

Three Chains Theory: A General Analysis of Sustainable Development in Human Society¹

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The evolution of human societal systems rarely manifests qualitative leaps or revolutionary transformations. More commonly observed are subtle, cumulative evolutionary processes characterized by smooth transitions of incremental developments. Such evolutionary trajectories can generally be described through quantitative change patterns within societal systems. Yet, what constitutes sustainable development in human society? How might sustainable development be articulated or operationalized? The Three Chains Theory under the framework of System Exchange Theory provides a preliminary exploration and analysis of these questions, offering tentative interpretations.

Keywords: social systems, System Exchange, sustainable development, chain-domain thinking space, Three Chains Theory

Before commencing a general analysis of the Three Chains Theory, it is imperative to first address new quality productivity and establish a foundational understanding of System Exchange Theory.

On New Quality Productivity

What is New Quality Productivity? The concepts of "productivity" and "new productivity" are familiar to us. As widely recognized, "Productivity refers to the capacity of humans to produce material goods, reflecting their ability to transform and harness nature, and encapsulating the relationship between humanity and the natural world." (Ma, 1999, p. 17). Building on this definition, "new productivity" naturally denotes advancements relative to older or preceding forms of productivity. Extending this logic, the critical interpretation of "new quality productivity" lies in its "quality"—specifically, an analysis of its qualitative dimension. New quality productivity, therefore, refers to transformative productive forces that drive epochal shifts in human society, such as the proliferation of land cultivation techniques, the invention of steam engines, the application of electrical technologies, and the internet revolution. These represent the new quality productivity of their respective eras.

Within the framework of System Exchange Theory, productivity is conceptualized as an economic chain, and new quality productivity corresponds to novel economic chains. Traditional economics views economic exchange chains as modes of production. However, under System Exchange Theory, an economic exchange chain encompasses both productive forces and relations of production. Their interaction and emergent properties enable system-to-system linkages, forming economic (exchange) chains.

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¹ System Exchange Theory often analyzes the evolution of political, economic, and cultural domains in human society as political, economic, and cultural chains, thereby forming the Three Chains Theory.

Human modes of production have evolved through distinct phases:

- Primitive Civilization era: Foraging and fishing;
- Agrarian Civilization era: Land-based grain production;
- Industrial Civilization era: Machine- or energy-driven production;
- Contemporary era: Evolving internet and AI-driven production.

These modes exhibit an iterative relationship, where each subsequent mode replaces its predecessor. Conceptually, the productive forces emerging from this iterative process—relative to prior modes—constitute new quality productivity.

Systemism: The System Exchange Theory²

System Exchange Theory is a systemic framework developed through in-depth exploration of exchange—and exchange chains—as its core conceptual apparatus. The theory posits that exchange constitutes the essence of systems, with six fundamental quantum elements underpinning all exchanges: matter, energy, information, time, space, and consciousness. It asserts a fragmented worldview, arguing that while materialism investigates material motion as its primary focus, systemism centers on analyzing exchange relationships among systemic elements.

Systemic Redefinition

Building on Bertalanffy's classic definition of a system as "a complex of interacting elements", we propose substituting "interacting" with "exchanging" (Von Bertalanffy, 1987, p. 51). This yields: "A system is a complex of elements in mutual exchange (elements: matter, energy, information, time, space, and consciousness)." (Yuan, 2021, p. 2).

Further, by centering the concept of exchange, we refine a more concrete systemic definition:

A system generally engages in multiple exchange chains with its external environment, among which at least one serves as the primary exchange chain within a specific spacetime. This primary exchange chain constrains and influences all other chains. Absent exchange chains—or a primary exchange chain—a system ceases to be a system or cannot maintain independence and stability. (Yuan, 2010, p. 89)

This definition not only abstracts our current understanding of subjective and objective realities but also extends to uncover unknown or poorly understood systemic phenomena. From it, three corollaries emerge (Yuan, 2010, pp. 90-91):

• Corollary 1 (Primordial Exchange):

During systemic exchanges, an inherent tendency toward expansion and intensification persists. Whenever opportunities arise, systems or intersystemic entities will engage in decomposition, annexation, or consolidation.

• Corollary 2 (Comparative Exchange):

Regardless of scale or category, a system's developmental sophistication can be measured by its exchange

² System Exchange Theory is a novel systems theory. Starting from the phenomenon of systemic emergence, it observes external realities and internal experiences to propose the concept of systemic exchange, replacing the term "interaction" with "exchange" in Bertalanffy's classical definition of systems as "complexes of interacting elements". Building on this revised definition, the theory further introduces concrete systemic constructs such as exchange, exchange chains, six fundamental elements (matter, energy, information, time, space, and consciousness), chain-domains, Dual-Phase of Contemplation and Existence, and systemic thinking, ultimately evolving into a comprehensive theoretical framework. This overview of System Exchange Theory originates from scholar Hongjian Yuan's monograph *The Essence of Systems: A Preliminary Exploration of System Exchange Theory* (Wuhan University of Technology Press, 2021).

intensity with the external environment—specifically, the strength, frequency, scope, and depth of interactions in information, matter, energy, and ideation.

• Corollary 3 (Closed Exchange):

The primary exchange chain of a system operates as a closed loop.

Due to space constraints, a detailed discussion of these corollaries is reserved for future elaboration.

Chain-Domain Thinking Space



Figure 1. Chain-domain conceptual framework.

The exchanges arising from systemic emergence invariably form exchange chains and exchange domains (or chain-domains). Figure 1 illustrates an idealized schematic of this chain-domain thinking space from our thought experiment. Each point represents a subsystem, with emergent interactions and elemental exchanges occurring between nodes. The diagram adopts a hexagonal lattice framework (one central node with six directional links) to construct the chain-domain space. However, real-world chain-domain thinking spaces are far more complex:

(1) Exchanges are not confined to six directions but operate in N-dimensional interactions;

(2) Systemic exchanges often occur non-locally (跨系统), transcend spatial dimensions (高维度), and exhibit interdependencies too intricate for 2D/3D representation. Such complexity typically exists as abstract mental constructs or requires computational simulation for visualization.

By leveraging this chain-domain thinking space, we concretize how abstract systemic concepts evolve into holistic systems. It elegantly explains systemic properties such as integrity (整体性), stochasticity (随意性), and uncertainty (不确定性). Connecting emergent nodes into an envelope diagram further delineates systemic boundaries while simultaneously defining the system's holistic identity.

Notably, the rapid evolution of artificial intelligence is rooted in neural networks—systems that simulate human cognition with remarkable success. Intriguingly, we might interpret Figure 2 as a microscopic chain-domain thinking space and Figure 1 as a macroscopic neural network, revealing structural parallels between theoretical systemism and applied AI architectures.



Figure 2. Neuval network.

The Three Chains Theory and Its General Analysis³

Human societies—whether primitive or modern—are undeniably large natural systemic organizations. From nations and regions to hierarchically decomposed units (down to individual persons), all constitute organizational structures within human societal systems. Analyses of societal evolution traditionally rely on broad conceptual domains like politics, economics, and culture. Within System Exchange Theory, these domains are interpreted as system exchange chains. While real-world societies exhibit far more exchange chains, these three dominate, fundamentally determining a society's developmental trajectory, fluctuation intensity, persistence frequency, and impact scope.

Formation of the Primordial Three Chains

In late primitive societies, foraging wild fruits and crafting stone tools marked the embryonic form of the economic exchange chain—a brutal struggle for survival. This struggle necessitated ideological convergence and behavioral alignment to maximize collective survival, thereby forming the primitive cultural exchange chain. With the emergence of food surplus, redistribution demanded order, fairness, justice, and leadership, giving rise to the primitive political exchange chain.

Evolution of the Primordial Three Chains

With the maturation of economic, cultural, and political chains in primitive societies, human territorial expansion accelerated. Food acquisition gradually transitioned from foraging and hunting to agrarian

³ As an applied framework, the Three Chains Theory simplifies the analysis of complex human societies by focusing on dominant sociopolitical trajectories. It investigates temporal, spatial, and conscious causality in the interplay of the three chains, seeking to uncover latent societal dynamics for practical utilization.

cultivation, yielding relatively stable harvests. Land thus emerged as a new, paramount productive (and exchange) element integrated into economic chains. Annual food surpluses extended and intensified economic chains, catalyzing the shift from primitive nomadism to agrarian societies. Concurrently, agrarian civilizations developed cultural chains centered on land, enriched by the advent of language, writing, and abstract symbols.

In the West, the unique Mediterranean geography fostered a brief Aegean ethos of democracy and humanism in ancient Greece, ultimately consolidating into a theocratic-political chain under papal dominance. In the East, semi-isolated geographical conditions, influenced by Legalist and Confucian philosophies, solidified a highly centralized authoritarian political chain.

Over millennia of sociopolitical flux, pivotal shifts emerged by the 12th century. The Magna Carta's ratification in England, coupled with prolonged Christian-Islamic rivalry in Europe, culminated in the 1453 fall of Constantinople. The abrupt cessation of Eastern spice, tea, porcelain, and silk supplies threatened European survival, triggering three centuries of maritime exploration and the Renaissance.

The Age of Discovery secured material prosperity, igniting European fascination with wealth accumulation. The Renaissance revolutionized European thought, restoring intellectual confidence and propelling scientific and institutional innovation. This intellectual awakening, paired with resource abundance, catapulted Europe into the Industrial Revolution. Energy supplanted land as the dominant productive element, fueling global economic expansion.

Simultaneously, Western cultural chains evolved under scientific rationalism, while political chains embraced liberal-democratic ideals, spreading across Europe and the Americas.

General Analysis of the Three Chains Theory

Research reveals that, regardless of a society's developmental stage, the interactions among the economic, cultural, and political chains follow discernible patterns. Exchanges within the political and cultural chains primarily focus on intra-societal adaptation and adjustment. In contrast, the economic chain not only engages in internal societal adaptation but also participates in exchanges with the extra-societal environmental system.

Thus, the Three Chains Theory posits:

(1) Epistemological Division:

The demarcation of economic, cultural, and political chains is epistemological. In practice, these chains operate and evolve simultaneously within societal systems.

(2) Economic Chain's Dual Role:

Only the economic chain mediates exchanges both within human societies and with the natural world (e.g., food/energy procurement, scientific/technological innovation). Cultural and political chains remain confined to intra-societal exchanges.

(3) Political-Cultural-Economic Synergy:

Enlightened political governance (political chain) catalyzes economic prosperity (economic chain). As economic chains extend, cultural chains (cultural chain) evolve to sustain this growth. Cultural chains actively engage with economic exchanges because material abundance fuels cultural flourishing.

(4) Cultural Chain Evolution:

Cultural evolution first disrupts moral systems and subsequently contractual systems. In Eastern societies, moral frameworks precede contractual norms; the inverse holds in the West.

Regardless, cultural evolution manifests as incremental shifts in production habits (e.g., agrarian "sunrise-to-sunset labor" \rightarrow industrial "8-hour workday" \rightarrow digital-era "flexible schedules") and lifestyle norms (e.g., feudal "three-year mourning" \rightarrow modern "regular family visits").

(5) Political Chain's Mandate:

The political chain's primary function is to uphold fairness, justice, and orderly exchange. Its advancement reflects the evolution of statecraft through the codification, reinforcement, or relaxation of statutory frameworks.

(6) Sustainable Development Nexus:

A society achieving synergistic coordination among the three chains will exhibit sustainable development, marked by ceaseless scientific discovery and technological innovation.

Analysis of New Quality Productivity in the Contemporary Era

Since World War II, human society has entered a relatively peaceful phase marked by an explosion of transformative technologies—controlled nuclear fusion, semiconductor advancements, space exploration, digital technologies, the internet, and now AI and large language models.

While these technologies (excluding AI) have contributed to societal evolution and triggered localized changes, their impacts remain fragmented and lack fundamental, systemic significance for human development. Consequently, they represent new productivity rather than new quality productivity.

In stark contrast, rapidly advancing AI demonstrates unprecedented capabilities that permeate all societal domains. Its breakthroughs stem from humanity's deepening understanding of neural networks. AI's core triad—computing power, algorithms, and data—materializes through chips, mathematical innovation, and digital accumulation. AI not only assimilates, condenses, and applies millennia of human knowledge but may also engender a wholly novel human species. If the internet birthed a virtual social space, this new species could emerge as its physicalized progeny—a reality for which humanity remains psychologically unprepared.

Thus, designating AI as the new quality productivity of our era is both justified and imperative.

Conclusive Analysis

Firstly, the political chain must uphold fairness and justice for the *collective populace*—not merely for factional or familial interests. Public authority must be constrained (公权力必须放进笼子里), while private rights must be liberated (私权力必须放开). This means public authority, within its institutional confines, may regulate private rights, while private rights must comprehensively oversee public authority. The liberation of private rights will catalyze the advancement of social ideologies, unleashing human imagination and creativity, thereby propelling prosperity in religion, philosophy, and art—the tripartite pillars of humanity's spiritual realm.

Secondly, the emancipation of thought and flourishing spiritual realms will invigorate scientific discoveries and technological innovations along the economic chain. Creativity and inventiveness will proliferate, thickening and extending the economic chain.

Thirdly, the cultural chain will synchronize by harmonizing and refining new interpersonal and human-object relationships. It will amend, adjust, and perfect societal moral systems and contractual systems to align with evolving realities.

Finally, the political chain, grounded in emergent ideas, norms, and transformations from these iterative processes, will progressively amend, refine, discard, or abolish legal statutes to institutionalize its evolution.

Such recursive, spiral progression through iterative cycles—is this not the sustainable development of human society we aspire to achieve?

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