Journal of the International Society for the Systems Sciences | 70th Meeting of the International Society for the Systems Sciences, Cyprus.
Wilby, J., Makar, J. and Laouris, Y. eds.

REINFORCEMENT UNDER CONSTRAINT: A SYSTEMS MODEL OF FORWARD, CYCLE, AND BACKWARD DYNAMICS (FXCXB)

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Abstract
Systemic breakdown in complex adaptive systems rarely results from a lack of forward momentum; rather, it frequently emerges from uncontrolled reinforcement and the erosion of constraints needed to govern it. This paper proposes the Forward × Cycle × Backward (FxCxB) framework as a conceptual systems model for diagnosing reinforcement under constraint. Building on systems theory and cybernetics, FxCxB distinguishes three structural components: Forward, the ignition of variation (new possibilities); Cycle, the reinforcement structure that amplifies behaviors via feedback loops; and Backward, explicit structural selection under constraint—a constitutive braking mechanism that governs which reinforced trajectories are permitted to persist. Methodologically, the paper develops a conceptual cybernetic model and proposes diagnostic indicators (selection latency, reallocation half-life) for identifying drift. Under constraint, reinforcement tends to expand outcome dispersion faster than validation and allocation capacities update. Durability therefore depends on whether selection mechanisms update at a rate commensurate with reinforcement-driven amplification. When amplification outpaces structural selection, systems enter structural drift: a divergence between visible expansion and governability. Extending generic variation–selection accounts, FxCxB defines drift as a rate-mismatch condition and highlights operational diagnostics for detecting it, even while surface growth metrics remain positive. As a minimal illustration, consider a growing socio-technical service organization (e.g., SaaS) where acquisition and usage expand while churn and support burden creep upward: top-line indicators appear "green," yet selection updates lag, fragility accumulates, and reallocation becomes costly once constraints tighten. FxCxB is intended as a diagnostic lens for identifying leverage points within reinforcing systems, rather than prescribing domain-specific techniques.
Keywords
Cybernetics, Reinforcement Dynamics, Structural Drift, Selection Latency, General Systems Theory.

1 | Introduction: Reinforcement Can Outpace Governability

Growth is often described as a problem of acceleration. In strategy, management, entrepreneurship, and socio-technical innovation, success is frequently associated with speed: faster acquisition, faster adoption, faster iteration, and faster scale. This view is often useful in early-stage conditions, where visibility is low and the capacity to move first may create advantage. Yet in mature and constrained environments, persistence is rarely determined by acceleration alone.

Complex adaptive systems do not fail only because they move too slowly. They also fail because reinforcement continues while the structures required to govern reinforcement fail to update. In such cases, expansion remains visible, participation may still increase, and surface indicators may continue to look healthy. Yet fragility accumulates underneath. The system continues to move, but it no longer remains governable at the same pace that it amplifies.

This paper proposes a conceptual systems model for diagnosing that condition. The model is called Forward × Cycle × Backward (FxCxB). Its core argument is simple: durable growth in constrained systems depends not only on generating movement, but on maintaining commensurability between amplification and binding selection. When reinforcement expands faster than validation, allocation, and selection can update, the system enters structural drift—a divergence between visible expansion and governability.

FxCxB is not intended as a universal theory of systems. Its focus is narrower. It applies most directly to systems in which reinforcing loops operate under finite validation, allocation, coordination, and adaptive capacities. In such settings, the relevant question is not simply whether the system can generate more movement, but whether it can continue to select, constrain, and reallocate at the pace required by its own amplification.

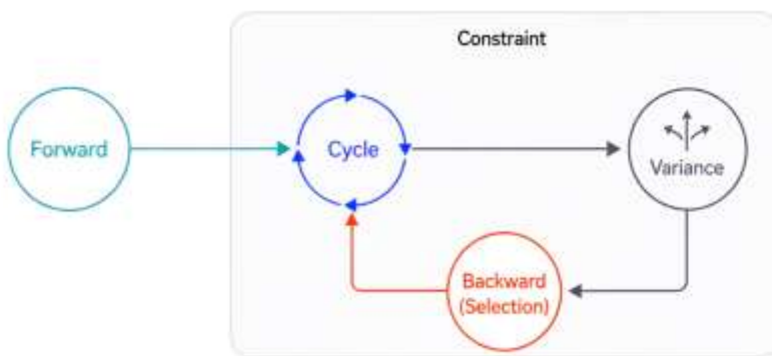
Relative to adjacent feedback, system dynamics, and variation–selection formulations (Campbell, 1969; March, 1991; Sterman, 2000), FxCxB makes three clarifications. First, it distinguishes initiation, reinforcement, and binding selection as analytically separate control functions. Second, it introduces variance as the expanded field of trajectories produced by reinforcement and subjected to selection under constraint. Third, it defines drift not as generic decline, but as a rate-mismatch condition between amplification and selective updating.

The purpose of this paper is not to reduce system diagnosis to a managerial checklist. Rather, it offers a conceptual lens for interpreting reinforcing systems under constraint, together with a small number of operational diagnostics that make the timing structure of drift more inspectable.

2 | FxCxB as a Diagnostic Model of Reinforcement under Constraint

FxCxB begins from a simple observation: systems do not persist merely because they initiate movement. They persist when amplified trajectories remain compatible with the constraints under which the system operates.

The model separates four analytically useful elements: Forward, Cycle, Variance, and Backward, all operating under constraint. The title of the framework remains FxCxB because Forward, Cycle, and Backward define its three primary control functions. Variance, however, is essential as the expanded field generated by reinforcement and processed by selection. Exhibit 1 summarizes this structural relation.



Structural drift begins when amplification outpaces binding selection.

Exhibit 1. Conceptual Structure of FxCxB Under Constraint.

This formulation is situated within systems science and cybernetics. Ashby's principle of requisite variety highlights the need for control mechanisms adequate to the variety they must regulate (Ashby, 1956). Beer's work on viable systems emphasizes the organizational capacity required to maintain control under complexity (Beer, 1972). Campbell's variation–selection account clarifies how systems evolve through the generation and retention of alternatives (Campbell, 1969). FxCxB builds on these traditions by focusing on a specific timing problem: reinforcement may expand the variety and consequence of active trajectories faster than the system's selection mechanisms can become binding.

In this sense, FxCxB does not replace feedback, viability, or variation–selection theories. It reorganizes their concern around a diagnostic question: when amplification increases variance under constraint, can the system select quickly and explicitly enough to remain governable?

This diagnostic framing is important because many systems appear viable while their selection architecture is already lagging. FxCxB therefore treats governability not as a static property, but as a relation between the pace of amplification and the pace at which constraints become effective. The framework asks whether selection is merely present as a principle, or whether it becomes binding quickly enough to shape reinforced trajectories before they accumulate into structural commitments.

2.1 | Forward: Ignition of Variation

Forward denotes the initiating force that introduces movement into a system. It generates entry, opens trajectories, and externalizes possibility. In social, organizational, and technological settings, Forward often appears as acquisition, onboarding, outreach, narrative, activation, or signaling.

Forward is necessary because systems cannot reinforce what has not first been initiated. Yet Forward alone does not explain persistence. It produces entry, not durability.

This distinction prevents the framework from treating visibility, acquisition, or initial activation as sufficient indicators of system strength. Forward may increase the number of trajectories available to a system, but it does not determine whether those trajectories remain compatible with the system's constraints once they are amplified.

2.2 | Cycle: Reinforcement Structure

Cycle denotes the reinforcing structure through which behavior becomes self-amplifying. It is not movement in the abstract, but movement organized through feedback.

A minimal Cycle may be represented as:

Action → Outcome → Subsequent Action

Cycle is the source of amplification. It expands usage, participation, exposure, throughput, and repetition. When Cycle is strong, prior outcomes alter future actions in a self-reinforcing direction.

The analytic point is not that reinforcement is inherently pathological. Reinforcement is often what allows learning, coordination, legitimacy, and resource concentration to accumulate. The problem begins when the same mechanism that amplifies useful trajectories also scales unresolved exceptions, weak signals, and governance burdens. Cycle therefore has a double character: it enables persistence, but it also increases the amount of variation that must later be selected under constraint.

2.3 | Variance: The Expanded Field Generated by Reinforcement

Reinforcement does not amplify only desirable outcomes. It amplifies trajectories. As a result, Cycle expands not only success, but also variance: edge cases, exceptions, operational burdens, performance dispersion, and hidden fragilities.

Variance is therefore not merely a side comment on Cycle. It is the expanded field of outcomes and deviations generated by amplification. It is also the object upon which selection must increasingly operate. As reinforcement intensifies, the system must evaluate and govern a widening set of trajectories, not just a single success path.

This is why Variance appears as an explicit node in Exhibit 1. It is the structural medium through which amplification becomes governability pressure.

2.4 | Backward: Binding Selection Under Constraint

Backward denotes explicit structural selection under constraint. It is the system's braking, filtering, reallocative, and admissibility function. It determines which reinforced trajectories continue, which narrow, which stop, and which no longer receive reinforcing resources.

Backward is not merely slowness, caution, or generic negative feedback. It is not passive friction. It is binding selection. It becomes real when changed judgment is reflected in the system's actual allocation, routing, prioritization, and permission structure.

This distinction is crucial. Backward does not select directly from abstract motion alone. It selects from the expanding field of variance generated by reinforcement. Its role is to determine what remains admissible under constraint.

For this reason, Backward includes more than evaluation or measurement. It includes the authority to stop, narrow, defer, reweight, or reallocate. A system may monitor variance in great detail and still lack Backward if the resulting signals do not change permissions, budgets, priorities, or continuation rules. In FxCxB, selection becomes structurally meaningful only when it changes what the system is allowed to reinforce next.

2.5 | Constraint and Structural Interaction

Constraint is central to the model. Systems operate under finite validation capacity, finite allocation capacity, finite attention, finite coordination bandwidth, and finite adaptive tolerance. Under such conditions, not every reinforced trajectory can be sustained.

Under constraint, Forward opens trajectories that Cycle may amplify. As amplification proceeds, Variance expands: the system faces more outcomes, deviations, exceptions, and commitments than it initially had to govern. Backward then determines which of those reinforced trajectories remain admissible, which must be narrowed, and which should stop. The diagnostic question is whether this binding selection occurs quickly enough to keep reinforcement governable.

FxCxB is thus not primarily a vocabulary of growth. It is a diagnostic model of whether reinforcement remains governable under finite constraint.

3 | Structural Drift: When Amplification Outpaces Binding Selection

The central failure condition in FxCxB is structural drift. Structural drift does not mean that a system has stopped growing. In many cases, it occurs precisely when visible growth continues. Nor does it mean that the system lacks goals, effort, or technical capability. Drift emerges when the rate at which amplification expands variance exceeds the rate at which binding selection can update.

Put differently, drift occurs when variance expands faster than selection can absorb, evaluate, and reallocate.This is a rate-mismatch condition. As shown in Exhibit 1, structural drift begins when amplification moves through Cycle and expands Variance faster than Backward can provide binding selection under constraint.

This formulation differs from a generic negative-feedback account. Negative feedback is often described as a mechanism that reduces deviation from a target. Structural drift, by contrast, concerns the interval in which deviation is being produced and amplified faster than the relevant selection mechanism can become binding. The issue is not only whether corrective feedback exists, but whether it has sufficient authority, speed, and reallocative force to update what the system is permitted to continue reinforcing.

It also differs from treating variety as a static control requirement. Under reinforcement, variety is not merely present; it expands. Edge cases, exceptions, coordination burdens, and alternative trajectories can multiply as a by-product of successful amplification. FxCxB therefore emphasizes the temporal relation between expanding variance and selective updating. Drift begins when the system's capacity to bind, narrow, terminate, or reallocate lags behind the variance generated by its own Cycle.

This temporal emphasis also explains why drift can be difficult to detect through ordinary performance dashboards. A system may still be improving along the dimensions that originally justified reinforcement, while simultaneously losing the ability to decide what should no longer continue. The diagnostic object is therefore not a single failed output, but a widening interval between amplified activity and authoritative selection.

3.1 | Drift Can Coexist With Positive Surface Metrics

A system in drift may still show healthy top-line indicators. User numbers may rise, throughput may expand, revenue may remain positive, and engagement may continue to look strong. These surface signals can coexist with weakening governability.

This matters because many systems are monitored primarily through visible growth indicators. FxCxB suggests that such indicators may remain green while structural fragility accumulates underneath.

3.2 | Drift Is a Pre-Failure Condition

Drift is not identical to collapse. It is a pre-failure condition in which reinforced expansion and governability begin to diverge. Some systems recover by updating Backward quickly enough. Others continue drifting until an external shock, internal contradiction, or tightened constraint reveals the fragility that has been accumulating.

3.3 | Drift Is Not Caused by Reinforcement Alone

Reinforcement is not the problem in itself. A strong Cycle can be compatible with durability if Backward updates at a comparable pace. Conversely, even moderate reinforcement can become dangerous when selection remains weak, implicit, or delayed.

The relevant systems question is therefore not, “How strong is the flywheel?” but, “How quickly does binding selection update relative to the variance generated by amplification?”

4 | Diagnostics: Making Drift More Inspectable

A conceptual model becomes more useful when it yields operational diagnostics. FxCxB proposes two primary indicators: selection latency and reallocation half-life. Together, they help make visible whether Backward is actually keeping pace with Cycle.

4.1 | Selection Latency

Selection latency is the elapsed time between the appearance of a meaningful falsification or strain signal and the effective update of selection. Operationally, it begins when a recognized signal reaches an authorized decision point and ends when changed judgment becomes binding in the relevant allocation, routing, or permission structure.

Signals may include rising churn, rising support burden, widening exceptions, margin compression, coordination overload, or evidence that previously reinforced trajectories are no longer viable. If reinforcement continues while such signals remain unprocessed or unbound, drift expands.

4.2 | Reallocation Half-Life

Reallocation half-life is the median time required to materially reallocate committed resources after a falsification signal becomes recognized. The issue is not whether the system verbally acknowledges a problem, but whether it can actually move money, people, engineering effort, operational attention, or strategic focus in response. This diagnostic captures structural inertia. A system may recognize a problem and still remain unable to reallocate in practice.

4.3 | Binding Selection

Selection is not fully updated when a concern is merely voiced. Selection is updated when changed judgment becomes structurally binding. This may occur through budget changes, product gating, narrowing criteria, priority shifts, termination conditions, or governance rules.

Binding selection is therefore the operational expression of Backward’s reality. A system may possess warnings and metrics, yet still lack effective Backward if those warnings cannot become authoritative updates to what the system is permitted to continue reinforcing.

4.4 | Observable Implications

If FxCxB is correct, several observable implications follow.

First, widening selection latency should often precede visible breakdown. If a system recognizes strain signals but cannot convert them into binding changes, the interval between recognition and selection becomes a leading indicator of drift.

Second, systems with shorter reallocation half-life should recover more effectively when constraints tighten. Recoverability depends not only on knowing that a trajectory is problematic, but on how quickly resources can be materially redirected after that judgment becomes clear.

Third, systems with weak binding selection should exhibit rising variance—more exceptions, more dispersion, more reversibility costs—before collapse becomes visible. In such cases, failure is preceded by an expanding field of unmanaged trajectories rather than by the immediate disappearance of growth.

Fourth, long-run durability should depend less on marginal reinforcement strength than on whether selection updates at a pace commensurate with amplification. Additional growth inputs may worsen fragility if the selection architecture remains slow, vague, or politically unable to bind.

These implications do not turn FxCxB into a closed predictive model. Rather, they show where the framework becomes empirically vulnerable. If systems diagnosed as high-amplification / low-selection do not display such patterns, the explanatory value of the model is weakened.

A compact diagnostic prompt set derived from these elements and indicators is provided in Appendix A.

5 | Minimal Illustration: Organizational Drift in a Growing Socio-Technical Service System

As a minimal illustration, consider a growing socio-technical service organization such as a SaaS business operating in a relatively mature market.

This example is not meant to stand for all organizations. Its purpose is to show how visible expansion and weakening governability can coexist when reinforcement grows faster than binding selection.

5.1 | Forward

The organization improves acquisition, narrative clarity, channel efficiency, and onboarding. These activities increase entry into the system. More customers arrive, more users activate, and more accounts participate.

5.2 | Cycle

The system contains reinforcing loops. Usage produces data, data improves targeting or onboarding, visible customer growth supports legitimacy, and scale improves further reach. Prior outcomes increase the likelihood and intensity of subsequent actions.

5.3 | Variance

As reinforcement intensifies, the organization does not experience only more success. It also experiences more variance. Churn rises in marginal segments, support burden increases, edge cases proliferate, feature exceptions multiply, and coordination load grows. These dynamics may remain partially hidden because top-line indicators are still positive.

5.4 | Backward

Now suppose that the organization’s selection structures do not update at the same pace. Termination conditions remain vague, reallocation is slow, validation loops are overloaded, and it becomes politically costly to stop reinforcing certain offerings. Signals are recognized, but no binding change occurs quickly enough. The organization has now entered structural drift. It is still moving, but it is increasingly dependent on reinforcement that selection no longer governs effectively.

5.5 | Why this matters

The problem is not simply that the organization grew. The problem is that amplification expanded the field of variance faster than binding selection could update under constraint. Exhibit 2 provides a compact mapping of this illustration.

The purpose of the example is to show how the same reinforcing process can generate both legitimate expansion and mounting governability pressure. In practice, such systems may not require less growth, but earlier and more explicit selection over which growth paths remain admissible. The illustration therefore functions as a minimal diagnostic setting rather than as a sector-specific explanation of SaaS performance.

Exhibit 2. Compact Mapping of the Minimal SaaS Illustration.

Element	Minimal SaaS mapping and diagnostic implication
Forward	Acquisition, narrative clarity, channel efficiency, and onboarding expand entry into the system.
Cycle	Usage–data–retention–legitimacy loops reinforce both value creation and amplification.
Variance	Churn, support burden, exceptions, and coordination costs expand alongside visible growth.
Backward	Scope narrowing, termination conditions, validation updates, and resource reallocation determine what remains admissible.
Drift sign	Top-line dashboards stay green while governability weakens and reversibility costs rise.

6 | Broader Relevance and Boundary Conditions

6.1 | Broader Relevance

Although the illustration above uses a socio-technical service organization, the same logic travels beyond business settings. Similar patterns appear wherever amplified behavior must remain governable under finite constraint.

A contemporary example arises in AI governance. As adaptive and agentic systems are deployed across changing organizational, economic, and compliance environments, reinforcement may continue through usage, automation, optimization, and workflow integration. Yet governing constraints may fail to update at the same pace. Oversight routines, intervention points, responsibility boundaries, escalation paths, and runtime admissibility controls can remain under-specified even as system behavior expands. In FxCxB terms, the Cycle continues to amplify operational trajectories while Backward remains too slow or too implicit to determine which trajectories should continue, be narrowed, be deferred, or be stopped.

Comparable selection problems appear in value allocation systems, organizational drift, and PoC decision-making. In value allocation, reinforced contribution or usage signals may expand faster than validation and settlement mechanisms can update. In organizational drift, growth or traction may remain visible while resource commitments become increasingly difficult to reverse. In PoC decision-making, experimentation may continue to generate activity without binding Go/No-Go criteria, escalation thresholds, or production-readiness constraints.

Across these domains, FxCxB does not prescribe a domain-specific governance method. Its role is diagnostic: to ask whether reinforced activity remains admissible under explicit, binding selection, or whether amplification is expanding variance faster than governability can be updated.

These domains are illustrative rather than exhaustive. Each would require its own operational definitions of variance, constraint, and binding selection. The common contribution of FxCxB is to clarify the shared structural question: whether reinforced activity remains governable under finite constraint. This keeps the claim narrow: FxCxB identifies a shared timing problem, while leaving domain-specific mechanisms to be defined by each empirical or applied context. In that sense, broader relevance is not presented as completed application, but as a structured agenda for subsequent systems diagnosis.

6.2 | Boundary Conditions and Limitations

Several limitations should be stated clearly.

First, this paper is conceptual. It proposes a systems model and operational diagnostics, but it does not claim to provide a complete empirical test across sectors.

Second, FxCxB is not a universal theory of systems. It applies most directly where reinforcing loops operate under finite validation, allocation, coordination, and adaptive capacities. It is less useful where reinforcement is not meaningful or where selection is not a relevant governing function.

Third, the framework does not explain all forms of failure. Some failures result from exogenous shock, deception, discontinuity, or manipulation that are not reducible to reinforcement dynamics alone.

Fourth, the proposed diagnostics are deliberately simple. Selection latency and reallocation half-life do not exhaust all relevant variables. They are starting points for making the timing structure of selection more visible.

Fifth, FxCxB should not be misunderstood as anti-growth. The framework does not criticize amplification in itself. It argues that amplification without commensurate selection under constraint creates fragility.

Finally, the framework identifies where selection problems may reside, but it does not by itself determine the correct intervention in any particular domain. What counts as an adequate Backward mechanism depends on institutional authority, available data, technical architecture, and the kinds of commitments that must be reversed or narrowed.

7 | Conclusion

With those limits in view, the paper's contribution can be stated plainly.

FxCxB proposes that durable systems require more than movement. Forward initiates trajectories. Cycle amplifies them. Variance widens the field of possible outcomes and deviations. Backward determines what remains admissible under constraint.

Structural drift begins when amplification outpaces binding selection.

The value of the framework lies in shifting attention away from acceleration alone and toward the structural conditions under which reinforcement remains governable. In constrained systems, the decisive question is not simply how strongly motion can be generated, but how explicitly and how quickly persistence is selected.

Durability, in this view, is not growth without friction. It is reinforcement governed under constraint.

The framework therefore shifts attention from whether a system can continue to accelerate to whether it can continue to choose. Where Forward and Cycle generate momentum, Backward determines whether that momentum remains compatible with the constraints that make persistence possible. FxCxB names this relation so that drift can be diagnosed while systems still appear to be moving forward.

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Appendix A | Minimal Diagnostic Questions

The following questions can be used as a compact diagnostic prompt set:

1. Forward. What mechanisms currently ignite new participation or new trajectories?

2. Cycle. What feedback structures currently amplify those trajectories?

3. Variance. What forms of outcome dispersion, exception load, operational burden, or hidden fragility are expanding alongside visible reinforcement?

4. Constraint. What finite capacities limit validation, allocation, coordination, or adaptation?

5. Backward. What explicit mechanisms determine which reinforced trajectories continue, narrow, or stop?

6. Selection latency. How long does it take for a meaningful falsification signal to produce binding selection?

7. Reallocation half-life. Once a reinforced trajectory is judged problematic, how long does it take to materially reallocate resources away from it?

8. Drift. Are surface growth signals remaining positive while governability weakens underneath?