

# Structural diagnostics for human relational systems: a translational framework converging independent development with peer-reviewed science

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## Abstract

This article presents the Relational Operating System (ROS), a structural diagnostic framework for human relational systems developed independently over three decades and reduced to practice in a live diagnostic application. The ROS introduces five structural regulators – Environment, Self, Mortar, Reciprocity, and Time – governed by eleven Laws of Relational Physics, and operationalised through the Rouse OS Equation (ROSE): a composite calculation converting environmental pressure, individual capacity, and bonding integrity into a single structural load score. Unlike existing wellness instruments, which measure the experience of stress, the ROS measures the structural inputs producing it. This article demonstrates how the ROS framework, developed without reference to peer-reviewed literature, independently converged with established findings across bioecological systems theory, emotion regulation research, attachment science, dyadic coping literature, and human-robot interaction (HRI) engineering. The translational pathway – from independent conceptual development to diagnostic application to institutional deployment – is examined as a case study in applied structural humanism, with particular attention to the epistemic legitimacy of frameworks developed outside conventional academic settings. The framework's extension into HRI engineering, corporate burnout prevention, and wearable biometric interpretation illustrates its cross-domain applicability and positions the ROS as a foundational contribution to the emerging field of Relational Systems Engineering. The article argues that structural regularities in human relational dynamics are robust enough to be independently identified through systematic non-academic observation and rigorous enough to align with controlled empirical inquiry – a convergence pattern that itself warrants attention within the translational humanities project.

**Keywords:** relational systems, structural diagnostics, translational humanities, stress measurement, human-robot interaction, dyadic coping, applied social science, burnout prevention

## **1. Introduction: The Translational Gap in Relational Science**

The humanities and social sciences have long generated knowledge about how human relationships function, fracture, and repair. What they have not produced is a standardised measurement architecture capable of converting that knowledge into quantifiable, intervention-ready diagnostic outputs. The result is a structural gap: practitioners, clinicians, organisational leaders, and engineers who work with human relational systems possess abundant descriptive vocabulary but no common measurement instrument.

This article presents the Relational Operating System (ROS) — a structural diagnostic framework that occupies that gap. The ROS treats human relationships not as emotional narratives to be interpreted, but as load-bearing systems to be measured, mapped, and structurally reinforced. At its core is ROSE, the first quantifiable composite metric for structural relational load, derived from environmental pressure inputs, individual capacity assessments, and bonding integrity measures rather than self-reported emotional states.

The ROS is a case study in translational science from an unusual direction. Rather than originating in academic research and moving toward application, it originated in direct experiential observation and independent systems thinking — and subsequently converged, component by component, with the findings of peer-reviewed literature across multiple disciplines. This convergence was discovered after the framework was complete, not used to construct it. That sequence is itself theoretically significant: it demonstrates that structural regularities in human relational dynamics are robust enough to be independently identified through careful observation, and rigorous enough to align with controlled empirical inquiry.

The translational pathway now runs in both directions. The ROS has been reduced to practice in a live diagnostic application (Reflection, available at [RouseOS.com](http://RouseOS.com)), adapted for human-robot interaction (HRI) engineering as an operator load-state monitoring system, and structured as a three-tier practitioner certification curriculum. This article documents that pathway and situates it within the emerging project of translational humanities — the effort to make humanistic and social scientific knowledge actionable without surrendering its epistemic foundations.

## **2. The Problem of Measurement in Relational Science**

Every major applied field operates on measurement standards. Financial systems use credit scoring. Medicine uses vital signs. Structural engineering uses load calculations. Human relational health has never had one.

Existing tools – the Holmes-Rahe Stress Inventory, the Perceived Stress Scale, standard clinical assessment batteries – measure the experience of stress through self-report. These tools are well-validated for their intended purpose. The gap is not in their design but in their scope: they describe how individuals feel under load, not what structural conditions are producing that load. Two individuals reporting identical perceived stress scores may carry radically different structural burdens. One has financial buffers, stable housing, reciprocal relational support, and consistent daily structure. The other has none. The same self-report score masks completely different structural realities – and produces completely different intervention requirements.

The absence of structural measurement produces three downstream failures. First, practitioners cannot distinguish environmental overload from individual capacity depletion from relational bond erosion – distinctions that require entirely different interventions. Second, organisations cannot detect structural load accumulation before behavioural failure occurs, limiting prevention to reactive crisis management. Third, engineers and technologists building systems that interact with humans – from collaborative robots to adaptive AI interfaces – have no standardised model for assessing the relational load state of their human partners.

The ROS addresses all three failure modes through a unified structural diagnostic architecture. The translational contribution is not merely a new framework – it is the first measurement layer that applied relational science has lacked.

### **3. The Relational Operating System: Structural Architecture**

The ROS organises human relational function across five structural regulators. Each represents a distinct layer of the system. Each can be independently assessed, scored, and intervened upon. All five interact dynamically under load.

#### **3.1 Environment: The Pressure Field**

The Environment regulator captures all external forces acting on the relational system from outside the individual. Financial pressure, housing instability, workplace stress, social environment quality, and physical safety conditions constitute environmental load. Environment is assessed first because it establishes the external pressure baseline against which all internal capacity must be measured. A system that appears to have adequate self-capacity may be fully depleted when environmental load is properly quantified.

The ROSE operationalises the Environment assessment: ROSE = Base Pressure - Resource Absorption - Stabiliser Dampening. Base Pressure is the total environmental load from economic, physical, legal, and situational stressors. Resource Absorption measures the degree to which available buffers – financial reserves, social support, physical health – dampen incoming pressure. Stabiliser Dampening captures the active dampening effect of four controllable environmental structures: daily routine consistency, behavioural follow-through, shared purpose or direction, and creative outlet access.

A critical diagnostic principle follows from this structure: stability under low environmental load is not evidence of structural integrity. It is the absence of a test. Relationships that appear healthy when ROSE scores are low may possess significant vulnerabilities that only become visible when load escalates. This principle reframes the interpretation of relational health assessments conducted during low-pressure periods.

### **3.2 Self: Center-Cell Capacity**

The Self regulator encompasses twelve domains of individual capacity: Identity Integration, Emotional Regulation, Executive Function, Feedback Interpretation, Emotional Articulation, Temporal Orientation, Vulnerability/Self-Intimacy, Sexual Self-Comfort, Coping Flexibility, Judgment Formation, Relational Valuation Weighting, and Bonding Deprivation Awareness. Together these form the structural core – what the ROS terms the center-cell – of the relational architecture.

When the center-cell is compromised, load cannot be effectively distributed across the surrounding relational structure. Self-capacity depletion is the most commonly misdiagnosed layer in relational assessment: it presents as relational conflict when the origin is internal exhaustion. The ROS designates this pattern Systemic Displacement – a structural consequence where internal pressure, having nowhere else to go, overflows onto the nearest relational cell.

A key reframe: behavioural failures under load are structural events, not character assessments. A person who cannot maintain relational commitments under critical load is not failing morally. They are failing structurally. Capacity shapes behaviour. When internal reserves reach zero, reactivity is not a character defect – it is a mechanical consequence of load exceeding capacity.

### **3.3 Mortar: Bonding Integrity**

The Mortar regulator represents the six behavioural compounds that bind relational structure: Respect (baseline regard for dignity), Honesty (alignment with shared reality), Reliability (predictable follow-through on commitments), Trustworthiness (active protection of partner vulnerability), Boundaries (calibration of access and demand), and Effort (unrequested acts that maintain bond activation).

Mortar is defined strictly as observable conduct, not as emotional state. This distinction is architecturally critical. Love – defined as the motivational state that places individuals in relational proximity – does not constitute Mortar. Mortar is what holds the structure together under load. A relationship with high emotional intensity but low behavioural reliability is structurally precarious: when pressure is applied, the bond collapses because predictability – the structural element capable of bearing weight – was never present.

Trust, in the ROS framework, is not an input to the relational system. It is an output – the emergent structural result of all six Mortar compounds functioning consistently over time. This reframing has direct intervention implications: trust cannot be repaired directly. The specific behavioural compounds that constitute trust must be rebuilt in sequence.

### **3.4 Reciprocity: Load Balancing**

The Reciprocity regulator measures the symmetry of effort, attention, and resource distribution across the relational system. Load imbalance – one system absorbing significantly more than the other – produces structural fracture at the overloaded point regardless of the quality of other structural components. Reciprocity functions as the activation mechanism for Mortar: without symmetrical load distribution, even structurally sound behavioural compounds cannot sustain bond integrity under pressure.

A critical distinction separates adaptive load shift from chronic load accumulation. Adaptive load shift is temporary: a finite stressor transfers weight to the partner until capacity is restored, and the bond is densified by the experience of shared survival. Chronic load accumulation is unidirectional: one partner carries disproportionate weight indefinitely, capacity is never restored, and Support Fatigue – structural exhaustion of the overloaded partner – eventually produces disengagement.

Reciprocity Suppression identifies a failure mode where load cannot return because the return pathway is blocked. This occurs when attempts to contribute are rejected, corrected, or rendered ineffective by the receiving partner. Imbalance in these cases is created not by absence of willingness but by structural obstruction of the redistribution mechanism.

### **3.5 Time: The System Amplifier**

Time is not a fifth domain of content but a neutral modifier that amplifies or dampens the effect of all four preceding regulators. Time does not heal – it magnifies the existing structural state in whichever direction that state is moving. A system with sound structure and reciprocal investment will deepen in trust and resilience over time; the same duration that densifies a healthy bond accelerates

the collapse of a compromised one. A system under sustained load without repair will fail at a lower threshold than a system experiencing identical acute pressure, because prior micro-fractures reduce structural capacity for each subsequent load event.

The ROS Repair Window Assessment operationalises the Time dimension across four stages: Early (trust reservoir intact, repair structurally inexpensive), Delayed (resentment calcifying, withdrawal emerging, intervention required), Critical (emotional fatigue replacing willingness, trust collapse and reciprocity refusal both present), and Terminal (core load-bearing elements collapsed, restoration beyond structural thresholds). Stage identification precedes all intervention sequencing decisions.

#### 4. The ROSE Equation: Structural Load Measurement

The ROSE is the computational engine of the ROS diagnostic system:

$$\text{ROSE} = \text{Base Pressure} - \text{Resource Absorption} - \text{Stabiliser Dampening}$$

The equation converts the five-domain assessment into a single structural load score. Base Pressure represents total environmental and relational load. Resource Absorption represents available buffers successfully dampening incoming pressure. Stabiliser Dampening represents the active load-reduction effect of the four controllable environmental structures identified in the Environment regulator.

ROSE outputs are mapped against a four-tier structural load scale:

ROSE Score	System State	Clinical Meaning	Indicated Response
0-20	Low Load	System mostly supportive	Monitor stabilisers
21-40	Moderate Load	Stable but under pressure	Monitor Resource Absorption
41-60	High Load	Strain appearing	Intervention indicated
61+	Critical Load	Structural reinforcement required	Immediate intervention

The strategic value of ROSE over existing stress measurement tools is the elimination of the self-report requirement. The equation measures structural

inputs, not emotional experience. A ROSE score of 47 communicates structural load state with the same immediate legibility as a heart rate of 112 – without requiring the user to accurately assess and report their own emotional state. This matters particularly in high-stakes environments where self-disclosure carries professional or social consequences, and in populations where emotional literacy or self-awareness is compromised by the very load conditions being measured.

## **5. Convergence with Peer-Reviewed Literature**

The ROS framework was developed independently over three decades through direct observation and iterative refinement. Peer-reviewed literature was mapped to the framework after its completion. The convergences below represent independent scientific validation of structural elements that were identified through non-academic means – a pattern that itself warrants theoretical attention within the translational humanities project.

### **5.1 Environment: Bioecological Convergence**

Bronfenbrenner's bioecological model (1979, 1994) establishes that layered environmental systems shape individual and relational development across time – that person-context dynamics can be modeled as a structured interaction between nested ecological layers. The ROS Environment regulator operationalises this insight as a diagnostic tool: mapping specific pressure sources and absorption capacities to generate a composite environmental load score. Conger et al. (2002) and Kavanaugh et al. (2018) document measurable economic pressure pathways into family system functioning consistent with the Base Pressure component of the ROSE calculation.

### **5.2 Self: Emotion Regulation and Capacity Research**

Gross (1998) established that emotion regulation shapes behaviour under pressure and that different regulation strategies produce distinct relational and physiological outcomes – directly corroborating the ROS principle that capacity shapes behaviour. Gratz and Roemer (2004) provide psychometric validation for multidimensional capacity assessment, supporting the twelve-domain Self regulator architecture. House et al. (1988) and Uchino (2006) document the physiological pathways through which social relationships affect health outcomes – consistent with the ROS model of center-cell depletion radiating outward into relational and physical systems.

### **5.3 Mortar: Attachment Science and Behavioural Bond Research**

Hazan and Shaver (1987) and Mikulincer and Shaver (2019, 2020) establish attachment orientation as a structural influence on emotion regulation and relational functioning – consistent with the Mortar compound model's emphasis on behavioural adhesion as the operative relational mechanism rather than emotional attachment per se. Gottman and Levenson (1992, 1999) document that observed marital processes – not reported emotional states – predict later dissolution through measurable behavioural and physiological patterns.

#### **5.4 Reciprocity: Dyadic Coping Literature**

Falconier and Kuhn (2019) and the broader dyadic coping literature (Falconier et al., 2015; Weitkamp and Bodenmann, 2022) establish dyadic coping as a conceptual and empirical domain for shared stress management – directly corroborating the Reciprocity regulator and its association with relational satisfaction outcomes. The distinction between adaptive and chronic load transfer maps precisely onto the dyadic coping literature's differentiation between supportive coping episodes and dependency-producing patterns.

#### **5.5 HRI Engineering: Structural Deficit Convergence**

The ROS framework's extension into human-robot interaction (HRI) engineering identifies an additional convergence point. Hancock et al. (2011) and Sanders et al. (2019) establish trust as a function of performance, predictability, and anthropomorphism in HRI contexts – but without a structural model of trust formation or failure over time. Akalin et al. (2023) separate objective from perceived safety in HRI without a dynamic pressure-based model connecting safety perception to environmental load.

The ROS fills the structural gap across all these domains simultaneously: by defining trust as an output of consistent behavioural compounds over time, mapping safety to dynamic environmental load and capacity states, and introducing time as an amplifier of both trust formation and fracture propagation. Hopko et al. (2023) on collaborative robotics workload management aligns directly with the Reciprocity regulator's load-balancing function in HRI contexts.

### **6. Translational Pathway: From Concept to Application**

The ROS translational pathway illustrates a mode of knowledge production that the translational humanities project has not yet fully theorized: frameworks developed outside academic institutions, through direct experiential immersion rather than experimental method, that subsequently demonstrate convergence with peer-reviewed findings and achieve institutional application.

## **6.1 Development Outside Conventional Academic Settings**

The ROS emerged from three decades of direct observation across relational, organisational, and technological systems – without institutional affiliation, formal research funding, or academic publication. The framework was developed on the premise that structural regularities in human relational dynamics are observable through careful systematic attention, regardless of the observational setting. The framework's development spanned multiple domains – engineering, public services consultation, production environments, and policy development – each providing a distinct vantage point on human systems operating under load. Author details withheld for double-anonymised review.

This developmental pathway raises questions central to the translational humanities project. What epistemic claims can frameworks developed outside academic institutions legitimately make? The ROS case suggests that the answer depends not on the institutional origin of the knowledge but on the structural rigor of its development, the consistency of its internal logic, and the degree of convergence with independently generated empirical findings. The ROS meets all three criteria.

## **6.2 Reduction to Practice**

The ROS has been reduced to practice across multiple application domains. The Reflection diagnostic application – currently live – provides a two-layer consumer deployment: a glanceable structural load indicator for wearable devices and a full five-domain honeycomb assessment for mobile platforms. The application implements ROSE with personalized baseline calibration and longitudinal fracture mapping.

The Human Relational Interface (HRI) API extends the framework into robotics and wearable technology integration. The API ingests biometric stream data (heart rate variability, sleep architecture, resting heart rate, recovery scores) and maps physiological signals to the five structural regulators, producing a real-time ROSE score with capacity state classification, dominant regulator identification, compounding risk assessment, and recommended intervention. This creates the first operator load-state monitoring system derived from a structural relational model.

A three-tier practitioner certification curriculum operationalises the framework for clinical and coaching practice. The curriculum trains practitioners to execute the five-domain integrated diagnostic scan in correct sequence – a sequencing requirement derived from the architectural logic of the system itself: Environment must be assessed before Self capacity can be evaluated; Self must be stabilized before Mortar compounds can be assessed; Mortar integrity is prerequisite to Reciprocity function.

### **6.3 Epistemic Legitimacy and the Translational Humanities Challenge**

The ROS case illustrates a challenge that the translational humanities project must address: how to evaluate the epistemic legitimacy of knowledge claims that arise outside conventional academic production processes. The convergence between independently developed structural observations and peer-reviewed empirical findings suggests that the academic validation process – while essential for certain purposes – is not the only pathway through which structurally valid knowledge can be produced.

This does not render academic validation unnecessary. The integrated ROSE awaits formal clinical validation study. The framework's component-level convergences with peer-reviewed literature are documented above; the system-level validation remains a priority for the next phase of development. The translational contribution of this article is to document the convergence pattern itself – to demonstrate that a framework developed through systematic non-academic observation can achieve sufficient structural coherence to warrant formal investigation.

## **7. Cross-Domain Applications**

The ROS framework's structural architecture produces consistent application logic across domains that are conventionally treated as separate fields. This cross-domain coherence is itself a translational contribution: it demonstrates that the structural regularities of human relational systems are domain-independent.

### **7.1 Clinical Psychology and Therapy**

The primary diagnostic error in relational therapy – applying communication training to a system failing due to environmental overload – is a direct consequence of the absence of structural assessment. The ROS provides the measurement layer that enables practitioners to distinguish environmental fractures from capacity depletion from bond erosion before prescribing intervention. The sequenced intervention protocol – Environment stabilisation before Self restoration before Mortar repair – prevents the most common repair failure mode: addressing symptoms rather than structural origins.

### **7.2 Corporate Wellness and Burnout Prevention**

Current corporate wellness programmes operate on self-report and reactive intervention. They describe how employees are doing without explaining why, and without structural guidance for intervention before performance metrics collapse. The ROSE produces a measurable wellness baseline comparable across

departments and project lifecycles. The HRI aggregate organisational health endpoint provides anonymized structural load mapping across teams – identifying systems under unsustainable load before behavioural indicators emerge.

### **7.3 First Responder and Military Resilience**

Personnel operating under extreme load require objective structural assessment that self-report cannot provide in environments where admitting strain carries professional consequences. The HRI integration layer delivers physiological data mapped to structural load without requiring verbal disclosure – the body reports what the person cannot. The operator load-state endpoint provides command systems a continuous objective read on structural capacity, enabling interface adjustment and load redistribution before critical failure.

### **7.4 Human-Robot Interaction Engineering**

The \$170 billion HRI market is moving toward social robotics – systems that must build and maintain trust with human operators over time. No structural model for human-robot relational dynamics currently exists. The ROS maps directly to engineering architecture: defining trust as an output of consistent behavioural compounds (Mortar), operationalizing load-aware task redistribution (Reciprocity), providing a longitudinal fracture model (Time), and offering a real-time operator load metric (ROSE) that robotic systems can use to adjust autonomy levels, communication transparency, and task complexity in response to human structural state.

## **8. Limitations and Future Directions**

The ROS framework carries three categories of limitation that are important to state clearly.

First, the integrated ROSE awaits formal clinical validation study. Component-level convergences with peer-reviewed literature are documented above, but the system-level equation – as a composite diagnostic instrument – has not yet been subjected to controlled empirical validation. This is the primary research priority for the next phase of development.

Second, the ROS is a structural diagnostic tool, not a clinical assessment instrument or psychological diagnostic system. It does not diagnose individuals with psychological conditions. The ROSE score is a structural load indicator – analogous to a structural load calculation in civil engineering – not a clinical determination. It is designed to function alongside, not instead of, licensed clinical practice.

Third, the framework's development outside conventional academic settings, while producing the convergence pattern documented above, also means that certain methodological safeguards standard in academic research were not present during development. The framework's internal consistency and cross-domain coherence are well-established; its external validity in controlled research settings remains to be demonstrated.

Future directions include formal clinical validation of ROSE as a composite instrument, longitudinal study of the Time amplifier's effect on repair window progression, empirical validation of the HRI operator load-state model in robotics deployment contexts, and investigation of the framework's application to organisational team structures as distinct from dyadic relational systems.

## **9. Conclusion**

The Relational Operating System represents a translational contribution that runs in an unusual direction: from independent structural observation, through convergence with peer-reviewed science, to institutional application in clinical, organisational, and engineering contexts. It offers the translational humanities project a case study in how humanistic knowledge about relational dynamics — knowledge that is as old as human community — can be formalized into a measurement architecture capable of generating diagnostic outputs, guiding sequenced intervention, and integrating with technological systems.

The framework's core proposition is simple: relationships are load-bearing systems. They fail not because of character defects or insufficient love, but because structural load exceeds structural capacity. Understanding that distinction — and having a measurement instrument capable of locating the structural origin of failure — changes what intervention looks like, what prevention looks like, and what the engineering of human-facing systems requires.

The translational challenge for relational science is not to generate more descriptive knowledge about how relationships feel. It is to build the measurement architecture that makes structural knowledge actionable. That architecture now exists.

## **Key Statements**

### **Competing Interests**

The author declares that the Relational Operating System framework, ROSE, and the associated application and certification system are proprietary intellectual property with a provisional patent application filed. This represents a potential competing interest that reviewers should consider in assessing the manuscript. The framework is presented here as a translational case study, not as a commercial recommendation.

### **Data Availability**

The Reflection diagnostic application referenced in this manuscript is publicly accessible via a URL withheld for double-anonymised review and available upon acceptance. It constitutes the primary proof-of-concept implementation described. No controlled experimental data was generated in the preparation of this manuscript. The framework's empirical validation is described as a future research direction; this manuscript documents convergence with existing peer-reviewed literature rather than reporting original experimental findings.

### **Ethics Declaration**

No human subjects research was conducted in the preparation of this manuscript. No ethical approval was required. The framework described is a structural diagnostic system; clinical applications of the framework are conducted by trained practitioners under their own applicable professional ethical obligations.

### **Author Contributions**

[Withheld for double-anonymised review. To be provided upon acceptance.]

### **Acknowledgements**

This research received no external funding. No institutional affiliation, grant support, or organisational sponsorship was involved in the development of this framework or the preparation of this manuscript.

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