Friction

Boundary Signal of Finite Load-Bearing Capacity in Subjective, Intersubjective, and Functional-Empirical Stability Spaces

Abstract

This paper develops friction as an epistemic structural concept for stability under finite conditions. Friction is not understood as a mere disturbance or as technical energy loss due to rubbing, but as a boundary signal: it indicates where stabilization under load is only possible with disproportionately increasing costs, or where stabilization loses its load-bearing capacity.

Starting from an analytic distinction between the subjective, intersubjective, and functional-empirical domains, the paper works out a unified functional logic of friction. Friction makes boundaries visible, translates load into cost profiles, and generates selection effects over time between competing stabilization patterns. Boundaries are understood strictly functionally, not as ontological barriers, but as markers of the limited load-bearing capacity of concrete models, routines, or institutions.

Friction thus functions as a diagnostic instrument for validity under load: it enables early detection of overstretching, externalization, and blocked revision, without generating ontological or normative ultimate claims. The paper develops a typology of forms of friction and derives friction competence as a principle of design and diagnosis for epistemic, social, and technical systems. Friction therefore appears not as the opposite of order, but as its functional condition.

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1. Why Friction Is a Basic Concept

Many central conflicts of modern societies share a common structure, even when they appear in completely different fields: a system claims stability, reaches boundaries under load, and then reacts either by adaptation or by shifting the load elsewhere. In everyday life, this boundary and this load are often perceived only as a "disturbance." This is precisely where the concept of friction begins, as a more precise expression for something that otherwise remains vague.

This paper advances a clear thesis: friction is not the enemy of order, but its condition. Without friction there would be no robust boundaries, no forced decisions, no stable selection of models, norms, routines, or technologies. Friction makes visible that stability is always finite and always has to be paid for, through time, energy, attention, legitimacy, or resources.

At the same time, friction is explicitly not elevated here in an ontological sense. It is not a "first principle," not a metaphysical basic element. Friction is a functional description: a signal that appears only where stability is claimed and finite load-bearing capacity exists. In this way, friction is both universal and modest. Universal because it occurs wherever systems are supposed to be stable. Modest because it adds nothing "new," but makes boundaries readable.

2. Minimal Definition: Friction as a Boundary Signal of Finite Load-Bearing Capacity

The working definition of this paper is as follows:

Friction is the epistemically readable manifestation of a boundary of load-bearing capacity within a stability space.

The term boundary is used strictly in a functional sense and does not denote an ontological impossibility, but rather the cost-related limitation of a concrete stabilization pattern under load.

This definition is deliberately minimal. It describes friction neither as a cause nor as an independent phenomenon, but as a signal that appears where a system, under relevant load, attempts to maintain its stability. Friction thus does not denote damage or disturbance in itself, but the point at which stabilization is only possible with increasing effort or begins to fail.

Three functional elements are decisive for this:

(1) Stability space. There exist rules, invariances, or mechanisms by which something counts as stable, for example coherence in experience, trust and expectation reliability in social orders, or reproducible efficacy in technical and empirical systems.

(2) Load. This stability is challenged by demands such as stress, conflict, scaling, resource scarcity, contradiction, or time pressure. Load is not exceptional, but the normal condition of finite systems.

(3) Boundary signal. Under sufficient load, signs emerge that the system's load-bearing capacity has been reached or exceeded. These signs typically manifest as nonlinearly increasing effort, delay, error rates, overload, or cost escalation.

Decisive is the signal character: friction is information about the costs of stabilization under load. It indicates where a system loses its stability or can only maintain it at the price of disproportionately increasing effort.

Not every difficulty or irritation constitutes friction. Friction is only spoken of here where increasing effort is systematically coupled to a claimed core of stability and, under repeated load, manifests as a structural cost profile. Random disturbances, singular errors, or short-term irritations without a stability claim do not fall under this concept.

Friction is therefore neither an event nor a state, and also not a causal operative factor, but a relational diagnostic quantity. It becomes visible in the relation between a claim to stability, load, and the costs of maintaining that stability. Friction does not explain why a system fails or remains stable; rather, it indicates where and under which conditions the validity of existing stabilization patterns comes under pressure.

3. Three Reality Domains as Axes of Analysis

In order to apply the concept of friction precisely, a clear distinction must be made between the contexts in which friction becomes readable. For this purpose, the paper distinguishes three reality domains. These are not to be understood ontologically, but serve as analytical axes. They function as an error-avoidance rule: many theoretical and practical conflicts arise because friction appears in one domain but is evaluated or processed in another.

(1) Subjective domain (experience).
In the subjective domain, stability refers to the internal coherence of perception, attention, decision-making capacity, and meaning integration. Friction manifests here as overload, inner tension, exhaustion, or increasing indecisiveness. These phenomena are not mere moods, but boundary signals of limited cognitive and motivational load-bearing capacity.

(2) Intersubjective domain (social order).
In the intersubjective domain, stability consists in shared expectations, trust, legitimacy, and the reliability of institutional arrangements. Friction appears here as conflict intensification, loss of trust, coordination problems, or crises of legitimacy. A characteristic feature is that friction in this domain rarely remains local, but tends to spread systemically and generate high secondary costs.

(3) Functional-empirical domain (efficacy under resistance).
The functional-empirical domain concerns the stability of systems measured by reproducible efficacy. This includes technical, organizational, computational, or physical systems whose performance must prove itself under real resistance. Friction manifests here as capacity limits, performance decline, error rates, energy or resource demand, and nonlinearly increasing maintenance or control effort. The term empirical does not refer exclusively to natural-scientific measurement practices, but more generally to the testing of efficacy under demanding conditions.

The distinction between these three domains does not serve to separate kinds of reality, but to enable the precise attribution of friction. If friction is interpreted or addressed across domains, typical malfunctions arise: subjective overload is moralized as individual failure, social legitimacy problems are treated as technical efficiency issues, or functional limits are dismissed as mere imagination. Domain differentiation, by contrast, makes it possible to read and address friction where it actually arises.

4. The Functional Logic of Friction

Friction marks the point at which the validity of a stabilization pattern tips under load. It is the primary signal indicating that existing commitments must be diagnostically examined before revision occurs. Friction does not itself enforce adaptation, but opens the decision space between continued stabilization, selective modification, and structural change.

4.1 Boundary

Friction makes boundaries visible. What is meant are not formal prohibitions, but points at which stabilization under load no longer functions linearly. It is characteristic that small additional demands produce disproportionately large effects on coherence, performance, or coordination.

In many contexts, such boundary phenomena are prematurely interpreted ontologically, as indications of principled impossibility or "limits of the world." This interpretation is epistemically relieving, because it terminates further processes of analysis and adaptation. Friction itself, however, does not decide this question. It merely indicates that stability under given conditions can only be maintained at increasing cost, or no longer at all. Whether this constitutes an external impossibility or merely a boundary of current stabilization remains an open question for further modeling.

4.2 Costs

Friction translates boundary phenomena into costs. Costs are not restricted to monetary quantities, but designate any additional effort required to maintain stability against load. They may appear as time expenditure, energy input, attentional binding, coordination effort, resource consumption, or rising complexity.

What matters is not the existence of costs as such, but their dynamics. Friction is present where costs grow disproportionately under repeated load, thereby indicating that a stabilization pattern is approaching its limit of load-bearing capacity. Friction thus makes visible that stability is never cost-free and that increasing effort is a central diagnostic criterion of finite load-bearing capacity.

4.3 Selection over Time

Under repeated load, different cost profiles become visible. These cost profiles have temporal selection effects: stabilization patterns that generate only low or controllable additional costs under relevant load remain viable over time; those with escalating costs lose stability or are transformed.

Selection is not to be understood here as an intentional or Darwinian mechanism, but as the minimal logic of finite systems. Repeated load, combined with differing cost trajectories, leads to some structures persisting while others are abandoned, modified, or replaced. In this context, friction functions as a diagnostic quantity through which these selection effects become readable early, before irreversible instabilities occur.

In this way, friction functionally connects possibility and actuality. What remains effectively real are those structures that are load-bearing under relevant friction, without requiring ontological commitments about what exists "in itself."

5. Typology: Forms of Friction

5.1 Subjective Friction

Subjective friction is the boundary of internal stabilization. It typically manifests as:

- overload, indecisiveness, exhaustion
- inner tension, doubt, ruminative loops
- loss of meaning, decoupling of motivation and action

Decisive point: these are not "mere feelings," but boundary signals of a limited architecture. Subjective friction is often the earliest signal that a system has been overstretched, even before measurable errors occur.

5.2 Intersubjective Friction

Intersubjective friction concerns expectations and order. Typical forms include:

- conflict spirals, loss of trust
- crises of legitimacy, diffusion of responsibility
- overstretching of norms, rule inflation, sanction backlog

Here friction is often costly because it does not remain local. A breach of trust can destabilize entire systems even though the functional-empirical infrastructure is still intact.

5.3 Functional-Empirical Friction

This is the classical case of "friction," but in an extended sense:

– energy demand, entropy effects, material fatigue
– capacity limits, bottlenecks, maintenance effort
– computational complexity, latency, error rates

A modern special case is digital friction. Scaling does not merely generate costs, but produces new classes of errors such as security risks, drift, and system couplings.

5.4 Cross-Domain Friction and Externalization

Many systems "solve" friction by shifting it:

– subjective friction is translated into social friction, overload becomes visible as aggression or withdrawal
– social friction is translated into functional friction, bureaucracy replaces trust with control, introducing friction into processes
– functional friction is translated into subjective friction, technical failure is experienced as chronic stress

Externalization is not wrong per se. It is often necessary. It becomes pathological when it remains invisible. In that case, a local appearance of frictionlessness emerges, while global instability grows.

6. Friction in Science and Model Building

6.1 Entity Focus and Boundary Focus as Competing Search Heuristics

A large part of scientific research has historically been shaped by an implicit focus on entities. Knowledge is primarily understood as the identification, specification, or ontologization of stable units, for example particles, fields, structures, or mechanisms. This focus has been successful where new stable regimes were opened up and robust invariances emerged. In boundary regions, however, its heuristic effectiveness often reverses.

Especially near presumed limits, entities become increasingly speculative, while the actual epistemic signals appear in the form of instabilities, nonlinearities, cost escalations, or model tensions. Historically, scientific ruptures therefore appear less as discoveries of new things than as reorganizations of existing descriptive regimes. The decisive impulses regularly originated from boundary phenomena, not from the successful stabilization of additional entities.

Scientific realism tends to read these boundary phenomena as deficits of existing theories that are to be remedied by extending, refining, or supplementing ontological assumptions. This shifts the research focus toward rescuing existing stabilization patterns, while friction itself is treated as a disturbance. This prioritization is not methodologically necessary, but represents a historically evolved heuristic.

By contrast, a boundary focus allows an alternative search strategy. Boundary regions are not understood as points of breakdown, but as epistemically high-density zones in which the load-bearing capacity of existing models under load is decided. In this framework, friction does not function as a signal of failure, but as an indication of where search spaces should be expanded, descriptions transformed, or new regimes considered. Entities then appear not as primary epistemic goals, but as local stabilization results within specific cost and validity ranges.

This reweighting does not imply anti-realism. It merely shifts methodological priority. Instead of maximizing ontological commitments at an early stage, boundary phenomena are systematically used as search indicators. In this sense, friction proves to be not only a diagnostic instrument, but an orienting quantity for scientific exploration. Knowledge then arises not primarily through the multiplication of entities, but through the reflective handling of the boundaries at which existing stabilization patterns lose their load-bearing capacity.

6.2 Friction as a Selection and Transformation Criterion for Scientific Models

Scientific knowledge can be understood as an organized culture of friction. Models are deliberately exposed to load so that boundaries become visible.

In this context, friction appears as:

– anomalies, replication problems, measurement conflicts

– model overstretching, parameter tuning, ad hoc repairs

– growing complexity, declining explanatory yield

An important result follows: not every instance of friction is a refutation. Some frictions are transformation signals. The decisive question is whether a model can integrate friction productively without destroying its cost structure.

In this way, friction becomes a precise criterion against two errors:

– naive realism: "If it is measurable, it is real."

– naive relativism: "If it is model-dependent, it is arbitrary."

Friction shows that model dependence is unavoidable, but not arbitrary, because cost profiles under load exert selection pressure.

The epistemic value of the concept of friction lies not in explaining new phenomena, but in better steering existing epistemic processes. Friction makes it possible to diagnose the boundaries of models, theories, and institutions functionally, without prematurely misinterpreting them as refutations or as mere disturbances. In this way, two systematic misdevelopments are avoided: the dogmatic stabilization of overstretched models through rising complexity, and the premature abandonment of viable approaches due to misread load signals. Friction thus functions as a middle level between falsification and arbitrariness. It makes costs visible before epistemic decisions become irreversible.

7. Physical Boundary Concepts, Mathematical Underdetermination, and the Ontologization of Hard Boundaries

In intuitive interpretations of physical theories, physics is often regarded as the domain of hard, objective boundaries. The speed of light, absolute zero temperature, Planck scales, or singularities appear as unambiguous limits of what is possible. This notion shapes not only popular images of physics, but also constitutes a central source of our ontological understanding of reality. The world appears as structured by fixed, objectively given boundaries, independent of modeling, costs, or conditions of knowledge. Precisely this intuition, however, represents an epistemic overstretch.

The following considerations are not intended as a critique of physical theories as such, but as an exemplary illustration of the concept of friction in a particularly precise field of application. Physics is chosen here as a paradigmatic case because its formal boundary concepts make friction especially visible. The analysis does not claim a physical re-evaluation or an ontological decision, but illustrates the general functional logic of friction within a highly stable model domain.

The concept of a boundary does not denote an ontological limit of reality, but a functional marking of those load levels at which the stabilization of a model is only possible with nonlinearly increasing costs.

Physical theories do not measure boundaries in the sense of ontological endpoints. What is empirically accessible are finite quantities, trends, scalings, and stability trajectories under finite conditions. Boundary values appear as idealized reference points that can only be approached asymptotically in empirical practice. What becomes experimentally visible are not absolute barriers, but characteristic regimes in which effort, instability, or inconsistency grow sharply and nonlinearly.

At this point, mathematics is typically invoked as an anchor of precision. While physical model descriptions often remain heuristic or linguistically underdetermined, mathematical formulation is expected to provide the decisive precision. In boundary regions, however, this expectation fails. The mathematical formalisms of physics are syntactically precise, but semantically underdetermined. They produce divergences, singularities, or limit values without formally indicating whether these should be read as real impossibilities, mere model limits, or transitions into new theoretical domains.

A paradigmatic example is relativity theory. If one inserts the speed of light into the formulas for a massive particle, the corresponding expressions diverge formally toward infinite values. This divergence is often shortened into the statement that reaching the speed of light would require "infinite energy." Physically, however, this is not a statement about real infinities, but about the asymptotic boundary behavior of a model. Non-attainability is not mathematically encoded, but is introduced only through an additional physical interpretation. The formula itself contains no symbol that distinguishes between formal divergence and physical realizability.

This semantic gap is not a special case of relativity theory. In thermodynamics, absolute zero temperature marks a boundary value that is mathematically defined but not attainable. In general relativity, singularities occur whose physical meaning remains unclear. In quantum field theory, divergences appear that become manageable only through renormalization. In all these cases, mathematics provides precise computational structures, but no unambiguous physical interpretation of the boundary values. Physics is not imprecise in the sense of incorrect calculations, but imprecise in the explicit marking of the epistemic meaning of its boundary concepts.

From this semantic indeterminacy arises the widespread tendency to read mathematical boundary structures ontologically. Divergences and limit values are interpreted as properties of the world itself, even though they initially function as markers of model boundaries. What appears as friction within a theoretical framework is thus reinterpreted as an allegedly objective boundary of reality. This shift favors ontologically realist readings of physical model boundaries, in which physical theories are understood as direct descriptions of the world, while the epistemic role of modeling, costs, and stabilization recedes into the background.

This interpretation is epistemically untenable. Physical theories are themselves historically the result of regime shifts. Relativity theory did not replace Newtonian mechanics because a hard boundary of the world was discovered, but because frictions accumulated at the edges of the older theory and new stabilization patterns became necessary. From this history it follows necessarily that, even for relativity theory, it cannot be excluded that further domain shifts may become necessary in boundary regions that are currently inaccessible to measurement. Whether boundary behavior remains asymptotic, turns into a breakdown, or releases new dynamics is in principle open.

It is precisely here that the concept of friction attains its full scope. Friction does not denote the end of reality, but the end of the load-bearing stabilization of a model under given conditions. It marks cost escalations, nonlinearities, and selection points without forcing ontological ultimate decisions. Physical friction thus does not differ in principle from subjective or intersubjective friction, but only in the kinds of costs that become visible.

The explicit dissolution of the notion of hard physical boundaries is therefore not a relativization of physics, but a clarification of its epistemic status. It makes visible that physics is not a special case outside the friction approach, but its most stable application. Precisely because physical models are highly precise, their boundary regions show particularly clearly that order does not arise from absolute barriers, but from selected stabilization under increasing costs. In this sense, physics does not form a counterpole to friction, but its paradigmatic example.

8. Friction in Technology, Organization, Law, and AI

In technical, organizational, and legal systems, friction becomes particularly visible, but is often misunderstood. A typical response is the attempt to reduce local friction in order to increase efficiency, speed, or reliability. Such optimizations, however, regularly generate new loads elsewhere. Friction does not disappear, but is redistributed, often into less visible areas.

In organizations, friction manifests as increasing coordination effort, densification of control and alignment processes, or slowing decision-making capacity. In legal systems, it appears as enforcement costs, implementation problems, or tensions between normative clarity and practical feasibility. The common feature is that friction becomes especially problematic where it is politically or institutionally rendered invisible. Decisions then appear as objective constraints or isolated cases, even though they in fact shift cost profiles and alter stabilization patterns.

Bureaucracy as a Case of Systematic Friction Displacement

Bureaucratic systems can be understood as institutional responses to intersubjective friction. Where trust, shared expectations, or informal coordination no longer provide stable support, rules, procedures, and control mechanisms are introduced to maintain order. In the short term, this can reduce intersubjective friction by narrowing decision spaces and formalizing responsibilities.

This reduction of friction is not cost-free. The relieved intersubjective domain generates growing functional-empirical friction in the form of process delays, coordination effort, rule inflation, and administrative complexity. If this shift is not explicitly reflected, the impression of objective necessity arises, even though what is involved is a redistribution of friction. Bureaucratic overstretching is, in this sense, not a moral failure, but a structural result of friction displacement that has become invisible.

Technical Automation and the Illusion of Local Frictionlessness

Technical automation often reduces local friction in work, decision, or coordination processes. Tasks become faster, more consistent, and seemingly smooth. These efficiency gains, however, regularly generate new forms of friction elsewhere.

Typically, functional-empirical friction is displaced into increased dependence on infrastructure, maintenance, energy demand, or susceptibility to failure, while intersubjective friction shifts toward questions of responsibility, control, and liability. Subjectively, this dynamic may be experienced as relief accompanied by deferred costs, for example through overreliance on technical systems or the loss of situational competence. Automation does not eliminate friction, but reorganizes it. Friction often becomes less visible, not smaller.

Artificial Intelligence as a Case of Accelerated Friction Reduction

Artificial intelligence is not treated here as an independent special case, but as an accelerated and condensed example of general friction displacement, making the structural principles developed in this paper particularly visible. The use of artificial intelligence can be described as a systematic reduction of local friction in decision-making, coordination, and knowledge processes. Tasks that were previously time-consuming, effort-intensive, or conflict-laden are seemingly automated or delegated smoothly. This reduction of friction, however, does not imply costlessness, but a shift in cost profiles combined with higher speed and lower transparency.

Functional-empirical friction appears in the form of computational, energy, and maintenance costs; intersubjective friction shifts into questions of responsibility, liability, and legitimacy; subjective friction manifests, for example, as overconfidence, illusion of control, or cognitive relief with downstream costs. Artificial intelligence thus does not constitute a special case, but an accelerated and condensed expression of already familiar friction patterns. Friction is not abolished, but redistributed and simultaneously made harder to read. The analysis of this mechanism is deliberately limited here to conceptual classification; further dynamics and risks of accelerated friction resolution remain the subject of separate investigation.

9. Pathologies: Friction Avoidance, Friction Displacement, Friction Fetish

The following pathologies are to be understood strictly in functional terms. The concept does not denote a moral deficiency, a political misjudgment, or individual guilt, but a long-term unstable state of epistemic or institutional architecture relative to explicit stability goals. A mode of dealing with friction is pathological precisely where rising costs, blocked revision, or concealed displacement systematically undermine the load-bearing capacity of existing stabilization under finite conditions.

Three typical failure modes can be distinguished:

1. Friction avoidance. Friction is regarded as fundamentally bad and is therefore to be eliminated. The result is hidden instabilities, because boundaries are no longer read.

2. Friction displacement. Friction is reduced locally, but systematically exported into other domains or onto other groups. The result is apparent efficiency and real loss of legitimacy.

3. Friction fetish. High friction is taken as proof of seriousness or truth. The result is unnecessary hardness, blocked innovation, and moralized suffering.

The criterion against all three is simple: friction does not need to be minimized, but correctly distributed and kept readable.

10. Practical Guidelines: Friction Competence as a Design Principle

The following guidelines are to be understood as principles of design and diagnosis, not as normative prescriptions. They describe conditions under which systems process friction in such a way that long-term stability under load remains possible, independent of specific value commitments.

Friction competence means building systems in such a way that friction becomes visible early, in a domain-appropriate manner, and in a responsible way.

Minimal principles:

1. Readability before optimization. First measure and understand friction, then reduce it.

2. Domain correctness. Address subjective friction subjectively, social friction socially, and functional friction functionally, without cross-domain misattribution.

3. Cost truthfulness. Every stabilization has costs. Hidden costs are instability credits.

4. Capacity for responsibility. If friction is distributed, it must be clear who bears it and why.

5. Transformation instead of suppression. Friction can indicate that a structure must change, not merely a parameter.

Diagnostic Routine: Reading Friction Systematically

The guidelines developed in this paper can be condensed into a simple diagnostic sequence that can be used to analyze concrete situations. This sequence is not normative, but serves the structured readability of friction relative to given stability goals.

(1) Domain attribution. In which domain does friction primarily occur: subjective, intersubjective, or functional-empirical?

(2) Stability core. What form of stability is being claimed, for example coherence, trust, performance, or reproducibility?

(3) Cost profile. How do the costs of this stabilization develop under increasing or repeated load? Do they show linear growth, nonlinear escalation, or tipping points?

(4) Displacement. Where is friction shifted when it is reduced or suppressed locally, into other domains, other actors, or later points in time?

This diagnosis does not replace detailed analysis, but enables an initial orientation as to whether observed problems point to local disturbances or to structural boundaries of existing stabilization patterns. Friction competence consists in posing these questions early, before cost profiles generate irreversible instabilities.

11. Friction as the Condition of Order and Meaning

Friction is a basic concept because it accomplishes three things at once: it marks boundaries, it makes costs visible, and it selects stability over time. In this way, friction becomes a diagnostic logic of selection through which stable actuality emerges from mere possibility, without requiring ontological ultimate claims.

The point is sober. Order is not the state without friction. Order is the state in which friction is so readable and so distributed that stability remains load-bearing under relevant strain. Meaning emerges where systems learn which cost profiles they accept and which they do not, and stabilize this selection over time.

Understood in this way, friction changes from a pejorative term into a diagnostic instrument. That is precisely where its epistemic value lies. The concept of friction developed here is not a metaphorical add-on, but a theoretical tool for analyzing stability, selection, and order in finite epistemic systems.

Canonical Framework

Adoption of the Epistemics Core Canon

This paper explicitly adopts the canonical framework established in the Epistemics base paper (Epistemics: Model Management Under Finite Conditions).
The canonical definitions provided there serve as the unchanged reference basis for the present work. The meanings of all core canonical terms are preserved and are neither redefined nor implicitly modified.

The adopted core canon includes, in particular, the concepts of *Epistemics, model*, *validity*, *domain*, *stabilization*, *costs*, *revision*, *overextension*, and *malfunction*, as defined in the base paper. These concepts retain their original functional scope and serve as the background architecture against which the concept of friction is developed in this paper.

No competing or alternative definitions of these canonical terms are introduced.

Canonical Deviations or Refinements

This paper introduces no deviations, reinterpretations, or refinements of the Epistemics core canon. All canonical terms are used strictly in the sense defined in the Epistemics base paper.
The scope, function, and validity conditions of the adopted canonical concepts remain fully unchanged.

Friction-Specific Canon Extensions

In addition to adopting the Epistemics core canon, this paper introduces a set of friction-specific canonical extensions. These terms do not alter the meaning of the core canon, but function as derived analytical and diagnostic concepts that specify how stability, costs, and validity become readable under load.

The following terms are introduced and stabilized for the purposes of this paper:

Stability Space
A stability space designates the functional domain within which a specific form of stability is maintained under load. Stability spaces are not ontological regions, but analytically defined spaces characterized by distinct stabilization mechanisms and cost structures (e.g., subjective coherence, intersubjective legitimacy, functional-empirical efficacy).

Load
Load denotes the set of demands placed on a stabilization pattern, including stress, scaling, conflict, contradiction, time pressure, or resource scarcity. Load is not exceptional but constitutes the normal operating condition of finite systems.

Boundary (functional sense)

A boundary marks the point at which stabilization within a given stability space becomes possible only with nonlinearly increasing costs or fails altogether. Boundaries are understood strictly functionally and do not denote ontological impossibilities.

Cost Profile

A cost profile describes the dynamic trajectory of effort required to maintain stabilization under repeated or increasing load. Cost profiles function as selection-relevant indicators over time.

Externalization

Externalization denotes the displacement of friction from one domain or stability space into another, for example from subjective overload into intersubjective conflict or from social coordination problems into functional-empirical control mechanisms.

Selection over Time

Selection over time refers to the differential persistence, transformation, or abandonment of stabilization patterns as a function of their cost profiles under repeated load. Selection is understood as a structural effect of finitude, not as an intentional or Darwinian mechanism.

Friction Competence

Friction competence designates the capacity of systems to render friction readable, to attribute it domain-correctly, and to process it without suppression or fetishization. It functions as a principle of diagnosis and design, not as a normative prescription.

Canonical Status and Scope

The friction-specific concepts introduced here constitute an explicit canonical extension of the Epistemics framework. They are stabilized for the scope of this paper and may serve as reference terms for subsequent work, provided their use is explicitly indicated.

No silent extension, reinterpretation, or retroactive modification of the Epistemics core canon occurs. Any future deviation, refinement, or further extension must be explicitly marked in accordance with the meta-rule governing canonical development.

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Appendix A: Didactic Illustration of the Concept of Friction

Note on the status of this appendix

The following section serves exclusively as a didactic illustration of the concept of friction developed in the main text. It introduces no new terms, establishes no additional theses, and has no independent argumentative function. Its purpose is to make the structural logic of friction in subjective, intersubjective, and functional-empirical domains intuitively accessible. (for teaching and communication contexts)

A.1 The Basic Image: A Group Moving through Water

Imagine a group of people moving together through clear, shallow water.
Movement is initially easy, coordinated, and not strenuous. There is no reason to discuss stopping or changing direction. The implicit situational model is:
"This is water; one can move here."
In this state, stability exists in all three domains.

A.2 Increasing Viscosity: Emergence of Subjective Friction

As movement continues, the water gradually becomes murkier and more viscous.
Objectively, movement is still possible, but the effort increases noticeably.
Individual group members experience:

– increasing exertion

– discomfort

– doubt about the appropriateness of continuing

These reactions mark subjective friction.
What matters is this: at this point, there is still no objective impossibility of movement. An interruption may nevertheless already occur here because the internal load-bearing capacity of individual participants is exceeded.

A.3 Coordination Costs: Emergence of Intersubjective Friction

As viscosity continues to increase, discussions begin within the group:

– How much farther should we go?

– Is everyone bearing the increasing load equally?

– Is the goal still worth the effort?

Movement remains possible, but coordination itself becomes costly.
Divergent assessments, load limits, and priorities make joint decisions more difficult.
Here intersubjective friction emerges.

A termination may occur even though:

– individual members could still continue,

– no physical boundary has been reached.

The reason for stopping then lies not in the medium, but in the impossibility of stable coordination.

A.4 Transition to a Swamp: Emergence of Functional-Empirical Friction

Eventually, the water turns into swampy terrain.
Each step requires disproportionately large effort, some individuals get stuck, and progress becomes factually impossible.

Here functional-empirical friction becomes visible.
This boundary is independent of:

– motivation,

– individual resilience,

– social agreement.

At this point, the possibility of movement itself comes to an end.

A.5 Didactic Mapping of the Three Forms of Friction

The image allows a clear distinction:

Subjective friction
Stopping because continuing can no longer be sustained internally.

Intersubjective friction
Stopping because joint coordination under increasing costs is no longer possible.

Functional-empirical friction
Stopping because the medium objectively no longer allows movement.

All three reasons for stopping are real, legitimate, and structurally distinct.
Friction designates precisely the phase in which stability is still possible, but only under increasing and nonlinearly rising costs.

A.6 Didactic Core Idea

The image shows friction not as a sudden obstacle, but as increasing viscosity that signals that the previous situational model is losing its load-bearing capacity. The decisive epistemic point lies not in the standstill itself, but before it, where effort, discomfort, and coordination costs already rise significantly.

A.7 Mnemonic (Didactic)

Friction is the state in which one can still make progress, but no longer without growing effort, no longer self-evidently together, and very likely not for much longer.