Matter Reconstruction v0.2

Pass 2 — Structural Reconstruction and Minimal Model 1

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Research program: An Elaboration of Smuts's Holism and Evolution

Methodological status: independent structural reconstruction prior to systematic Smuts/UPA comparison

Abstract

This working paper records the first major portion of Matter Reconstruction Pass 2. It begins from the fixed findings of Matter Reconstruction v0.1, Pass 1, and reconstructs the dependency architecture among identity, state, variation, relation, interaction, constraint, transformation, invariance, composition, organization, field, temporality, past, future, persistence, system, whole, and level. The analysis finds that the physical conceptual architecture is not well represented as a simple hierarchy of independent primitives. Several central concepts are reciprocally determined: identity criterion, transformation, and invariance; possibility and constraint; variation and distinction/equivalence. Organization and constraint are structured families rather than single mechanisms. Field must be restored as a major category because physical structure need not be object-first or reducible to pairwise relations. Variation is elevated to a core structural concept, while change is temporal variation and transformation is structured change. Past and future enter asymmetrically as realized history and structured accessible continuation relative to a present physical structure, without committing the reconstruction to a metaphysics of time.

Pass 2 then develops Minimal Model 1: variation through time under identity criteria and constraints. The model represents possible states, realized states, criterion-relative equivalence, accessible continuations, constraints, transformations, persistence, history, organization-dependent accessibility, and structural transformations that change the relevant possibility space itself. The model survives the principal Matter counterexamples considered in Pass 1 and supplies a possible formal route toward reconstructing Level as a dimension or ordering of structure. It does not establish a universal ontology, regulation, Holism, or the validity of prior UPA geometry. The paper concludes with a detailed handoff for a new session devoted to Model 2: Composition–Organization–Composite Identity.

1. Purpose, Scope, and Governing Method

Pass 1 ended with a constrained conceptual map rather than an ontology. Its handoff directed Pass 2 to reconstruct dependencies, distinguish primitive candidates from derived and family terms, test local formal models, preserve counterexamples, and avoid restoring Smuts, UPA, Axiomatic Ontology, or spherical geometry by assumption. Pass 2 is therefore a structural discovery exercise: concepts are retained, revised, split, or rejected according to what the independent physical reconstruction requires.

The present paper records the progressive findings of the session through Analysis A, Analysis B, the inserted investigations B.5 and B.6, and Analysis C Model 1. Smuts remains a later comparison target. His distinctions among co-operation, co-ordination, regulation, and regulatory selection/deselection are not used as definitions here, although the independent reconstruction has now produced structures that will make that later comparison unusually precise.

2. Starting Point from Matter Pass 1

The fixed Pass 1 record established the following constraints on Pass 2:

- Identity requires an explicit criterion; state and identity are distinguished relative to that criterion.
- Transformation and invariance are mutually informative; identity-through-transformation depends on specified invariants.
- Distinguishability is broader than polarity, and physical difference must be separated from representational difference.
- Aggregation, composition, relation, and organization are distinct.
- Constituent inventory does not determine composite identity; organized composites can become new bearers of states.
- Organization is heterogeneous: connectivity, configuration, distributed structure, collective order, and hierarchy are not obviously one mechanism.
- Collective organization can become part of the effective constraints governing subsequent constituent behavior.
- Collective order can occur without net polarity; polarity can itself be generated by organization.
- Constraints can compete and may be mutually incompatible; constraint is therefore broader than simple exclusion.
- Nonliving systems already exhibit coupling, coordination-like order, differential favoring, hierarchical organization, and dynamic persistence.
- Regulation, self-maintenance, function, biological information, reproduction, inheritance, adaptation, and evolution remain unresolved.

3. Analysis A — Dependency Reconstruction

3.1 No simple hierarchy of primitives

The first major Pass 2 result is negative but consequential: the Pass 1 concepts do not arrange themselves naturally into a single linear hierarchy. An initial sequence such as difference → identity criterion → identity/state → transformation/invariance is too simple. Transformation is characterized partly by what changes and what remains invariant; invariance is specified relative to transformations; identity persistence is assessed under criteria that themselves classify transformations as identity-preserving or identity-changing. Conceptual dependence therefore does not automatically establish foundational priority.

conceptual dependence ≠ foundational priority

3.2 Three initial dependency complexes

Analysis A identified three interacting complexes rather than one chain:

- Distinction–Identity–Transformation: difference/equivalence, identity criterion, identity/state, transformation, invariance.
- Relation–Composition–Organization: constituents or degrees of freedom, relations, composition, organization, composite identity, composite state space.
- Possibility–Constraint–Organization: possible states/transformations, constraints, organization, collective order, and effective local conditions.

These complexes overlap. Identity and state are criterion-relative; organization can generate new identity-bearing state spaces; constraints structure possible variation; transformations can alter both states and the structure of the possibility space.

3.3 Identity and state are derived or criterion-relative

Bare physical identity is not sufficiently informative to function as an unconditional primitive. The same physical event can preserve one identity while changing another. A useful representation therefore has the form x ~C y, where C is the criterion under which two states or structures count as the same tracked identity. State is likewise not independently primitive: a state is a determination or admissible variation of a bearer whose relevant identity is held fixed.

$$x \sim_C y$$

This result is especially important for atoms and molecules. Elemental identity may persist through isotope, ionization, or electronic-state variation; molecular formation or reaction can preserve constituent identities while creating or destroying composite identity.

3.4 Relation, organization, and composite identity

Aggregation is insufficient for composition, and constituent inventory is insufficient for composite identity. Molecular cases require organized constituent participation. Isomerism demonstrates that different connectivity or configuration can produce different composite identities with the same constituent inventory. Delocalization demonstrates that organization cannot be reduced to a list of independent binary relations. Macromolecular conformation demonstrates that organizational change need not always be identity change.

Relation therefore remains a strong primitive candidate, but its arity and physical form must remain open. Organization is not yet a primitive; it is a structured family whose members include connectivity, configuration, distributed structure, collective order, hierarchy, and potentially dynamic organization.

3.5 Constraint and possibility

Constraint emerged as a strong recurring category but not as simple prohibition. Frustration shows that constraints can compete, conflict, favor alternatives, and leave multiple locally preferred possibilities. The neutral physical formulation is differential structuring of a possibility space by constraints. Possibility and constraint are therefore mutually specified: a constraint requires possibilities to structure, while the physically relevant possibility space is partly determined by applicable constraints.

$$\textit{possibility} \leftrightarrow \textit{constraint}$$

3.6 Interaction restored to the ledger

Interaction had not appeared explicitly in the Pass 2 task list even though Pass 1 repeatedly depended on it. Analysis A restored Interaction as a structural concept requiring clarification relative to Relation and Transformation. This became important in Analysis B.

4. Analysis B — Concept Splitting and Reciprocal Determination

4.1 Reciprocal determination is not automatically defective circularity

Analysis B tested whether apparent circular definitions could be removed by better ordering. In several cases they could not without losing essential structure. The strongest examples are identity criterion–transformation–invariance and possibility–constraint. These are better treated as jointly specified structures than as failures of definition.

$$\textit{Identity Criterion} \leftrightarrow \textit{Transformation} \leftrightarrow \textit{Invariance}$$

$$\textit{Possibility Space} \leftrightarrow \textit{Constraint}$$

4.2 Difference and equivalence

Difference and equivalence are best treated together. Physical distinguishability is criterion-sensitive, and mathematical inequality need not imply physical distinction. Equivalence likewise requires a criterion. They are therefore candidate primitive-level relational structures, but not context-free primitives.

4.3 Relation, interaction, and transformation distinguished

Pass 2 now provisionally distinguishes three concepts. Relation is the broadest and need not imply change. Interaction is a physically consequential dependence in which variation in one structure affects the possible states, transformations, or trajectories of another. Transformation is structured change between states or structures. Stable interaction structures can exist without being identical to a particular realized transformation.

4.4 Independently reconstructed interaction progression

Without adopting Smuts's terminology, the physical reconstruction now distinguishes increasingly structured interaction-like phenomena: (1) coupled interaction, in which constituents or structures affect one another; (2) coordinated interaction, in which multiple coupled degrees of freedom participate in collective organization; and (3) organization-dependent selective constraint, in which established organization differentially structures subsequent local possibilities.

This progression is intentionally not named co-operation, co-ordination, and regulation at this stage. Pass 3 must test whether Smuts's categories genuinely correspond to the independently reconstructed structures, and especially whether his regulation begins with organization-dependent differential constraint or requires a stronger system-relative relation to persistence, restoration, or trajectory.

4.5 Regulation remains unresolved

Matter supports organization-dependent constraint but does not yet independently establish regulation as a distinct category. A stronger candidate concept of regulation may require state-dependent selection among processes relative to persistence, restoration, or system trajectory. This boundary is reserved for the Life reconstruction and later Smuts comparison.

4.6 Organization and constraint are structured families

Organization is neither one simple mechanism nor a collection of unrelated meanings. Its forms share a common schema: structured differentiation among physical degrees of freedom changes the admissible or favored possibilities of a composite or distributed structure. Constraint likewise forms a family that may include exclusion, favoring, incompatibility, competition, phase dependence, and organization-dependent local restriction.

4.7 System, Whole, and Level

System increasingly appears derived rather than primitive: a system requires some combination of identity criterion, organization, boundary or partition, and relevant relations. Whole remains too coarse; every rigorous Matter use encountered so far can be replaced by a more precise term such as composite, organized system, collective organization, or dynamically maintained organization.

Analysis B initially concluded that Level must split into scale, organization, identity criterion, description, and effective-theory meanings. That conclusion was subsequently revised after recovering the historical role of Level as the name of the progressive sphere dimension. The better question is whether those several associations are manifestations or indicators of a deeper structural dimension rather than definitions of several unrelated concepts.

5. Analysis B.5 — Field and Level as Structural Questions

5.1 Field repairs an object-first bias

Pass 1 explicitly recognized that the physical domain includes fields, field excitations, interaction structures, energy-momentum, and dynamical spacetime, yet Field disappeared from its final conceptual ledger. Restoring Field exposed a possible object-first bias in the emerging Pass 2 architecture. Physical structure need not begin with independently defined objects followed by relations among them. Distributed physical structure can itself be primary within a model.

Field is not simply Relation and is not identical to Interaction. A field is provisionally treated as distributed physical structure over a domain. It can possess states and organization, participate in interactions and transformations, and contribute to constraints without being reducible by definition to a set of pairwise object relations.

5.2 Two broad structural modes

The reconstruction therefore must accommodate at least:

- Constituent-relational structure: distinguishable constituents or degrees of freedom with relations and interactions.
- Distributed structure: physical quantities, states, order, or geometry distributed over a domain.

These modes can coexist. Collective condensed-matter organization, for example, can be represented by distributed order parameters while still arising from constituent interactions. Field therefore can be a mode or bearer of organization rather than a replacement for organization.

5.3 Organization broadened

The earlier formulation of organization as constraint-bearing relational structure among constituents was too narrow. A better provisional formulation is: organization is structured differentiation within or among physical degrees of freedom that changes the possible states, trajectories, or effective behavior of the relevant physical structure.

5.4 System boundaries reconsidered

Fields sharpen the unresolved System problem because physically relevant distributed structure may cross conventional compositional or analytical boundaries. Compositional, organizational, interaction, and analytical boundaries need not coincide. This strengthens the case that System is a context-relative derived construction rather than an unconditional primitive.

5.5 Level revised as an aspect or dimension of Structure

Recovering the original role of Level as the progressive sphere dimension changed the Pass 2 question. Level is no longer provisionally classified as a family term that must split. Instead it is treated as a candidate aspect, coordinate, ordering, or dimension of Structure. Scale, identity criteria, organization, descriptions, and effective theories may be indicators or consequences of structural level rather than definitions of Level itself.

$$L = L(S) \quad \textit{or, more cautiously,} \quad \textit{Level is an ordering/aspect of Structure}$$

The physical reconstruction suggests progressive structural transitions from distinguishable structures through interaction, composition, organization, new composite identity-bearing state spaces, collective organization, and organization-dependent constraints. It does not yet establish that these transitions form a single scalar metric or linear hierarchy. Level may be ordinal or partially ordered rather than metric.

6. Analysis B.6 — Variation, Temporality, Past, Future, and Structural Change

6.1 Variation elevated to the core architecture

Variation had been present throughout Pass 1 without receiving adequate structural status. It is broader than change: variation may be spatial, relational, configurational, ensemble-based, or temporal. Difference articulates distinctions within variation. Change is temporal variation. Transformation is structured change or a mapping/process between states or structures.

$$\textit{Variation} \supset \textit{temporal variation (Change)}$$

$$\textit{Transformation} = \textit{structured change/variation}$$

6.2 State, identity, and persistence as structures of variation

A state is a realized determination within a relevant variation or possibility space. An identity criterion partitions or classifies variation according to what counts as identity-preserving. Persistence is criterion-relative identity through temporal variation, while invariance is what remains unchanged relative to a specified transformation or transformation class. Persistence and invariance therefore support one another but are not identical.

6.3 Minimal role of time

Pass 2 does not attempt a metaphysics of Time. The reconstruction requires at least temporal ordering and relations sufficient to distinguish before/after, change, trajectory, and persistence. General relativity and the Pass 1 gravity analysis caution against treating Space and Time as passive independent containers: contextual spatiotemporal structure can itself be dynamically related to physical contents.

6.4 Past, present, and future are structurally asymmetric

Relative to a present physical structure, the past is represented by the realized trajectory that produced the current structure, while the future is represented by structured accessible continuation. This is a modeling distinction, not a claim that the past is unreal or the future nonexistent.

$$\textit{History: } Ht = (\ldots, S(t-2), S(t-1), S(t))$$

$$\textit{Future possibility: } P{+}t = \{\textit{accessible continuations from } S(t)\}$$

6.5 Present structure can embody realized history

Past states need not remain present as past states for their consequences to be physically incorporated into current structure. Earlier transformations can change present organization and therefore alter subsequent possibilities. This establishes path dependence without importing memory, representation, purpose, inheritance, or learning.

6.6 Future possibility clarifies constraint

Constraint can now be interpreted dynamically: present structure differentially structures possible future variation. Constraint need not specify a single future; it may exclude, favor, weight, compete, or frustrate possible continuations.

$$\textit{Present Structure} \rightarrow \textit{Constraints} \rightarrow \textit{Structured Possible Futures}$$

6.7 Recursive interaction–organization dynamics

The emergent-to-formative pattern is fundamentally temporal. Local interactions contribute to organization; established organization modifies effective constraints; those constraints alter subsequent possible local behavior; subsequent behavior contributes to later organization. This is a temporally recursive process, not a mysterious additional downward force.

$$I(t) \rightarrow O(t+1) \rightarrow C(t+1) \rightarrow P+(t+1) \rightarrow I(t+1) \rightarrow \ldots$$

6.8 Variation within structure versus variation of structure

A critical distinction emerged between transformations within a fixed relevant state/possibility structure and transformations that alter the state/possibility structure itself. Molecular formation provides the clearest physical motivation: the organized molecule becomes a new bearer of rotational, vibrational, electronic, and other states. The transformation therefore does more than select a different state; it establishes a new relevant domain of states and transformations.

$$\textit{within-structure: } s_i \rightarrow s_j, \textit{ with } s_i, s_j \in \Omega$$

$$\textit{structural transformation: } (\Omega_n, A_n) \rightarrow (\Omega_{(n+1)}, A_{(n+1)})$$

6.9 A stronger candidate interpretation of Level

Level may concern structural transformations that reorganize the space of possible states, identities, transformations, or constraints. A Level transition would then be different from ordinary variation within a Level. This does not yet define Level, but it provides a formal target against which the progressive sphere dimension can later be tested.

7. Analysis C — Minimal Model 1

7.1 Purpose and domain

Model 1 tests whether variation through time under identity criteria and constraints can be represented in a small structure that remains neutral between discrete objects, composites, fields, collective phases, and other physical bearers. It is a local model. Formal success is not interpreted as metaphysical truth.

7.2 Model elements

Symbol	Role	Interpretation
Ω_t	Relevant state/possibility space	Possible physical determinations at temporal index t.
s_t ∈ Ω_t	Realized state	The actually realized determination represented by the model.
D_C	Criterion-sensitive distinction	Physical distinguishability relative to criterion/context C.
~_CI	Identity equivalence	States count as the same tracked identity under identity criterion C_I.
A_t	Accessibility relation	Physically accessible continuations from states at t to states at t+1.
F_t(s_t)	Accessible future	Set/structure of accessible continuations from the present realized state.
K_t	Constraint	Modification or structuring of accessibility/future variation.
T_t	Realized transformation	An accessible transition actually instantiated.
H_t	Realized history	The realized trajectory relative to the current index.
O_t	Organization	Current organization that can modify accessibility and effective constraints.

7.3 Criterion-relative identity

$$s_i \sim_{(C_I)} s_j$$

The same two physical states may be equivalent under one identity criterion and inequivalent under another. This formally represents layered identity and prevents State from being collapsed into Identity.

7.4 Accessible future and constraint

$$F_t(s_t) = \{x \in \Omega_{(t+1)} : (s_t,x) \in A_t\}$$

$$K_t : A_t \mapsto A'_t$$

The model does not assume determinism. A present state can have multiple accessible continuations. Constraints act on the accessibility structure and therefore on future variation. The minimal model uses accessibility only; later models may require graded probability, energy, cost, preference, or other theory-specific structure.

7.5 Persistence and invariance

Persistence under C_I iff $s_t \sim_{(C_I)} s_{(t+1)}$

An invariant may be represented by a property I satisfying I(s_t)=I(s_(t+1)) under a specified transformation. Persistence is not identical to invariance; rather, identity criteria may depend on invariants or invariant structures.

7.6 History and path dependence

$$A_t = A(H_t)$$

When accessibility depends on realized history, the model represents path dependence. No concept of memory is required: past transformations may simply have altered current physical structure.

7.7 Organization-dependent accessibility

$$O_t \rightarrow K_t(A_t) \rightarrow F_t$$

This is the formal core of the emergent-to-formative pattern. Organization can be both produced by earlier interactions and formative of subsequent accessible variation.

7.8 Structural transformation

$$(\Omega_t, A_t) \rightarrow (\Omega_{t+1}, A_{t+1})$$

This is stronger than ordinary state change. It represents a transformation in which the relevant state/possibility structure itself changes. It is the key bridge from Model 1 to the coming composition/organization model and the strongest current formal clue toward Level.

7.9 Interaction in Model 1

For structures A and B, interaction can be represented when the accessible possibilities of one depend on the state or variation of the other. Schematically, Δs_A changes F_B and/or Δs_B changes F_A. This keeps Interaction distinct from Relation and Transformation while giving it a formal role.

7.10 Collective organization

For multiple component spaces $\Omega_1,...,\Omega_n$, an organized joint structure may occupy or make accessible a structured subset of the unconstrained product space. This is only a schematic bridge to Model 2; it does not yet define composition or composite identity.

$$\Omega_{organized} \subset \Omega_1 \times ... \times \Omega_n$$

8. Countermodel Tests Applied to Model 1

Countermodel	Result
Macromolecular conformation	Organization may change while the tracked identity persists. Model 1 permits ΔO with $s_t \sim_{CI} s_{(t+1)}$.
Isomerism	The same constituent inventory can support different organized identities. Identity criteria can depend on organized structure rather than inventory alone.
Antiferromagnetism	Strong collective organization need not produce net polarity. Model 1 does not identify organization with polarity.
Frustration	Multiple constraints need not produce one simple coordinated outcome. Accessibility can be structured by incompatible or competing constraints.
Dissipative organization	Organization may persist only under continuing throughput. Model 1 can make accessibility dependent on external conditions without calling the pattern self-maintaining.
Field/distributed structure	The realized state s_t and possibility space Ω_t need not describe an object; they may describe a field configuration or distributed order.

9. Progressive Structural Findings at the End of This Session

- Physical reconstruction is better represented by interacting structural relations than by a single hierarchy of independent primitive nouns.
- Reciprocal determination is a genuine candidate structural feature, not merely a defect to be eliminated. Identity criterion–transformation–invariance and possibility–constraint are the clearest cases.
- Variation belongs in the core architecture. Difference articulates variation; change is temporal variation; transformation is structured change.
- Identity is criterion-relative; state is a realized/admissible determination relative to a tracked identity and possibility structure.
- Relation, Interaction, and Transformation should remain distinct. Interaction is where variation in one physical structure changes possibilities for another.
- Organization is a structured family with a common possibility-structuring role; it is not one physical mechanism.
- Constraint is a structured family and is broader than exclusion or binary selection.
- Field must be restored as a major category. Physical structure may be distributed and need not be object-first or reducible to pairwise relations.

- System is increasingly likely to be derived/context-relative; Whole may be technically dispensable unless later domains establish a stronger role.
- Level is no longer treated as a family term that must split. It is a candidate aspect/dimension/order of Structure, historically associated with the progressive sphere dimension.
- Past and Future have different roles in the minimal temporal reconstruction: realized history versus structured accessible continuation relative to the present structure.
- Present structure may embody consequences of realized history; this establishes path dependence without memory or purpose.
- Organization can recursively become formative by changing subsequent accessibility/constraint structure.
- Structural transformation must be distinguished from ordinary state transformation. A structural transformation can establish a new relevant state/possibility space.
- Model 1 gives a coherent local formalization of variation, identity, constraint, transformation, persistence, history, future possibility, and organization-dependent accessibility without claiming a universal ontology.
- The independent reconstruction is approaching a possible interaction progression resembling coupling → coordination → organization-dependent selective constraint, but whether this corresponds to Smuts's co-operation → co-ordination → regulation remains explicitly deferred.

10. Revised Structural Findings Ledger

Evidence-note: The added columns identify atom/molecule examples used in the reconstruction where they genuinely support the finding. Where a finding arose primarily from condensed matter, non-equilibrium physics, field theory, or the Pass 2 formal reconstruction, the ledger says so rather than forcing an atomic or molecular example.

Concept	Pass 2 status after Model 1	Atom / molecule	What the example supports
Variation	Core structural concept; broader than temporal change.	Atoms: isotopic, ionization, electronic-state variation; macromolecular	Variation can occur while a tracked identity persists; variation is broader than identity change
Difference / Equivalence	Criterion-sensitive articulation of variation; candidate primitive-level relational pair.	Electron/type identity; isotopes; isomers	Physical distinction and equivalence depend on the criterion being applied; representational difference alone is insufficient
Identity Criterion	Foundational structural concept; jointly specified with transformation/invariance.	Atomic number for elemental identity; molecular organization for molecular identity	Shows that identity must be specified by a criterion and that different criteria can operate at different structural descriptions
Identity	Derived or criterion-relative; can be layered.	H atom → H_2; H_2/O_2 → H_2O; isotopes/ions	Constituent identity may persist while a composite identity is created or destroyed; identity is
State	Realized/admissible determination relative to a relevant possibility structure and tracked identity.	Atomic electronic/ ionization states; molecular conformations	Different realized states can belong to the same tracked identity.
Relation	Strong primitive candidate; not assumed exclusively binary.	Chemical bonding; benzene delocalization	Relations are required for composition, but molecular organization is not exhausted by independent pairwise relations
Field	Major structural category: distributed physical structure; not reducible by definition to Relation or Interaction.	No single atom/molecule example is sufficient; molecular electronic structure/delocalization is	The molecular evidence supports distributed structure, but the stronger Field finding comes from the broader physical representation
Interaction	Physically consequential coupling: variation in one structure changes possibilities for another.	H + H → H_2; constituent interactions in molecular bonding	Interaction changes accessible configurations and can contribute to formation of organized
Constraint	Family of relations/conditions that differentially structure possible variation.	Bonded molecular structure; conformational restrictions	Organization restricts or differentially structures the states and transformations available to
Transformation	Structured change; may be state transformation or structural transformation.	H + H → H_2; H_2/O_2 → H_2O; ionization/state transitions	Distinguishes state-changing transformations from transformations that create/destroy

Concept	Pass 2 status after Model 1	Atom / molecule	What the example supports
Invariance	Transformation-relative unchanged structure; supports but is not identical to persistence.	Elemental identity across isotope/ionization/	Some properties/criteria remain invariant through transformations
Organization	Structured family; organized differentiation that changes accessible states, trajectories, or effective behavior.	H_2/H_2O bonding; isomerism; benzene delocalization;	Organization is necessary beyond inventory; it can be connectivity-based, configurational, distributed,
Composition	Structured constituent participation; to be formalized in Model 2.	$H + H \rightarrow H_2$; $H_2/O_2 \rightarrow H_2O$	A collection of constituents is not thereby a composite; composition
Composite Identity	Derived; not determined by constituent inventory alone.	H_2, O_2, H_2O; isomers	Organized composites become new identity bearers, and constituent inventory alone does not determine
Composite State Space	New legitimate possibility structure associated with organized composite identity.	Molecules: rotational, vibrational, electronic	An organized molecule is a legitimate bearer of system-level
History / Past	Realized trajectory relative to the present model index; consequences may be embodied in present structure.	No decisive atom/molecule example isolated in Pass 1	This finding arose in Pass 2 from temporal reconstruction; chemistry can exhibit path dependence, but
Future	Structured accessible continuation relative to present structure; not prediction.	Bonded molecular structure constraining accessible subsequent	Present organization structures accessible continuation, though the general Future concept is a Model
Persistence	Criterion-relative identity through temporal variation.	Elemental identity through isotope/ionization/ electronic-state variation;	Persistence is identity through variation under a specified criterion.
Trajectory	Temporally ordered succession/path of states or structures.	Reaction/state sequences such as constituents →	Supports temporally ordered transformations, but the general
Collective Order	Derived organizational regime; broader than polarity.	Not primarily atom/ molecule evidence; developed from condensed	No adequate molecular example in the selected sequence; principal support comes from
Polarity	Special structured distinction/order; may be generated by organization.	H_2 versus H_2O; molecular polarity where applicable	Polarity is a special structured distinction and is not identical to
Frustration	Competing/incompatible constraints.	No principal atom/ molecule example used	The finding is supported primarily by frustrated magnetic systems, not
Dynamic Organization	Organization maintained through throughput; not thereby biological self-maintenance.	No principal atom/ molecule example used	The finding is supported primarily by non-equilibrium dissipative
System	Probably derived/context-relative; boundary and identity criteria unresolved.	Molecule as a candidate bounded composite; macromolecular hierarchy	Molecules show that organized composites can be treated as systems, while hierarchical
Whole	Possibly dispensable technical term in Matter; later domains may reopen.	H_2/H_2O as organized composites	The examples show that precise terms such as composite and organized system do the needed work; they do not independently
Level	Candidate aspect/dimension/order of Structure; possibly tied to transformations of possibility/ state structure.	Atom → molecule; atomic organization → molecular composite state space	Provides the strongest molecular candidate for progressive structural Level: formation of a new
Regulation	Not independently established in Matter; stronger than organization-dependent constraint may be required.	No atom/molecule example establishes regulation	Molecular constraint and organization do not by themselves justify the stronger category of

11. What Has Not Been Established

- The reconstruction has not established that its emerging framework is Holism.
- It has not established that Smuts's co-operation, co-ordination, regulation, or regulatory selection/deselection have been recovered.
- It has not established that physical differential constraint is identical to regulation or selection in Life.

- It has not restored UPA Unity, Polarity, World, Level, System, the spherical model, or prior geometric interpretations.
- It has not established Axiomatic Ontology as the final form or name.
- It has not established that Reality literally consists of state spaces or that time is discrete.
- It has not selected a metaphysical theory of past, present, or future.
- It has not established determinism, indeterminism, quantum contextuality, or a quantum ontology from the conceptual resemblance to reciprocal/contextual determination.
- It has not established a scalar or linear metric of Level.
- It has not shown that Matter's structures generalize unchanged to Life, Mind, or Social Organization.

12. Assessment of Pass 2 Progress

Pass 2 is not yet complete under its original stopping rule. Several recurring structures now have defensible provisional definitions; important concept splits and reciprocal dependencies have been identified; Model 1 provides one warranted local formalization; and major omissions in Field, Variation, and Temporality have been repaired. However, Composition–Organization–Composite Identity has not yet been formally modeled, and the relation between structural transformation and Level remains only a candidate. The next session should therefore continue Pass 2 rather than begin Pass 3.

13. Handoff to the Next Session — Model 2

13.1 Governing question

Model 2 should ask: Under what minimal conditions does organization of existing physical structures justify treating the result as a new composite bearer with its own identity criterion, state/possibility space, transformations, and constraints?

13.2 Required starting distinctions

- Aggregation versus composition.
- Constituent membership versus constituent participation.
- Constituent inventory versus organized relational/configurational structure.
- Organization that changes composite identity versus organization that changes only state.
- Local/pairwise relation versus distributed organization.
- Composite identity versus constituent identities.
- New composite state/possibility space versus restriction of a pre-existing product space.
- State transformation versus structural transformation.
- System boundary versus compositional, organizational, interaction, and analytical boundaries.

13.3 Candidate minimal formal objects

Do not assume these are all required. Begin with the smallest structure that can survive the molecular counterexamples:

- Component structures X_i with state/possibility spaces Ω_i.
- A participation or composition relation P specifying which components participate in a candidate composite.

- An organization structure O that may include connectivity, configuration, distributed relations, or other non-pairwise structure.
- A composite identity criterion C_Q for candidate composite Q.
- A composite possibility/state structure Ω_Q, if justified.
- Mappings between constituent states and composite states that need not be one-to-one or reducible to a Cartesian product.
- Transformation classes acting within Ω_Q and transformations that create/destroy Q.
- Constraints induced by O on constituent and composite possibilities.
- Boundary/partition information only if required by the model rather than assumed.

13.4 Core Model 2 tests

1. Aggregation test: show formally why a mere set or collection of components is insufficient for composition.
2. Isomerism test: same constituent inventory, different organization, different composite identity.
3. Delocalization test: organization must not be reducible by definition to independent pairwise relations.
4. Conformation test: organizational change can occur without composite identity change.
5. Composite-state test: determine when Ω_Q is genuinely a new state/possibility structure rather than merely notation for constituent combinations.
6. Creation/destruction test: model transformations that create or destroy composite identity while preserving some constituent identities.
7. Field compatibility test: ensure the model can admit distributed organization and does not require every composite structure to be object-like.
8. Constraint test: determine how O changes accessible constituent and composite variation.
9. Boundary test: determine whether composite identity supplies a principled boundary or whether boundary remains context-relative.
10. Level test: determine whether successful composite formation supplies a defensible instance of structural Level transition.

13.5 Specific theorem/countermodel opportunities

Only formulate these if the definitions become sufficiently precise:

- Non-sufficiency of inventory: identical constituent inventory does not entail identical composite identity.
- Non-sufficiency of aggregation: membership in a collection does not entail composite identity.
- Organization sensitivity: under specified identity criteria, changes in organization may be sufficient for composite identity change.
- Organization non-identity theorem/countermodel: organizational change need not imply identity change.
- Composite state-space criterion: conditions under which a composite supports states/transformations not representable merely as independent constituent state assignments.
- Structural transformation criterion: conditions under which formation of Q changes the relevant possibility structure from constituent spaces to a new composite space.
- Level-transition proposition: if warranted, identify conditions under which such structural transformation defines an ordering relation $L_n < L_{(n+1)}$.

13.6 Questions Model 2 must not answer prematurely

- Do not call composite formation Holism merely because a new organized bearer appears.
- Do not equate composite identity with a metaphysical Whole.
- Do not assume every organized collection forms a new Level.
- Do not assume Level is linear, scalar, or identical to complexity.
- Do not restore the progressive sphere geometry during model construction.
- Do not infer regulation, purpose, function, or self-maintenance from constraint-bearing organization.
- Do not assume the composite possibility space is irreducible in a strong metaphysical sense merely because it is useful or legitimate at the composite description.

13.7 Recommended sequence for the new session

11. Re-state Model 1 only to the extent needed to reuse Ω, accessibility, identity criterion, constraint, and structural transformation.
12. Define aggregation, participation/composition, organization, and candidate composite identity with minimal assumptions.
13. Construct the simplest aggregation countermodel.
14. Add organization and test H_2/H_2O-type composite formation conceptually without adding unnecessary chemistry.
15. Apply isomerism, delocalization, and conformation as adversarial countermodels.
16. Determine whether a new composite state/possibility structure is warranted and how it relates to constituent spaces.
17. Connect Model 2 to Model 1 through structural transformation.
18. Test whether the resulting relation supports a defensible concept of Level as structural ordering.
19. State exactly what Model 2 proves within its domain and what remains representational or empirical.
20. Decide whether a third model is needed before completing Pass 2—likely collective organization/constraint, polarity, or the emergent-to-formative pattern—or whether Models 1 and 2 already subsume enough of those cases.

13.8 Stopping rule for Model 2

Stop Model 2 when aggregation, composition, organization, composite identity, and composite state/possibility space have sufficiently precise relations to state: (a) what is necessary for a composite in the model; (b) what is not sufficient; (c) how the counterexamples revise the model; (d) whether composite formation is a structural transformation in the sense of Model 1; (e) whether any Level relation is warranted; and (f) what remains unresolved for later collective-order modeling and Pass 3.

14. Pass 3 Comparison Targets Preserved for Later

The following comparison targets should be preserved but not used to construct Model 2: Smuts's three strengths/senses of Holism; co-operation, co-ordination, regulation, and regulatory selection/deselection; the role of variation and time; past and future; and the relation between whole-formation and progressive structural organization. UPA legacy concepts to be tested later include Unity, Polarity, World, System, Level, Transformation, Mapping, Context, Recursion, spherical/geometric interpretations, and prior theorem claims.

The important methodological advantage is now clearer: Pass 3 will compare Smuts and UPA against an independently reconstructed architecture that already contains interaction, organization, variation, temporality, field, constraint, structural transformation, and a candidate structural interpretation of Level. Similarities can therefore be classified rather than assumed.

15. Source and Status Note

This paper is a continuation of Matter Reconstruction v0.1 — Pass 1 — Independent Conceptual Reconstruction. Scientific claims inherited from Pass 1 retain that paper's working-reference status. The present document is primarily a conceptual and formal reconstruction record, not yet a publication-ready literature review. A later publication pass should verify and attach primary or authoritative scientific citations to individual empirical claims.

Model 1 is intentionally minimal. Its symbols are representational devices. They do not establish that physical reality is fundamentally set-theoretic, discrete in time, object-based, deterministic, or exhausted by the variables used in the model.