purely epistemic nor purely conventional. It reflects a real loss of structure.

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6. Context Sensitivity Without Relativism

6.1 Context Selects, It Does Not Invent

Different contexts may track different structural features of the same system. This does not imply that systems are observer-relative. Context determines which constraints matter for a given inquiry, not whether the system exists.

6.2 Blocking “Everything Is a System”

Not everything qualifies as a system. Only regions of organization that maintain constraint coherence under perturbation do. The framework is selective, not promiscuous.

This blocks collapse into trivial system universalism.

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7. Compatibility With Downstream Regimes

The account developed here is presupposed by downstream analyses:

- Salience presupposes boundaries that delimit availability
- Agency presupposes persistent systems capable of trajectory modulation
- Responsibility presupposes stable re-identification across action and time

None of these require intrinsic boundaries or substance ontology. They require only structural persistence.

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8. Conclusion

Systems, boundaries, and identity can be treated as real without being treated as intrinsic or essential. By grounding systemhood in constraint-bound organization, boundaries in emergent transition zones, and identity in structural invariants, the Informational Ontology provides a framework that preserves realism without reifying substances or sharp borders.

Non-sharp boundaries do not undermine existence. Context sensitivity does not entail relativism. Re-identifiability does not collapse into convention. What persists is structure, and where structure persists, systems remain available for reference, interaction, and responsibility.

Appendix A: Mereology as a Derived Descriptive Framework

A.1 Purpose and Scope of the Appendix

This appendix clarifies how part–whole descriptions may be applied within the structural framework developed in the main text. It does not introduce mereological primitives, revise any ontological definitions, or treat composition as ontologically fundamental.

Nothing in the paper's core argument depends on mereological assumptions. The account of systems, boundaries, and re-identifiability is fully specified in terms of constraint-bound organization. This appendix exists solely to address how mereological language may be interpreted where it is commonly employed, and to prevent misreadings that would incorrectly attribute either mereological nihilism or unrestricted composition to the framework.

A.2 Why Part–Whole Language Persists

Part–whole language persists because many systems admit local decomposition for purposes of explanation, intervention, or prediction. Scientific and practical reasoning frequently isolates subsystems, components, or modules in order to track behavior under constraint.

Within the present framework, this persistence does not indicate that parts are ontologically basic. It reflects the fact that constraint structures are often *partially separable*: some internal relations can be tracked without modeling the entire system at once.

Part-talk therefore corresponds to **organizational decomposability**, not to metaphysical atomism.

A.3 Parts as Regions of Organizational Decomposition

A "part," as used descriptively here, denotes a sub-region of a system whose internal relations exhibit sufficient local coherence to be treated independently for limited purposes.

Such regions are:

- not substances,
- not intrinsically bounded, and
- not independently persisting entities.

Their status is always conditional on the system within which they are embedded. A region counts as a part only insofar as decomposing the system along that region preserves explanatory or predictive coherence.

This decomposability is regime- and context-sensitive. A region that functions as a part under one analytical scale may not do so under another.

A.4 Blocking Mereological Nihilism

Rejecting fundamental parts does not entail that there are no parts. It entails only that part-hood is not an ontological primitive.

The framework affirms that:

- systems may contain stable, recurrent sub-organizations, and
- those sub-organizations may be tracked, intervened upon, and re-identified.

What it denies is that such substructures ground the existence or identity of the system itself. Parts exist as *organizational features*, not as independent bearers of being.

Accordingly, the view does not collapse into mereological nihilism. It rejects fundamentality, not applicability.

A.5 Blocking Unrestricted Composition

The framework equally blocks unrestricted composition. Not every aggregation of entities or regions qualifies as a system, and not every grouping supports part–whole relations.

Composition is constrained by organization. Only aggregates that exhibit constraint coherence sufficient for persistence under perturbation qualify as systems. Part–whole relations arise only within such systems.

Arbitrary sums lacking organizational integration do not acquire systemhood merely by aggregation. This restriction follows directly from the system criteria articulated in the main text and does not require additional mereological principles.

A.6 Identity Priority: Systems Before Parts

System identity is prior to part identity. A system remains re-identifiable when its defining organizational invariants persist, even if the substructures that may be described as parts change over time.

Parts may be replaced, reorganized, or dissolved while the system persists. Conversely, perfect preservation of components does not guarantee system identity if organizational coherence collapses.

Re-identification therefore tracks system-level structure, not part persistence. Part identity is derivative and subordinate, not constitutive.

A.7 Status of Classical Mereological Axioms

Classical mereological axioms—such as unrestricted composition, extensionality, or global transitivity—are neither assumed nor required by the framework.

Some such axioms may fail to apply where:

- boundaries are non-sharp,
- parts overlap or interpenetrate, or
- organizational roles change across contexts.

This is not treated as a failure of mereology, but as an indication of its limited scope. Mereological formalisms may be useful tools where their conditions are met, but they are not treated as ontological foundations.

A.8 Summary and Containment Statement

This appendix provides a mapping between the structural account developed in the main text and familiar part–whole descriptions. It does not introduce new commitments or revise any core claims.

Rejecting this appendix leaves the main argument intact. Accepting it adds only a constrained interpretive layer, clarifying how mereological language may be used without reintroducing substance ontology, intrinsic boundaries, or essentialist identity conditions.