Dialectical Wheels for Systems Optimization

Abstract

This paper introduces a novel, general-purpose method for systems optimization grounded in dialectical reasoning and circular causation. Each concept (T) is paired with a semantic antithesis (A), with positive and negative aspects (T^+, T^-, A^+, A^-) arranged such that the positive traits of one directly oppose the negative traits of its counterpart (e.g., T^+ vs A^-). These elements are mapped into a circular sequence, where diagonally opposed positions model long-range synergy, delayed compensation, and systemic blind spots. Applications across economics, engineering, conflict resolution, and natural systems suggest that greater dialectical complementarity correlates with stronger systemic constructiveness and self-regulation. It complements both participatory and expert-driven approaches by adding a unified semantic structure that connects meaning-making with systemic modeling.

Key words: Dialectical Reasoning, Circular Causation, Self-Regulation, Semantic Complementarity, Systems Optimization, Socio-Technical Systems

INTRODUCTION

What makes a system self-regulate—beyond what traditional systems science can explain? We argue that the missing ingredient is dialectical complementarity: a form of long-range, non-local interaction that complements circular causality by generating a kind of centripetal force. It is analogous to quantum entanglement and de Broglie waves in physics, resonance effects in chemistry, and Jung's acausal synchronicity in psychology (Jung, 1960).

Surprisingly, systems science still lacks a formal framework for such long-range effects. What is often labeled "rationality"—as seen in both game theory and chaos theory—functions only up to a bifurcation point, beyond which it collapses into reactive short-termism while overlooking deeper feedback mechanisms. This paper introduces that missing layer. Rooted in Hegelian dialectics (Hegel, 1807), our method formalizes how opposites interact through both latent tensions and circular causation. Using semantic reasoning supported by generative AI, we identify structural contradictions, blind spots, and hidden synthesis pathways—without the complexity of formal modeling found in systems dynamics or cybernetics.

DIALECTICAL FRAMEWORK

Types of Synthesis

Dialectical complementarity is a universal principle observed across physics, biology, and social systems (Kelso & Engstrøm, 2006). It resonates with both ancient and modern insights—from Taoist philosophy to thermodynamic theory—which suggest that systems evolve by expanding their functional dimensionality for more efficient energy dissipation (England, 2020). As a result, systems tend to resist abrupt, one-dimensional changes and instead favor gradual, multidimensional reorganization.

Yet dialectical reasoning requires also acknowledging its opposite: the mainstream tendency to optimize a single dominant dimension—typically through control and standardization. Accordingly, we distinguish between two types of synthesis:

- Negative synthesis increases intensity along specific axes while reducing overall diversity. It manifests as synchronization or standardization, where $1 + 1 < 2$. Examples include pendulums aligning their rhythms, or centralized rules that suppress variation.
- Positive synthesis expands dimensionality and fosters uniqueness, producing emergent qualities through complementarity, where $1 + 1 > 2$ (Csikszentmihalyi, 1990; Kauffman, 1993; Margulis, 1998; Kelso & Engstrøm, 2006). Consider the birth of a child from two parents, or binocular vision producing depth perception.

Both forms are necessary and mutually reinforcing. Negative synthesis enables focus and control; positive synthesis brings stability, meaning, and adaptability. Fig. 1 unites them into a simple scheme.

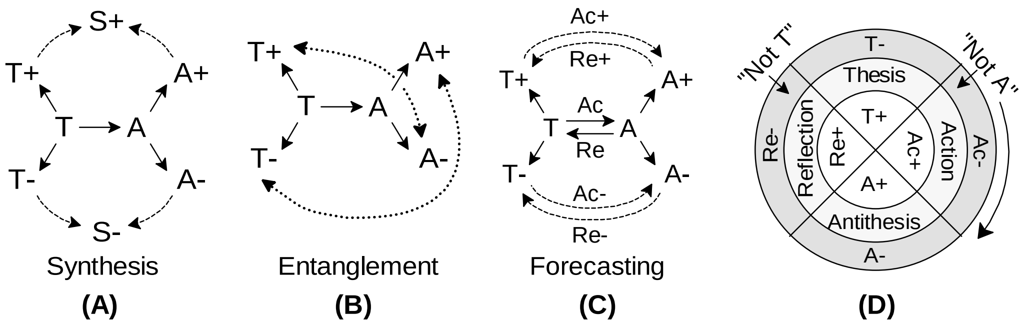


FIG. 1. (A) Synthesis between thesis and antithesis. (B) Diagonal “entanglements”. (C-D) Construction of dialectic wheel (detailed in Supplementary Material).

T denotes thesis or concept, A – antithesis or opposition. Each has positive (+) and negative (-) aspects. Positive aspects are subtle and constructive, open to the synthesis of new dimensions (S+), while negative forms are exaggerated and destructive, expanding certain dimensions at the expense of others (S-).

Dialectical Entanglement

A key concept here is the "diagonal entanglement" between oppositely signed components (Fig. 1B), that offers universal analytical value in system optimization. On the one hand, it determines the optimum complementarity and synthesis conditions, while on the other hand, it prohibits synthesis between diagonal elements (e.g., T+ and A-) as they are direct semantic contradictions. Consequently, oppositions unite only in like-signed phases, as exemplified in Table 1

Table 1. Examples of dialectical components

Components	**Emotions**	**Business**	**Mechanics**
T (Thesis)	Love	Sales & Marketing	Air-Fuel Intake
T+ (Goal)	Happiness	Sales, Revenue	Efficiency
T- (Risk)	Fixation, Obsession	Pushy Short-Termism	Clogging
A (Antithesis)	Hatred or Indifference	Customer Experience	Power Stroke

A+ (Obligation, Opposite to T-)	Independence, Autonomy	Caring, Deep User Understanding	Work
A- (Subseq. Risk, Opposite to T+)	Misery Unhappiness	Passivity, Unnecessary Expense	Blowby Jamming
S+ (Positive Synthesis)	Enlightened Growth	Value co-creation (Apple eco-system)	Optimal Combustion
S- (Negative Synthesis)	Toxic Attachment	Manipulative selling (Wells Fargo scandal)	Mechanical binding/ seizure

This table illustrates that each diagonal pair (T^+ vs A^-, T^- vs A^+) represents direct contradictions that cannot logically coexist, let alone synthesize. Yet these oppositions are entangled—much like quantum particles—such that a change in one element induces reciprocal changes in the others.

This reflects the principle of dialectical neutrality, which states that positive and negative aspects of any concept are intrinsically balanced, regardless of subjective perception. Thus, emphasizing an attractive trait (e.g., T^+) automatically implies a latent risk (T^-) due to the danger of exaggeration. At the same time, the antithetical pair (A^+, A^-) must adjust accordingly, since they are semantically opposed to the original pair. The result is a 4-way entanglement, where modifying any one component affects the entire structure.

This logic parallels physical laws: the conservation of energy (kinetic vs. potential), Newton's third law (action and reaction), and Noether's theorem, which links symmetry to conservation principles.

From this, we derive universal criteria for fairness and constructiveness:

- Fairness: equal weight is given to all dialectical components.
- Bias: disproportionate emphasis on one side of the dialectical system.
- Constructiveness: fostering synthesis (S^+) by embracing the positive side of opposition (A^+).

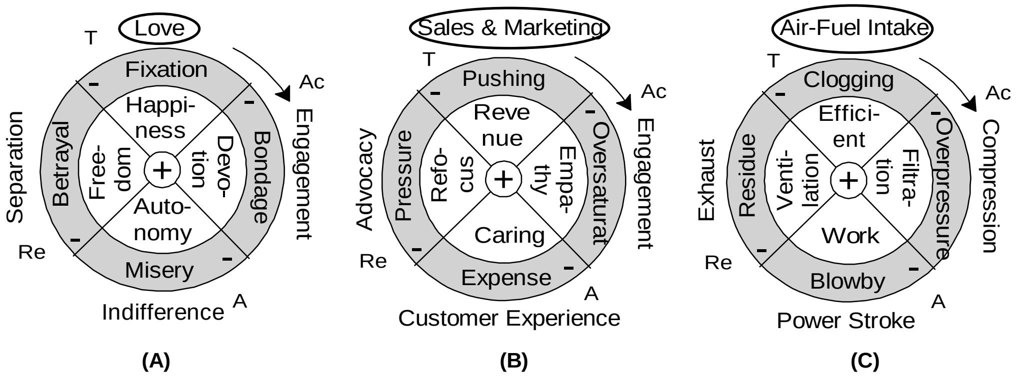
- Destructiveness: triggering collapse (S^-) by reinforcing exaggerated oppositions (A^-).

These principles apply equally to social, natural, and mechanical systems.

Because dialectical neutrality is universal, it allows us to optimize any system where positive and negative aspects can be identified. At minimum, the rule is simple: A^+ should directly oppose T^-, and A^- should oppose T^+. Additional semantic verification rules are described in the Supplementary Material.

Simplest Dialectic Wheels

Schemes C and D in Fig. 1 illustrate practical synthesis paths by introducing intermediate stages between Thesis (T) and Antithesis (A): Action (Ac) and Reflection (Re). These components follow the same relational rules as T and A—for example, Ac^+ opposes Re^-, and Ac^- opposes Re^+. Additionally, they must satisfy evolutionary or transformative roles. For instance, Ac^+ is not only the positive side of Action and the opposition of Re^- - it must also be capable of transforming T into A^+. Similar functional conditions apply symmetrically to the remaining components. As a result, the center of the wheel forms a self-regulating core—the "fifth element"—while the outskirts represent maladaptive loops and negative syntheses (S^-). Fig. 2 demonstrates this for abovementioned examples.



(A) (B) (C)

Fig. 2

Scheme A shows that Happiness and Autonomy arise through Devotion and Freedom, while Fixation and Misery emerge from Bondage and Betrayal. Scheme B – that Revenue and Customer Care are sustained through Empathy and Refocusing, but deteriorate into Pushiness and Expense under Oversaturation and Pressure. And scheme C - that *Efficient Work* requires *Filtration* and *Ventilation*, whereas *Clogging* and *Blowby* result from *Overpressure* and *Residue*.

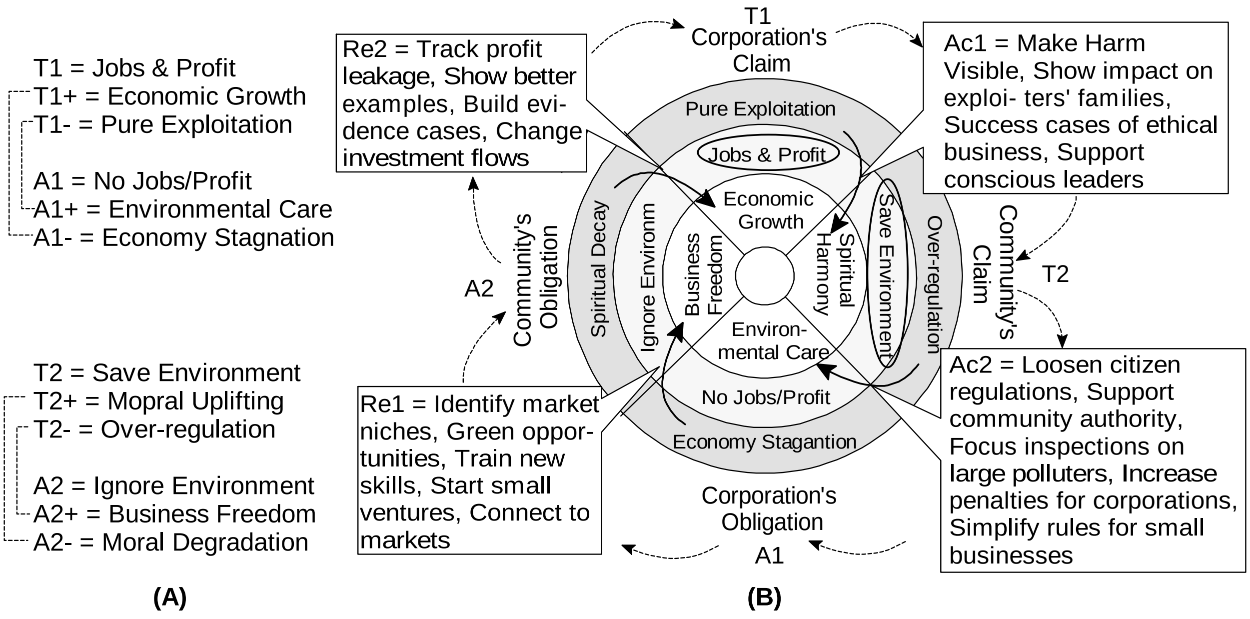
Real Life Example

Consider a conflict between global corporation (T1) and local community (T2) with the following claims:

T1 (Corporation): "We bring jobs and prosperity through legal resource extraction. Environmental concerns are exaggerated."

T2 (Local Community/Advocates): "They destroy our land and water. Their compliance claims hide systematic violations."

Fig. 3 shows the resolution path.



T1 = Jobs & Profit
T1+ = Economic Growth
T1- = Pure Exploitation

A1 = No Jobs/Profit
A1+ = Environmental Care
A1- = Economy Stagnation

T2 = Save Environment
T2+ = Mopral Uplifting
T2- = Over-regulation

A2 = Ignore Environment
A2+ = Business Freedom
A2- = Moral Degradation

Re2 = Track profit leakage, Show better examples, Build evidence cases, Change investment flows

Ac1 = Make Harm Visible, Show impact on exploi- ters' families, Success cases of ethical business, Support conscious leaders

Re1 = Identify market niches, Green opportunities, Train new skills, Start small ventures, Connect to markets

Ac2 = Loosen citizen regulations, Support community authority, Focus inspections on large polluters, Increase penalties for corporations, Simplify rules for small businesses

Fig. 3

Scheme A converts the original statements into antithetical domains. Scheme B arranges all domains into dialectical wheel, and suggests resolution steps Ac1, Ac2, Re1, Re2, each converting negative aspects of previous step to positive ones in the subsequent step. This creates an iterative procedure spiraling toward the wheel's center:

Positive synthesis (S+) yields Sustainable Development Partnership that integrates economic growth with environmental stewardship, combining moral responsibility with business autonomy. Corporate operations benefit local communities through transparent monitoring, accountability mechanisms, and business models treating environmental protection as opportunity rather than cost. This empowers communities as resource management stakeholders, producing outcomes exceeding what either side could achieve independently ($1 + 1 > 2$).

Conversely, disobeying these transformations or attempting them in reverse order results in Negative synthesis (S-): Deadlocked Deterioration merging corporate exploitation with counterproductive regulations and economic paralysis with ethical compromises. This creates a system achieving neither economic nor environmental goals, wasting resources on legal conflicts rather than solutions. The resulting mutual distrust prevents collaborative problem-solving, producing worse outcomes than either side would achieve separately ($1 + 1 < 2$) and standardizing an adversarial relationship that blocks innovation.

In essence: The method converts "impossible situations" into manageable, step-by-step transformation processes with clear actions for all parties. Supplementary Material provides more of similar examples.

Complex Systems: Deeper Synergy Mechanisms

Up to this point, we have examined simple systems constructed from just one or two initial statements. In contrast, most real-world systems involve multiple interacting components, potentially revealing deeper synergy mechanisms—illustrated in Fig. 4

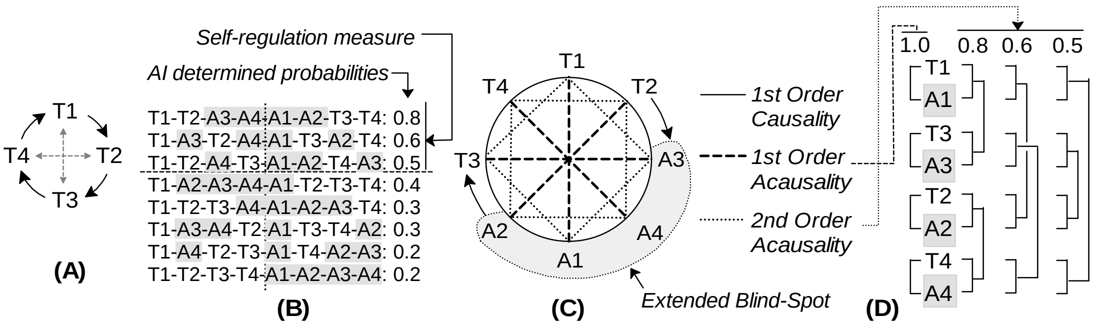


Fig. 4

Scheme A represents a 4-step cycle in which diagonally opposed elements (T1–T3 and T2–T4) reflect conceptual oppositions—analogous to the four classical elements. For each thesis (T), an antithetical domain (A) is generated as described earlier, and positioned diagonally opposite its original T. This layout ensures that the most dissimilar concepts are placed furthest apart, while the most similar remain adjacent—preserving semantic gradients, as illustrated in Schemes B and C. Importantly, each sequence preserves the original T1–T2–T3–T4 order, with each antithesis (A) placed exactly four steps away from its respective thesis (T).

These constraints significantly reduce the number of possible sequences. Scheme B lists all such cases, with exemplary feasibility probabilities estimated by AI (from 0 to 1). The dotted vertical line separates the first half of each sequence—which includes a specific combination of T and A elements—from the second half, which retains the same order but substitutes each item with its semantic antithesis.

The dashed horizontal line highlights the sequences with sufficiently high feasibility (≥0.5). These indicate the system's degree of self-regulatory capacity. A minimally self-regulating system would support only one or no practically feasible sequences, while a highly self-regulating system could support all eight. This logic draws from the synchronization of oscillators (Strogatz, 2003), cooperative interdependence in complex networks (Barabási, 2016), and the holographic interconnectedness of systemic elements (Bohm, 1980; Kauffman, 1993). In such systems, causal sequences become interchangeable, each with comparably high probability. however, if some cooperative pathways are blocked, certain sequences will become unlikely.

Scheme C illustrates the three forces that support homeostasis: direct causality (shown as a continuous circular line), diagonal complementarity—the first-order acausality (bold dashed lines), and quadrilateral complementarity—a second-order acausality that combines two orthogonal diagonals (dotted lines). The latter emerges from a key condition: for one diagonal to yield synthesis, its orthogonal counterpart must also do so. This interdependence is evident in Figures 2–3, where the unification of any T–A or Ac–Re pair requires the simultaneous unification of a second pair. This dual entanglement gives rise to the fifth element—a self-regulating force that serves as the hidden leverage point in more complex configurations. Regardless of how many intermediate steps are introduced, the system's capacity for cooperation ultimately depends on the preservation of orthogonal symmetry.

Scheme D shows these leverage mechanisms, annotated with the probabilities drawn from the most feasible sequences in Scheme B. In this specific case, the strongest entanglement occurs between the T1–A1 and T3–A3 pairs on one axis, and T2–A2 and T4–A4 on the other. For example, T1 is primarily influenced by A1 (first-order acausality), and secondarily by the T3–A3 pair (second-order acausality). These indirect pathways often produce greater cumulative effects than direct causal interventions—and they tend to be softer, more adaptive, and ultimately more humane.

Scheme D shows these leverage mechanisms with probabilities drawn from the most feasible sequences in Scheme B. In this particular case, the highest entanglement is between T1-A1 and T3-A3 pairs in one quadrant, and T2-A2 and T4-A4 in another. For example, T1 is primarily influenced by A1 (first-order acausality), and secondarily by the T3–A3 pair (second-order acausality). These indirect pathways often produce greater cumulative effects than direct causal interventions—and they tend to be softer, more adaptive, and ultimately more humane.

The bottom part of Scheme C shows all antithetical domains (A1–A4) grouped in a continuous shaded region between T2 and T3. This zone represents the system's main blind spot, where unresolved tensions and opportunities for innovation tend to cluster. Such blind spots exist in all systems, though in some cases, they may be distributed across multiple smaller regions.

METHODOLOGICAL APPROACH

The following steps were applied to each system, using GPT-4o or Claude 3.7 Sonnet.

First, we begin by selecting four core components of the system and arranging them into a natural causal loop (T1 → T2 → T3 → T4). T1 should conceptually oppose T3, and T2 should oppose T4—ensuring that the starting set captures the system's fundamental tensions. If these oppositions are absent, it likely means the selected components are not the primary structural elements.

Second, we analyze each component to identify its antithetical domain (A), along with the positive and negative aspects of both thesis (T) and antithesis (A). These are structured such that the positive aspect of one opposes the negative aspect of the other (i.e., T^+ vs A^- and T^- vs A^+). The positive side is defined as balanced, constructive, and subtle—representing the system's inherent goal. The negative side is defined as exaggerated, destructive, and distorted—representing an inherent risk (e.g., *Bravery – Foolhardiness*, *Pensiveness – Sadness*, *Love – Obsession*). Additional examples and criteria are provided in the Supplementary Material.

Third, we iteratively match each domain with real-world elements most likely to embody them. This process continues until both T and A correspond to recognizable concepts or phenomena. For each pair of oppositions, we determine the qualitative changes (S^+) and quantitative "bottom limits" (S^-) as guidance paths. S^+ represents the ideological or aspirational aspect – what we really want, while S^- denotes what we don't want.

Fourth, we estimate the feasibility of various causal sequences that preserve both the original causal chain (T1 → T2 → T3 → T4) and the diagonal entanglements with their corresponding antithetical domains, as illustrated in Fig. 4(B). All feasibility scores were generated using Claude 3.7 Sonnet.

Fifth (optional): When transitions between adjacent domains are not self-evident, we generate transitional recommendations—suggesting how to transform the negative aspect of one step into the positive aspect of the next. This step is especially relevant in conflict resolution contexts, where the synthesis pathway must be explicitly facilitated.

The optimization process is inherently iterative, alternating between dialectical framing and non-dialectical exploration, until arriving at the practically useful conclusions.

EXAMPLES OF RESULTS

The following cases illustrate application across diverse systems. Except for the first, we present only final outputs; full analysis and diagrams are available in the Supplementary Material.

Economic Cycle

Table 2 provides dialectical analysis for the following steps: Policy Planning (T1) – Implementation (T2) – Market Response (T3) – Adaptation (T4).

Table 2. Dialectical Analysis of Economic Cycle

	Steps (T1, T2)	**Blindspots (A1, A2)**	**Steps (T3, T4)**	**Blindspots (A3, A4)**
Step	T1 = Policy Planning	A1 = Emergent Behavior	T3 = Market Response	A3 = Control Framework
Goals Risks	T1+ = Foresight T1- = Detachment	A1+ = Natural Flow A1- = Market Failures	T3+ = Innovation T3- = Volatility	A3+ = Stability A3- = Stagnation
Owner	Congress, Think Tanks	Large Banks, Investment Funds, Multinat. Corporat.	Small/medium enterprises, consumers	Ministries, Regulatory Agencies, Admin. Bodies
Syn-thesis	S+ = Democratic Capitalism (Nordic dream) S- = Corporate Feudalism (gilded age USA)		S+ = Citizen-Powered Regulation (Swiss dream) S- = Administrative Suffocation (like in Venezuella)	
Step	T2 = Implementation	A2 = Experimentation	T4 = Adaptation	A4 = Subordination
Goals Risks	T2+ = Execution T2- = Overregulation	A2+ = Learning A2- = Inefficiency	T4+ = Flexibility T4- = Inconsistence	A4+ = Consistency A4- = Rigidity
Owner	Government Action, Policy Execution	Cenntral Bank, Econom. Council, Fin. Regulat.	Lobbyists, Prof. Networks, Unions	Taxation, Linecsing, Compliance
Syn-thesis	S+ = Dynamic Governance (Estonian dream) S- = Mechanical Bureaucracy (Soviet Union)		S+ = Intelligent Accountability (New Zeland dream) S- = Autoritarian Standardization (North Korea)	

In the table, diagonal arrows between T and A indicate dialectical entanglements (e.g., T^+ vs. A^-). This helps identify domain "owners"—the institutions or actors that typically embody each polarity. The synthesis outcomes (S^+ and S^-) support early-stage diagnostics by anticipating either constructive or regressive developments.

Figure 5 visualizes this analysis in three parts.

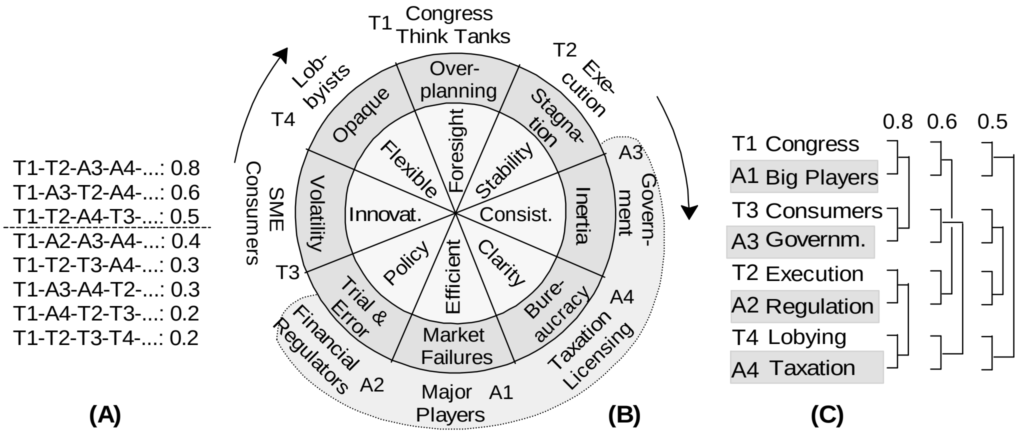


Fig. 5

Scheme A presents the estimated feasibility of regulatory sequences (first halves shown; second halves are their antitheses). Only 3 out of 8 exceed the threshold—suggesting weak self-regulation.

Scheme B highlights the optimal causal pathway, revealing a major blind spot between Policy Execution (T2) and SME/Consumer Response (T3)—a crucial leverage point for policy intervention. This structure may shift if the initial T1–T4 definitions are changed.

Scheme C identifies leverage mechanisms: T1–A1 (Congress vs. Major Players) is bound with T3–A3 (Consumers vs. Government), reflecting familiar effects like regulatory capture and policy lag (Stigler, 1971; Lindblom, 1959). T2–A2 (Execution vs. Regulators) is entangled with T4–A4 (Lobbying vs. Taxation), showing the push–pull between enforcement and influence—well documented in institutional economic theory (North, 1990).

These results align with traditional views while potentially revealing new effects through longer-range causal structures (cf. Arthur, 1999).

Business Cycle

Figure 6 analyzes the cycle: Vision (T1) → Plan (T2) → Execution (T3) → Adjustment (T4). (Full analysis is provided in the Supplementary Material.)

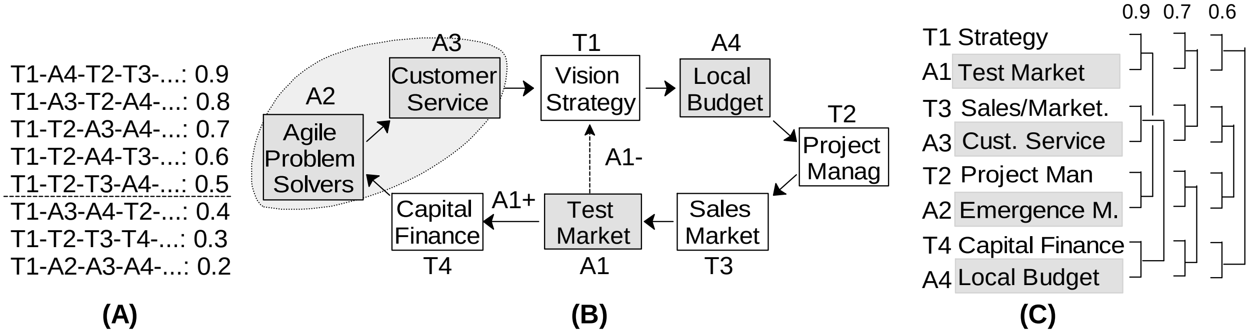


Fig. 6

Scheme A shows that 5 out of 8 sequences exceed the 0.5 probability threshold—indicating a strong homeostatic capacity, provided the organization can align around one of these optimal sequences.

Scheme B shows the optimal sequence. The strategic vision (T1) is tested through a localized budget (A4), which funds execution (T2) and market entry (T3). Market response (A1) reveals feasibility ($A1^{+}$) or exposes short-termism ($A1^{-}$). If negative, the cycle loops back to revise the strategy (T1). If positive, capital (T4) should support not traditional project structures (T2), but agile problem-solving teams (A2), shifting focus toward customer service (A3) rather than extended marketing (T3). This enables value to grow through resonance and trust rather than persuasion.

Scheme B shows the optimum causality. The strategic vision (T1) is tested through a localized budget (A4), used to create a product or service (T2), which is then introduced to the market (T3). Market response (A1) reveals either operational feasibility (A1+) or short-termism (A1-). If the outcome is negative, the vision must be revised (loop back to T1). If the outcome is positive, capital finance (T4) should be directed not to traditional project management (T2), but to its complement: agile problem-solving teams (A2).

This dynamic reflects patterns of disruptive innovation (e.g., early Facebook), where value emerges not through capital-pushed marketing but through ecosystem alignment and feedback. Over-reliance on mass marketing may yield shallow wins and unstable models.

Notably, the largest blind spot lies between Capital Finance (T4) and Vision (T1)—the innovation inflection point where reframing or leapfrogging occurs.

Scheme C highlights entanglements: Strategy and Market Testing (T1–A1) are entangled with Sales and Customer Service (T3–A3), while Execution and Adaptability (T2–A2) are entangled with Capital and Budgeting (T4–A4). These feedback loops align closely with principles from agile management and dynamic capabilities theory (e.g., Teece, 2007), though their expression may vary by business context.

4-Stroke Engine

Figure 7 analyzes the following cycle: T1 = Fuel Intake, T2 = Compression, T3 = Combustion, T4 = Exhaust.

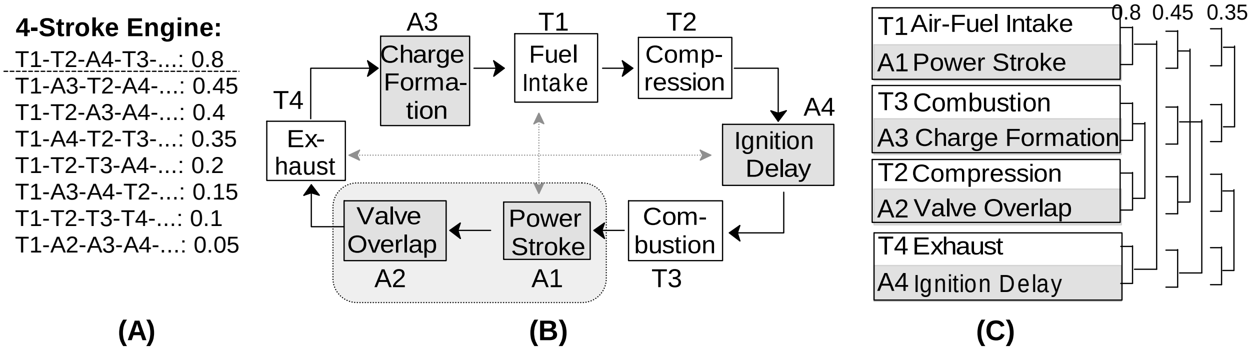


Fig. 7

Scheme A shows only one valid path, suggesting extremely limited self-regulatory capacity. Scheme B highlights this sequence. The antithetical domains are distributed fairly evenly, with a notable two-step blind spot between T3 (Combustion) and T4 (Exhaust)—a key zone for performance tuning.

Scheme C identifies key leverage points: T1–A1 (Fuel Intake / Power Stroke) is entangled with T4–A4 (Exhaust / Ignition Delay), while T2–A2 (Compression / Valve Overlap) is entangled with T3–A3 (Combustion / Charge Formation). These couplings reflect known interdependencies in combustion timing and airflow dynamics—areas long studied in mechanical engineering optimization (Heywood, 1988).

Photosynthesis

Fig. 9 analyzes the following stages: T1 = Light Absorption, T2 = Water Splitting, T3 = Carbon Fixation, T4 = Glucose Synthesis.

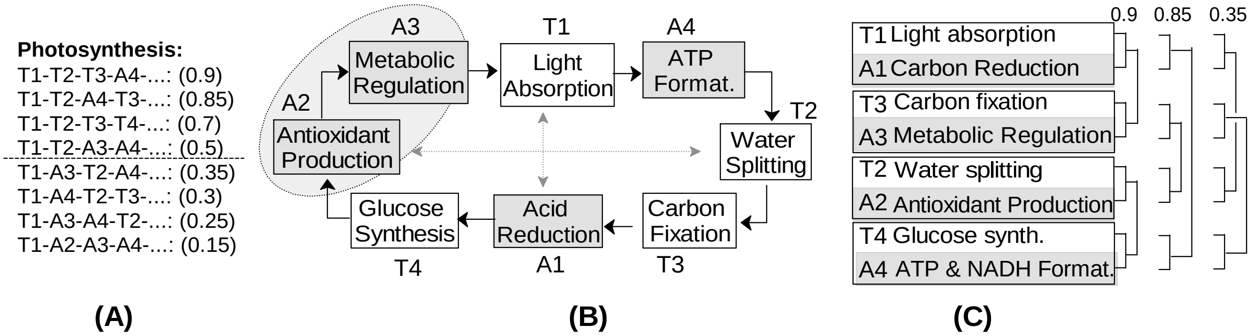


Fig. 9

Scheme A shows four out of eight sequences scoring ≥ 0.5, indicating moderate self-regulatory capacity. However, for such a highly evolved and fundamental process as photosynthesis, one might expect full homeostatic potential—i.e., all sequences to be feasible. This discrepancy most likely reflects incomplete AI knowledge of biochemical pathways, rather than any deficiency in the natural system itself.

Scheme B presents the most likely sequence, while Scheme C highlights entanglement zones. The low entanglement between T1–A1 and T2–A2 likely reflects AI's limited knowledge of compensatory mechanisms such as water-splitting and oxidative stress. The weak linkage between T3–A3 and T4–A4 may point to an underrepresentation of downstream metabolic feedback—like ATP or glucose levels—affecting upstream carbon fixation.

Psychology / DISC Character Traits

Fig. 10 analyzes the classic DISC sequence: T1 = Influence, T2 = Dominance, T3 = Conscientiousness, T4 = Steadiness. The flow from assertive traits (T1, T2) to methodical traits (T3, T4) creates a natural leadership-to-implementation arc.

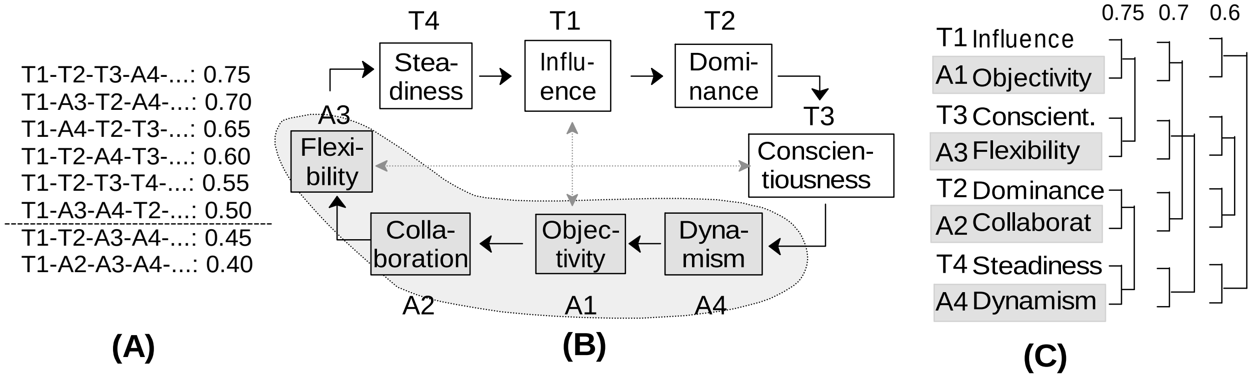


Fig. 10

Scheme A shows that six of eight sequences score ≥ 0.5, with the remaining two not far behind—indicating the highest self-regulatory capacity observed in this study. Scheme B reveals the most probable cycle, with all antithetical domains clustered between T3 and T4. This suggests that methodological traits may host the highest internal variability—an area worth deeper attention, especially when analyzing personality differences among individuals or teams with similar DISC profiles.

Scheme C shows two dominant entanglements: Influence/Objectivity (T1–A1) links with Conscientiousness/Flexibility (T3–A3), while Dominance/Collaboration (T2–A2) aligns with Steadiness/Dynamism (T4–A4). In other words, those who are "Conscientiously Flexible" tend to be both influential and grounded, while "Steadily Dynamic" individuals balance assertiveness with cooperative execution. These couplings, however, may shift easily—given the closeness of competing sequence probabilities.

Political Conflict

Consider the conflict between Israel and Palestine. We use the following four key positions (not necessarily in optimal order) as initial theses:

Israeli Claims:

T1: Israel must exist as the national home for the Jewish people.

T2: Israel requires robust security measures to protect its population.

Palestinian Claims:

T3: Palestinians must have their own independent sovereign state.

T4: Palestinian refugees should be allowed to return to their ancestral homes.

Non-dialectical AI suggested using international peacekeepers, humanitarian corridors, and phased implementation with international guarantees. Yet, this approach has been attempted multiple times, and repeatedly failed because it relies on external actors and top-down implementation. The dialectical approach (Fig. 11) aims to structure bottom-up complementarity instead.

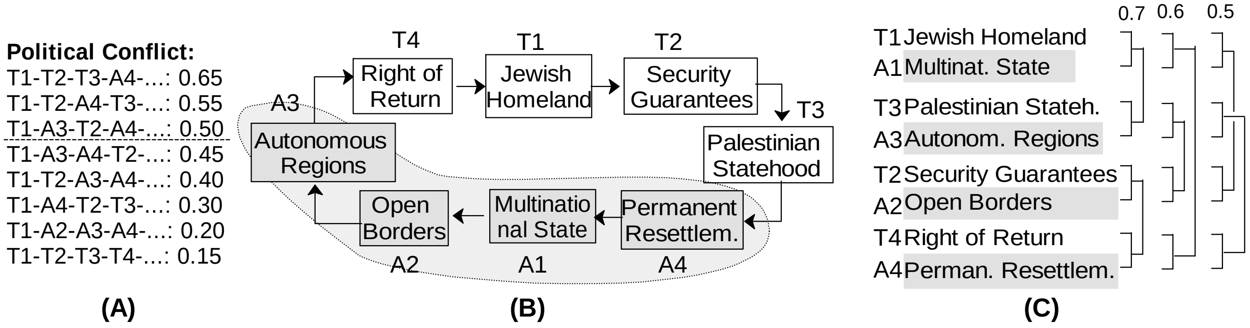


Fig. 11

Scheme A shows moderately high feasibility across multiple sequences, indicating latent potential for systemic resolution. These values might be improved by reordering the initial claims into a more balanced configuration. Scheme B shows the best sequence for the given T1-T4 arrangement. It moves from Israeli security concerns (T1, T2) to Palestinian statehood (T3), then pivots to refugee resettlement (A4) rather than full return (T4). It then moves through multinational state concepts (A11) and open borders (A12) before addressing historical justice. The compromise positions are interspersed with traditional positions.

All blind spots occur between T3 (Palestinian Statehood) and T4 (Right of Return), perhaps due to the fact that both of Israeli claims were placed as the two starting points.

Scheme C reveals two key entanglement pairs. T1–A1 (Jewish Homeland vs. Multinational State) and T3–A3 (Palestinian Statehood vs. Autonomy) reflect identity–sovereignty trade-offs. T2–A2 (Security vs. Open Borders) and T4–A4 (Right of Return vs. Resettlement) capture the tension between national protection and human mobility.

The Supplementary Material outlines recommended action pathways, similar to successful post-conflict resolution cases in Northern Ireland and South Africa.

Global Problematique

Fig. 12 represents analysis of the following cycle: T1 = Inadequate Education, T2 = Lack of Understanding, T3 = Manipulation, T4 = Inadequate Participation. This cycle was obtained by the virtual Structured Dialogic Design (SDD) applied to the climate crisis problematique (Petrauskas, Diedrich, & Christakis, 2025).

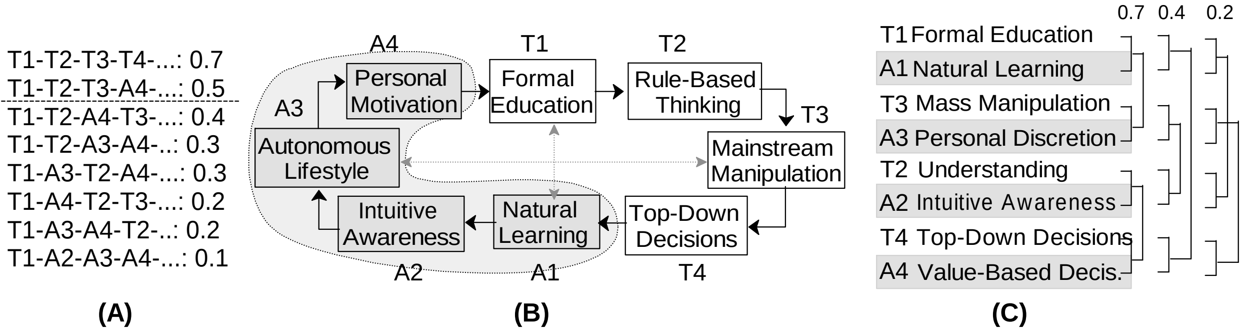


Fig. 12

Scheme A shows distribution of probabilities commensurate to those from the Israeli-Palestinian Conflict. Only 2 sequences show acceptable values, indicating high vulnerability to external factors.

Scheme B shows that all blind-spots are located between the Top-Down Decisions (T4) and Formal Education (T1), clearly indicating that the root cause of humankind’s problematique lays in the biased views of the top decision-makers and socio-political governance.

Scheme C identifies the strongest entanglements between the Learning/Education (T1-A1) and Information Perception (T3-A3) on one hand, and between type of thinking (T2-A2) and decision-making (T4-A4) on another hand. This implies for instance, that mass media (T3) is most sensitive to the level of economic autonomy (A3) and thought independence of population (T1-A1), while political decisions (T4) are most sensitive to value system (A4) and the balance between common sense (A2) and indoctrination (T2).

DISCUSSION

Constructive Self-Regulation

A central insight of this study is that dialectical complementarity, combined with circular causality, forms the structural basis of synergy, self-regulation, and emergent behavior in any complex systems. As shown in Table 3, a system's self-regulatory capacity can be estimated by the number of causal sequences with ≥0.5 feasibility probability (No ≥0.5) and the average feasibility of the remaining sequences (Avg <0.5). The analyzed systems are arranged in decreasing order of constructive self-regulatory potential, revealing a consistent correlation between these indicators.

Table 3.

Cycle	**No ≥0.5**	**Avg <0.5**	**No of People**	**2^{nd} Order Entanglement**	**LBS**
DISC Traits*	6	0.43	1	1-3~1-2>1-4	4
Organization's optimization (1)**	6	0.43	Dozens - hundreds	1-2~1-3>1-4	4
Viral Business*	5	0.30	Hundreds - thousands	1-2>1-3>1-4	2+1+1
Self-Driving Vehicle (SDV)*	4	0.32	-	1-3>1-4>1-2	4
Organization's optimization (2)**	4	0.25	Dozens - hundreds	1-2>1-3>1-4	2+1+1
Photosynthesis*	4	0.26	-	1-3~1-4	2+1+1
Economy*	3	0.28	Millions	1-3>1-2>1-4	4
Political Conflict*	3	0.25	Millions	1-3>1-4>1-2	4
Global Problematique*	2	0.25	Billions	1-3	4

4-Stroke Engine*	1	0.24	-	1-4	2+1+1

*Additional mdetails in Supplementary Material. **Available from author.

In human-centric systems, lower constructive self-regulatory capacity generally corresponds to greater difficulty in resolving problems. This difficulty tends to increase with the number of people involved. However, the two key indicators — number of causal sequences with ≥0.5 feasibility (No ≥0.5) and the average feasibility of the remaining sequences (Avg <0.5) — depend on both the specific AI model and the context, and should thus be treated as approximate rather than absolute.

Mechanical systems (e.g., the SDV and 4-stroke engine) and natural systems (e.g., photosynthesis) show interesting deviations. One might expect mechanical systems to exhibit minimal self-regulation and natural systems to show high regulatory capability. Yet, the SDV scores higher than expected — likely due to AI's broad potential to integrate sensor feedback, prediction, and control. Conversely, photosynthesis ranks lower than anticipated, likely because current AI only considers mainstream biochemical models, while unmodeled phenomena should increase its regulatory potential (No ≥0.5) to the maximum value (from 4 to 8).

Across systems, the most frequent second-order entanglements (with ≥0.5 feasibility) occurred between steps 1-3 and 1-2, indicating early-stage tensions between vision and implementation. The 1-4 loop, by contrast, dominated in mechanical systems like the engine — suggesting a strong causality link between intake and exhaust.

The final column summarizes blind-spot clustering using the "Length of Blind-Spots" (LBS) metric. In most systems, LBS = 4, indicating that blind spots are densely clustered. In a few cases, blind spots were split across domains (e.g., 2+1+1), suggesting differentiated bottlenecks that may require more nuanced interventions.

Complementarity with Other Methods

DW can enhance other systems approaches by adding semantic structure, ethical depth, and synthesis logic (Table 4)

Table 4. Complementarity with other methods

Method	**Type**	**Core Focus**	**Relevance to DW**	**Complementarity with DW**
SDD (Structured Dialogic Design)	Soft / Facilitator	Structured dialogue and stakeholder mapping	Closest in spirit — dialogic, conceptual	DW reveals hidden blind spots and supports deeper iteration
Soft Systems Methodology (SSM)	Soft / Facilitator	Pluralistic worldview structuring and transformation	Most abstract; shares interpretive depth	DW maps tensions and pathways for synthesis across views
TRIZ (Theory of Inventive Problem Solving)	Hard / Expert	Contradiction resolution in technical & business innovation	Structurally distinct but shares tension-resolution logic	DW adds ethical, systemic layers to TRIZ solution templates
System Dynamics (SD)	Hard / Expert	Modeling feedback loops and causal structures	Behavior-focused; links well with DW's sequence logic	DW uncovers semantic contradictions and reframes goals

All methods are subdivided into *soft* (facilitator-driven) and *hard* (expert-driven), while DW can integrate both worlds. It supports structured facilitation (as in SDD and SSM) with deep semantic scaffolding, and enriches formal expert tools (like TRIZ and SD) with ethical framing and dialectical synthesis. As such, DW serves as a semantic bridge across methodological cultures.

SDD and DW have already demonstrated practical synergy: SDD structures stakeholder dialogue, while DW surfaces blind spots and identifies leverage paths—enabling iterative co-evolution of shared meaning. A similar integration seems promising with **SSM**, where DW can support pluralistic worldview modeling by mapping structural tensions and synthesis opportunities across perspectives.

In contrast, **TRIZ** focuses on resolving localized contradictions using predefined solution templates. DW complements this by offering a systemic lens for long-range, cross-domain effects. While TRIZ identifies “what works now,” DW reveals “what this might require or produce later.” This opens the door to new TRIZ-style tools—tables of potential *delayed consequences*, *long-range compensations*, or *latent synthesis scenarios* based on dialectical entanglement. However, these remain theoretical proposals; it is yet to be seen how such integration could evolve in practice.

System Dynamics (SD) models feedback behavior in closed-loop systems, usually from a technical perspective. DW extends this by introducing blind-spot detection and ethical tensions, suggesting synthesis pathways that transcend the visible loop logic. Like with TRIZ, the integration with SD remains conceptual—pointing to a possible philosophical complementarity rather than a fully realized technical merger.

Broader Implications

Dialectical complementarity is not just a systems modeling tool—it suggests a deeper logic by which reality itself may be structured. In contrast to mainstream paradigms grounded in linear causality, fixed hierarchies, or first principles, DW points to a world driven by delayed compensation, mutual transformation, and co-evolving oppositions.

This shift challenges the traditional academic obsession with certainty, control, and quantification. In a dialectical worldview, contradictions are not errors to resolve, but tensions to engage—where every “truth” eventually meets its limit and must be synthesized with its antithesis. This changes how we interpret good and bad, success and failure, even right and wrong.

Just as complex numbers expanded the scope of mathematics, dialectical reasoning expands how we think. It reveals that balance is not stasis but dynamic coordination across conflicting dimensions—where meaning emerges not from simplification, but from integration. This echoes insights from Taoist philosophy, where opposites give rise to one another and true harmony is found not in dominance, but in complementarity. Embracing this mindset calls for a new intellectual ethic: one that values ambiguity, honors opposition, and sees wisdom not in certainty, but in the ability to evolve through tension.

CONCLUSION

The Dialectical Wheels (DW) introduce a novel way of viewing systems—not as static mechanisms to be controlled, but as living structures governed by semantic complementarity. Optimization becomes a process of nurturing: iteratively revealing blind spots, rebalancing tensions, and fostering self-regulation.

What makes DW fundamentally distinct from other methods is its:

1. Cross-Domain Generality – applicable across technical, human, and natural systems, standing above domain-specific logic.
2. Unified Ethical–Causal Reasoning – embedding fairness, meaning, and long-term viability into system design.
3. Self-Regulation Diagnostics – quantifies resolution potential in human systems and knowledge gaps in non-human systems via feasible causal paths and entanglements.
4. Semantic Iteration – adapts and refines itself through recursive loops, co-evolving with AI or dialogic processes like SDD.

These features enable DW to act as a semantic architecture—connecting analysis, ethics, and innovation.

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