Journal of Modern Technology and Engineering
Vol.10, No.3, 2025, pp.189-212
https://doi.org/10.62476/jmte.103189

Jomard Publishing

MAKING INTELLIGENCE PUBLIC: THRESHOLDS OF POLICY, DEMAND, AND AI-READINESS

Oktay Ibrahimov*

Smart Solutions Group, Baku, Azerbaijan

Abstract. AI is emerging as a general - purpose infrastructure whose technical capabilities and governance institutions co - evolve. Societies are increasingly embedding algorithmic decision support across public administration, resource allocation, and production. This produces divergence in outcomes: effective integration yields compounding improvements in efficiency and productivity; ineffective integration risks persistent capability gaps. This paper develops the Societal Intelligence Thresholds (SINT) framework, a diagnostic model that explains when AI systems - and the AI - intensive digital infrastructures surrounding them—become functionally non-optional under sustained human governance. Building on companion studies of Cultural - Technological Synergy (CTS), which conceptualizes culture as adaptive coordination infrastructure, and AI as Public Infrastructure (AIPI), which defines measurable infrastructural maturity through the Infrastructure Status Index (ISI), this paper isolates the missing transitional layer: the Policy – Demand equilibrium, modulated by AI readiness, that governs AI threshold dynamics. SINT formalizes how policy intent, societal demand, and AI-readiness interact to determine the pace of threshold crossing and the persistence of infrastructural dependence. Societies oscillate across four characteristic quadrants - Dormant Drift, Mandate Compliance, Grassroots Pull, and Convergent Momentum - each associated with distinct fragility patterns. Cultural architectures (heritage adaptability, cross-civilizational competence, innovation ethos, strategic determination) modulate these trajectories by influencing legitimacy, trust, and learning capacity. An interpretive application to Azerbaijan (2012—2025) illustrates pre-threshold alignment and AI-readiness asymmetries typical of transitional economies. The paper concludes with a typology of AI thresholds, a sequencing model for policy interventions, and a research agenda for comparative validation. Recognizing threshold mechanics clarifies that sustainable AI integration depends less on technology supply than on governing how societies build, coordinate, and institutionalize AI capacity — the collective ability to turn technological possibility into stable, legitimate infrastructure.

Keywords: Societal Intelligence Thresholds, policy–demand dynamics, cultural drivers, AI and society, human–AI collaboration, Azerbaijan.
Corresponding author: Oktay, Ibrahimov, Smart Solutions Group, Baku, Azerbaijan,
e-mail: *ogtay.ibrahim@outlook.com*
Received: 10 October 2025; Revised: 29 November 2025; Accepted: 3 December 2025;
Published: 22 December 2025.

1 Introduction

AI is no longer a peripheral capability; it increasingly constitutes core infrastructure for economic systems, public security, and defense, as well as for knowledge production and governance. Yet societies differ dramatically in how swiftly and coherently they convert emerging AI capacities into durable, legitimate, and governable infrastructure. Technical capability alone does not determine success. What distinguishes societies that cross the AI threshold early from those that hesitate and lag behind is the ability to synchronize policy intent, societal demand, and

AI-readiness capacity into a self-reinforcing dynamic that transforms experimentation into infrastructural dependence. This paper conceptualizes these synchronization dynamics as SINT - population-scale transitions in which digital and AI systems become functionally non-optional under sustained human governance.

1.1 From Diffusion to Threshold Dynamics

Traditional innovation-diffusion frameworks explain *who adopts when* but not *when adoption becomes irreversible.* In the AI era, reversibility itself becomes a central analytical variable: once professional norms, market expectations, and public legitimacy co-align, discontinuities appear - manual fallbacks are no longer maintained, and non-use effectively amounts to non-competence.

While national strategies often present AI integration as discrete initiatives—sandboxes, ethics charters, and skills programs - few define the conditions under which these efforts consolidate into everyday reliance, or the mechanisms by which delays produce fragility across policy, operations, and legitimacy.

China's *New Generation AI Development Plan* explicitly links infrastructure buildout, industrial deployment, and governance evolution through staged targets: facial-recognition systems that began as public-security pilots became embedded in payment systems, transportation access, and social services within defined timelines, establishing clear thresholds for scaling from experimental to mandatory. The European Union's *AI Act* categorizes risk levels that trigger distinct regulatory requirements, marking when systems move from low oversight to high scrutiny—though it stops short of defining dependency conditions. The United States exhibits a fragmented, sectoral approach: the Department of Defense employs formal AI readiness levels and deployment gates, while most civilian agencies lack comparable frameworks for determining when algorithmic systems become mission-critical. The United Kingdom's distributed regulatory model, assigning AI oversight to existing sectoral regulators, creates coordination gaps—no central authority defines when dependencies across healthcare, finance, and transport generate systemic interdependence that requires integrated governance. Singapore's *National AI Strategy* shows partial progress: its *100 Experiments* program specifies criteria for scaling pilots to production, including metrics for when healthcare diagnostics or traffic management tools transition from trial to operational dependency. Denmark's public-sector AI adoption includes governance checkpoints-legal review, algorithmic auditing, and fallback procedures—before systems move from experimentation to citizen-facing deployment. Estonia's *X-Road* infrastructure, while not a full threshold framework, maintains operational redundancy and service-level requirements that explicitly acknowledge systemic dependency.

Together, these cases show that some nations are beginning to recognize the *phase transitions* involved in AI integration. Even so, most structured approaches still lack articulation of how delays in one domain-regulatory clarity, skills development, or infrastructure investment - compound fragility across policy coherence, operational reliability, and public legitimacy.

1.2 Conceptual Lineage and Analytical Gap

This study builds on two companion frameworks developed in earlier work.

First, **Cultural–Technological Synergy (CTS)** (Ibrahimov, 2025a) conceptualizes culture as a coordination infrastructure — a cognitive – normative system that lowers transaction costs, anchors expectations, and authorizes reform. CTS explains why societies with similar resources diverge in their ability to legitimize and institutionalize technological change.

Second, **AI as Public Infrastructure (AIPI)** and its **Infrastructure Status Index (ISI)** (Ibrahimov, 2025b) formalize the progression from *tool* to *infrastructure* to *public infrastructure*, identifying when AI becomes essential, embedded, legitimate, and governance-dependent.

What remain undertheorized are the transitional mechanics that connect these stages—the conditions under which societies move from cultural preconditions (CTS) to infrastructural consolidation (ISI/AIPI).

Existing literatures on innovation diffusion (Rogers, 2003), technology acceptance, and institutional path dependence describe adoption or co - evolution but rarely specify *when adoption becomes irreversible*. Governance research largely emphasizes principle - and risk - based approaches (e.g., (OECD, 2019); (HLEG, 2019) ; (UNESCO, 2021) ;*Recommendation on AI Ethics*; mappings by (Jobin et al., 2019) and (Fjeld et al., 2020)), while critiques note the absence of operational sequencing, feedback loops, and consolidation triggers (e.g., (Mittelstadt, 2019); (Morley et al., 2021); (Veale & Borgesius, 2021); (Raji et al., 2020); (Brundage et al., 2020)).

To address this gap, the present paper develops the Societal Intelligence Thresholds (SINT) framework—a diagnostic model of how policy intent, societal demand, and AI-readiness interact to produce threshold crossings. SINT formalizes the field that links CTS (cultural preconditions) with AIPI/ISI (infrastructural outcomes), showing how alignment across motivation, capability, and legitimacy turns experimentation into dependence.

1.3 Core Argument

Successful AI integration depends less on the presence of advanced systems than on alignment within a Policy-Demand equilibrium. Societies evolve through four characteristic quadrants:

- **Dormant Drift (Q1):** low policy intent and weak demand; initiatives remain aspirational.
- **Mandate Compliance (Q2):** strong policy, weak demand, leading to fatigue and fragile legitimacy.
- **Grassroots Pull (Q3):** low policy, high demand; innovation outpaces regulation, causing operational incidents.
- **Convergent Momentum (Q4):** high policy and high demand sustained by AI-readiness - where thresholds are crossed and stabilized.

Time outside Q4 accumulates fragility across policy, operations, and legitimacy. AI - readiness — comprising skills, institutions, data infrastructure, and governance learning—acts as the *conversion efficiency* that determines threshold crossing velocity and post-threshold stability. Cultural architectures, in turn, condition AI-readiness itself: heritage adaptability, cross - civilizational competence, innovation ethos, and strategic determination (CTS dimensions) shape whether coordination costs fall or rise during transition.

1.4 Scope and Illustrative Setting

Empirically, the paper employs an interpretive application to Azerbaijan (2012–2025), a transitional economy with high policy ambition, growing societal demand, and uneven AI - readiness. The case demonstrates pre-threshold alignment dynamics without claiming full crossing. Azerbaijan's multicultural and multilingual social environment, strong state coordination capacity, youth-driven engagement with digital technologies, and pro-development orientation toward science, technology, business, and regional–global collaboration provide fertile ground to observe policy–demand asymmetries and the cultural modulation of AI - readiness. Regional comparisons (Georgia, Armenia, Kazakhstan, Uzbekistan) offer plausibility checks.

1.5 Contribution and Structure

Conceptually, the paper advances a diagnostic framework of societal AI - readiness and threshold mobility for the transition toward AI as public infrastructure, refining SINT as the bridging layer between cultural foundations (CTS) and infrastructural consolidation (ISI). Analytically, it offers testable propositions and early-warning indicators for governance practice. Methodologically, it integrates interpretive and diagnostic reasoning, positioning the study as illustrative rather than confirmatory.

The paper introduces an AI Threshold-Crossing Dashboard that operationalizes management of the Policy – Demand equilibrium through three linked indicators:

i. Policy Saturation Index (PSI)—fulfilled institutional commitments relative to adaptive capacity remaining;

ii. Demand Elasticity Index (DEI)—responsiveness of civil society and market actors to newly introduced AI-enabled services; and

iii. AI-Readiness Efficiency (AIRE)—realized adoption per unit of digital-capability investment.

Together, these gauges provide an early-warning panel for imbalance (policy overshoot, enthusiasm decay, readiness drag) and make SINT operational for policymakers.

The paper proceeds as follows: Section 2 situates SINT within existing theoretical landscapes and clarifies its distinct contribution; Section 3 develops the framework and threshold typologies; Section 4 examines AI-readiness modulation and cultural drivers; Section 5 illustrates the framework through Azerbaijan's digital trajectory; Section 6 introduces the Threshold Dashboard within the comparative/policy analysis; Section 7 outlines a research agenda; and Section 8 concludes.

2 Theoretical Positioning

2.1 From Cultural and Infrastructural Foundations to Threshold Mechanics

Research on digital transformation and AI governance has diversified into three broad analytical strands:

(1) **Cultural preconditions of modernization**, emphasizing value orientations, social capital, and legitimacy ((Weber, 2002) (Inglehart & Welzel, 2005));

(2) **Infrastructure theory**, tracing how technologies evolve from tools to public utilities through embedding and standardization ((Star & Ruhleder, 1996); (Plantin et al., 2018); (Frischmann, 2012)); and

(3) **Governance and AI-readiness models**, assessing institutional, educational, and policy capacities for digital integration.

Each captures an aspect of AI's societal diffusion, yet taken together these literatures still do not fully explain the discontinuous, population-level shifts through which AI transitions from optional to necessary.

Two companion frameworks previously developed by the author—CTS and AIPI/ISI frameworks—address the first two strands. Together, these studies explain why cultural architectures matter and what infrastructural consolidation entails once achieved.

What remains undertheorized is how societies traverse the space between cultural preconditions (CTS) and infrastructural consolidation (AIPI/ISI)—how collective motivation, institutional policy, and technical AI-readiness align to produce irreversible dependence on AI infrastructure. The SINT framework introduced here seeks to address this gap. It formalizes threshold formation as a field phenomenon governed by the interaction of policy intent and societal demand, modulated by AI-readiness.

2.2 The Gap: From Adoption to Irreversibility

Classic diffusion models (Rogers, 2003) illuminate adoption rates and patterns but assume continuous and reversible trajectories. Technology-acceptance models (TAM/UTAUT) focus on micro-level perceptions of usefulness and ease of use. Innovation-system and path-dependence literatures (Lundvall, 1992); (Nelson and Winter, 1982); (Pierson, 2000) analyze institutional technological co-evolution but conceptualize change as gradual. Governance and ethics frameworks articulate principles for alignment yet offer limited guidance on temporal sequencing or feedback. Yet none of these approaches specify the threshold conditions under which non-use becomes socially or economically non-viable.

SINT introduces a diagnostic framework for country-level thresholds. Adoption becomes irreversible when three forces co-align:

i. **National policy frameworks** institutionalize AI use through mandates, funding, and regulatory oversight.

ii. **Domestic societal and professional demand** generates bottom-up legitimacy and expectation.

iii. **National AI - readiness** - skills, infrastructure, and governance learning - enables sustainable performance once integration occurs.

The intersection of these vectors produces country-level threshold crossings, whereas their imbalance generates fragility—manifesting as economic, technological, or intellectual stagnation, operational incidents, or legitimacy brittleness.

2.3 Motivational Asymmetry and the Aladdin–Genie Heuristic

A persistent misconception in AI discourse is that technological capability alone determines societal transformation. In practice, identical systems yield divergent outcomes across contexts. To illustrate this motivational asymmetry, we may invoke the Aladdin–Genie metaphor as a heuristic: the genie's power is constant, but outcomes depend on who commands the lamp.

In this analogy, AI represents the genie—vast computational capacity devoid of intrinsic motives—while societies embody different "Aladdins", each shaped by cultural norms, ambitions, and governance habits. The metaphor highlights three analytical insights:

i. **Instrumental Power vs. Intentional Direction**. AI's strength lies in optimization and scale; it possesses no self-defined purpose. Human and institutional intent supply direction, just as Aladdin's wishes define the genie's actions.

ii. **Cultural Variation of Use.** Countries and societies differ in how they articulate shared ambitions and translate them into policy intent. A collectivist service culture may emphasize social welfare applications, while a competitive innovation ethos may channel resources toward entrepreneurial acceleration. The cultural configuration determines which thresholds are prioritized and how legitimacy is constructed.

iii. **Governance Persistence.** Because the genie lacks will, the lamp remains in human hands: sustained governance is inherent. Threshold crossing therefore depends on institutional competence, trust, and accountability—qualities grounded in cultural values, norms, and coordination patterns that sustain effective governance.

This heuristic complements rather than replaces formal modeling. It distills the motivational logic underpinning SINT: technological capacity is universal, but the societal imagination and governance to use it are not.

2.4 Integrating Culture, AI-Readiness, and Governance

The SINT framework thus occupies a meso-level analytical space between cultural preconditions and infrastructural outcomes. Culture through heritage adaptability, cross-civilizational competence, innovation ethos, and strategic determination (CTS dimensions)-conditions how AI-readiness develops and how policy demand coordination unfolds. AI-readiness, in turn, acts as conversion efficiency: it translates cultural motivation and policy ambition into operational capability. Governance architectures close the loop by institutionalizing feedback, learning, and legitimacy.

The result is a dynamic, multi-layered process rather than a linear progression. Thresholds emerge not from technological determinism but from synchronization across cognitive, institutional, and technical layers. Once synchronization is achieved, reversal becomes costly or infeasible AI ceases to be a tool and becomes infrastructure.

3 Conceptual Framework: Societal Intelligence Thresholds

3.1 Core Constructs

The SINT framework formalizes how societies cross from discretionary adoption of digital technologies to infrastructural dependence on AI systems under sustained human governance. It models threshold dynamics as the interaction of policy intent, societal demand, and AI-readiness capacity within a culturally conditioned field, bridging the Cultural–Technological Synergy (CTS) focus on cultural preconditions and the AI as Public Infrastructure / Infrastructure Status Index (AIPI/ISI) emphasis on infrastructural consolidation.

SINT comprises three foundational constructs - threshold, AI-readiness, and the Policy Demand equilibrium that together capture the dynamic geometry of AI integration.

(a) Threshold

A societal AI threshold denotes the point at which digital and AI systems shift from being optional aids to becoming functionally indispensable within everyday economic, administrative, and civic routines. After this threshold, non-use approximates non-competence, and reversal becomes prohibitively costly or socially unacceptable. Thresholds thus mark irreversibility under sustained human governance, not technological inevitability.

This definition refines the broader infrastructural transitions described in the ISI model by specifying the moment of crossing rather than the resulting maturity level.

(b) AI - readiness

AI-readiness is the conversion efficiency that translates policy ambition and social motivation into operational capability. In SINT, it comprises three sub-dimensions: technical (compute, data, and connectivity), institutional (governance, regulation, state capacity, financing, political coordination), and cultural/human (skills, literacy, professional ethics, trust, and learning norms). Low AI-readiness dissipates energy from policy or demand; high AI-readiness synchronizes them, accelerating threshold crossing and stabilizing post-threshold performance.

(c) Policy–Demand equilibrium

The Policy–Demand equilibrium models the interplay between top-down intent and bottom-up motivation. Policy encompasses national AI strategies, broader digitalization agendas, regulatory frameworks, state-stimulated investment, and institutional mandates. Demand includes professional desire, societal expectation, and user adoption momentum. Their interaction creates a dynamic configuration that determines whether AI-powered diffusion stabilizes into infrastructural dependence.

3.2 Quadrant Dynamics

To visualize this interaction, SINT defines four characteristic quadrants representing distinct alignment regimes (Fig. 1). Each quadrant corresponds to a typical combination of policy intensity and demand strength, producing recognizable behavioral patterns and fragilities. A concise, AI-readiness–modulated summary appears in Table 1.

Table 1: AI-Readiness–Modulated Quadrant Descriptions

Quadrant	Policy–Demand Alignment	Dominant Dynamics	Typical Risks / Outcomes
Q1 – Dormant Drift	Low Policy × Low Demand	Minimal innovation energy; scattered pilot projects	Economic, technological stagnation; skills erosion
Q2 – Mandate Compliance	High Policy × Low Demand	Top-down implementation without social traction	Legitimacy brittleness; reform fatigue
Q3 – Grassroots Pull	Low Policy × High Demand	Bottom-up experimentation; shadow innovation	Operational disruptions; workflow failures; fragmentation
Q4 – Convergent Momentum	High Policy × High Demand	Coordinated transformation; feedback loops reinforce adoption	Threshold crossing; sustained stability

The Policy-Demand equilibrium is not static: societies move between quadrants as AI - readiness evolves. Time spent outside Q4 accumulates fragility, manifesting as either policy exhaustion (Q2), uncontrolled experimentation (Q3), or chronic inertia (Q1). Threshold crossing occurs when alignment and AI - readiness jointly exceed a stability boundary — when both institutional rails and social energy sustain the shift from experimentation to dependence.

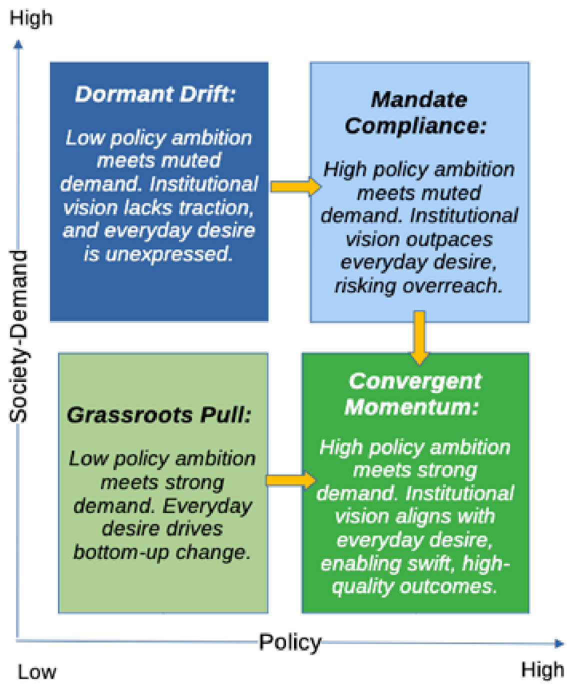

Figure 1: AI-Readiness-Modulated Quadrant

3.3 Threshold Typology

SINT differentiates among several types of thresholds that collectively constitute the societal AI transition. These thresholds can appear sequentially or in nested combinations.

1. Technological Thresholds - achieved when core digital and AI capabilities (connectivity, compute, data governance) reach sufficient penetration to enable system-wide integration.
2. Institutional Thresholds - crossed when governance architectures, regulations, and funding frameworks make AI an allowed—and increasingly recommended—normal operating practice.
3. Cultural Thresholds - occur when societal narratives and professional ethics normalize AI-assisted work and decision-making as legitimate and expected.
4. Operational Thresholds - reached when manual or non-AI alternatives become inefficient, non-competitive, or disallowed by standards.

While the ISI framework measures infrastructural maturity after these conditions stabilize, SINT focuses on transitional interplay—the critical co-alignment phase when these thresholds interact. For example, institutional advancement without cultural legitimation (policy > demand) yields brittleness, while grassroots enthusiasm without standards (demand > policy) risks disorder.

3.4 AI-Readiness Modulation and Conversion Efficiency

AI-readiness functions as the mediating layer that determines whether motivation (Policy × Demand) converts into durable capability. Formally:

$$\textbf{Threshold Velocity} \propto (\textbf{Policy} \cdot \textbf{Demand}) \times \textbf{AI - Readiness}$$

Low AI-readiness dampens threshold velocity even under strong policy or demand; medium AI - readiness produces oscillations - pilot fatigue, uneven implementation, and partial reversions; high AI - readiness enables stable acceleration toward infrastructural consolidation.

AI-readiness is cumulative and path-dependent—it matures through learning loops linking technical education, organizational practice, and governance experience. Cultural dimensions from CTS function as coefficients influencing how efficiently AI-readiness amplifies policy and demand.

3.5 Risk Typology and Failure Modes

SINT identifies three characteristic failure modes that arise when alignment collapses before the threshold stabilizes:

1. **Stagnation (Low–Low):** Weak policy and demand create a low-energy system where pilot programs decay and institutional memory erodes.
2. **Operational Incidents (Low Policy / High Demand):** Uncoordinated innovation leads to security breaches, algorithmic failures, or reputational damage that erode trust.
3. **Legitimacy Brittleness (High Policy / Low Demand):** Strong mandates without social traction provoke compliance fatigue and declining public confidence.

These modes correspond to early-warning indicators for policymakers: surges in unregulated AI use, recurring pilot attrition, or declining trust surveys often signal threshold misalignment. The SINT diagnostic can therefore function as a governance dashboard, informing sequencing and corrective intervention.

3.6 Conceptual Integration

Conceptually, SINT bridges three analytical layers - culture, threshold dynamics, and infrastructural maturity—as summarized in Table 2.

Table 2: SINT as a Bridge Across Three Analytical Layers

Layer	**Representative Framework**	**Analytical Focus**	**SINT Contribution**
Cultural Foundations	Cultural–Technological Synergy ((Ibrahimov, 2025a))	Values, legitimacy, coordination norms	Provides cultural coefficients shaping AI-readiness
Transitional Dynamics	Societal AI-Intelligence Thresholds (this paper)	Policy–Demand alignment and threshold crossing	Diagnoses AI-readiness-modulated transitions
Infrastructural Outcomes	AI as Public Infrastructure / ISI (Ibrahimov, 2025b)	Measurement of maturity (Essentiality, Embeddedness, Legitimacy, Governance)	Defines post-threshold state

Together, these frameworks form an integrated continuum from **cultural enablers** → **threshold mechanics** → **infrastructural consolidation**. SINT thereby operationalizes the transitional middle the *moment of synchronization* when societies acquire the institutional reflexes and cognitive consensus to sustain AI as infrastructure.

4 AI - Readiness and Cultural Drivers

Threshold crossings are rarely determined by technical or financial factors alone. They depend on the collective AI-readiness of a society—its capacity to mobilize skills, institutions, and legitimacy in a synchronized manner. Yet AI-readiness itself is not neutral: it is culturally modulated. The same policy design or infrastructure investment yields different outcomes depending on a society's cognitive habits, value orientations, and coordination norms. This section therefore links the SINT framework to the CTS model, treating culture as a *multiplier* of AI-readiness efficiency.

4.1 AI - Readiness as Conversion Efficiency

Within SINT, AI - readiness functions as the mediating variable that converts motivation (Policy $\times$ Demand) into sustainable capability. Conceptually, it encompasses five interdependent layers:

1. **Technical Infrastructure** - provisioned compute, secure/scalable data systems, and resilient connectivity that together enable AI deployment at scale.

2. **Institutional Infrastructure** - governance frameworks, regulatory maturity, and public-sector competence ensuring accountability.

3. **Human Infrastructure** - education, digital literacy, and professional ethics translating technology into everyday performance.

4. Economic Capacity - fiscal space, investment climate, and innovation-finance mechanisms that sustain AI ecosystems and scale-up potential.

5. **Political Readiness** - stability, policy coherence, and leadership commitment that enable long-term coordination and public trust in AI transformation.

However, equal investments in these layers produce unequal returns across societies. The variance stems from what CTS terms cultural coordination efficiency the extent to which social norms reduce friction among actors. AI-readiness thus behaves less as a stock and more as a *conversion function*:

$$\textbf{Effective AI - Readiness} = f(\text{Resources}, \text{Institutions}) \times C$$

where **C** is a *cultural multiplier* capturing shared values, trust, and strategic adaptability. A high - C environment transforms policy directives into practical competence; a low - C environment dissipates momentum through bureaucratic inertia or risk aversion.

4.2 Cultural Modulators of AI - Readiness

Drawing from CTS, four dimensions of cultural capital shape AI-readiness velocity and post-threshold stability. Table 3 summarizes their mechanisms within SINT and typical manifestations.

Table 3: Cultural Dimensions Shaping AI-Readiness: Mechanisms and Typical Manifestations

CTS Dimension	Mechanism in SINT Context	Typical Manifestations
Heritage Adaptability	Ability to reinterpret tradition as resource for modernization; lowers normative resistance to change.	Cultural narratives framing innovation as continuity (e.g., “digital craftsmanship”).
Cross-Civilizational Competence	Familiarity with multiple epistemic and institutional traditions; enhances absorptive capacity for imported standards.	Multilingual education, hybrid legal-technical institutions.
Innovation Ethos	Valuation of experimentation, failure tolerance, and individual creativity; fuels demand and grassroots pull.	Startup culture, open-data movements, civic tech initiatives.
Strategic Determination	Collective determination and discipline to sustain reform under uncertainty; stabilizes thresholds once crossed.	Long-term policy commitment, national AI strategies with continuity.

These dimensions operate jointly. High innovation ethos without strategic determination produces volatility (many pilots, few systems); strategic determination without adaptability yields rigid bureaucratization. Balanced configurations minimize coordination costs, enabling societies to reach Convergent Momentum (Q4) and remain there.

4.3 Mapping Cultural Coefficients onto the Policy – Demand equilibrium

Each CTS dimension strengthens a distinct component of the Policy-Demand equilibrium - policy momentum, societal pull, or their alignment-shaping a country’s trajectory toward Q4.

- **Heritage Adaptability $\rightarrow$Policy Traction.** When policymakers can frame digital reforms as culturally legitimate continuations of national tradition, resistance diminishes, and top-down directives gain acceptance.

- **Innovation Ethos $\rightarrow$ Demand Energy.** Grassroots creativity and entrepreneurial appetite generate bottom-up pressure that sustains adoption even without immediate mandates.

- **Cross-Civilizational Competence $\rightarrow$ AI-Readiness Elasticity.** Exposure to diverse institutional models allows flexible translation of global standards into local contexts.

- **Strategic Determination → Temporal Stability.** Ensures persistence after early enthusiasm fades, preventing policy fatigue or reversal.

The highest threshold velocity occurs when these cultural coefficients reinforce both axes simultaneously strong policy traction, high demand energy, elastic AI-readiness, and temporal stability. Conversely, deficiencies in any dimension create asymmetries that trap societies in sub-threshold quadrants (Q2 or Q3).

4.4 Institutional Sequencing and Learning Loops

Threshold crossing is not a single leap but an institutional learning loop. SINT identifies three critical sequences where cultural modulation determines success:

i. **Culture → Policy (Vision → Mobilization → Standardization):**
Cultural legitimacy enables early vision to mobilize actors; as adoption widens, institutions codify emerging norms into formal standards.

ii. **Culture → Legitimation (Pilot → Feedback → Scaling):**
Innovation ethos encourages experimentation, while strategic determination ensures feedback is institutionalized rather than discarded - transforming temporary success into legitimate practice.

iii. **Policy → Legitimation (Policy → Demand → Policy Reform):**
Adaptive governance integrates citizen and market feedback into successive strategy iterations, sustaining momentum and renewing legitimacy.

4.5 Cross-Level Synergy: From Individual Skills to Societal Motives

SINT operates across two interlinked levels: Individual Capabilities – learning agility, collaborative competence, and ethical discernment; Societal Drivers – collective ambition, trust, and mobilization capacity.

When the two levels align, a reinforcing cycle emerges: individual success stories legitimize reform, and societal ambition attracts new learners. Misalignment - ambitious policy without skilled labor, or creative individuals without institutional recognition—dissipates momentum. AI - readiness governance must therefore cultivate cross-level feedback, a hallmark of societies approaching threshold equilibrium.

4.6 Cultural AI - Readiness as Predictor of Post - Threshold Stability

Cross-national observation suggests that culturally conditioned AI readiness predicts not only the velocity but also the durability of AI threshold crossings. Countries with deep social trust and adaptive heritage exhibit smoother normalization and fewer reversals once AI becomes infrastructural. Where trust deficits persist, post threshold legitimacy crises often emerge: citizens question algorithmic fairness or fear surveillance, triggering regulatory oscillations. In this context, the CTS dimensions function as stability predictors within post threshold governance strategic determination provides temporal consistency, while innovation ethos and adaptability sustain legitimacy through continuous renewal.

4.7 Analytical Implications

Integrating CTS into the SINT framework yields several propositions for empirical testing:

i. **Cultural coefficients amplify AI-readiness.**
Higher levels of *innovation ethos* and *cross-civilizational competence* increase the conversion efficiency between policy intent / societal demand and realized capability.

ii. **Balanced cultural portfolios accelerate threshold velocity.**
Societies combining *heritage adaptability* with *strategic determination* achieve Q4 (Convergent Momentum) faster and maintain it more stably over time.

iii. **Cultural feedback loops mediate policy legitimacy.**
Heritage adaptability and *trust-based coordination* reduce resistance to AI governance reforms, strengthening institutional legitimacy and sustaining public mandate.

These propositions conceptualize culture not as a background variable but as an active infrastructure of AI-readiness. Future research can test them through cross-national surveys, composite AI-readiness indices, and longitudinal policy analyses linking cultural attributes to threshold transitions.

5 Illustrative Application: Azerbaijan 2012—2025

Azerbaijan's digital modernization over the past decade offers an instructive case for examining pre - threshold dynamics of AI integration in a transitional economy. The country combines strong state coordination capacity with vibrant, youthful digital demand, yet continues to face AI-readiness asymmetries rooted in institutional inertia and uneven skills diffusion.

Within the SINT model, Azerbaijan represents a society oscillating between *Mandate Compliance* (Q2) and *Grassroots Pull* (Q3)—high policy ambition and mounting public enthusiasm moderated by incomplete AI-readiness.

5.1 Phases of Digital Modernization

Azerbaijan's digital transformation can be periodized into three overlapping phases, each corresponding to an evolving position within the Policy–Demand equilibrium.

1. **Foundation (2012 - 2016) - Policy → Legitimation.**
Launch of e-government portals, digital ID, and public - service optimization under ASAN Service. Policy commitment was strong (a high-policy vector), yet demand remained largely transactional. AI - readiness was limited to basic digitization and service integration.

2. **Acceleration (2017 - 2020) - Culture → Legitimation.**
Expansion of broadband infrastructure, FinTech experimentation, and higher - education programs in data science. Grassroots enthusiasm grew—particularly among youth entrepreneurs and freelancers — but institutional capability lagged. The system exhibited a Q3 dynamic: strong societal demand and innovation energy but limited policy scaffolding.

3. **Alignment (2021 - 2025) - Policy → Culture.**
Emergence of an explicit National AI Strategy, national data - governance projects, and AI pilots in energy optimization and smart agriculture. This phase marks the onset of policy - demand convergence, though constraints in AI - readiness - skills mismatch, limited public - sector literacy, and fragmented data regimes - still impede full threshold crossing. Formal consolidation continued with adoption of the Artificial Intelligence Strategy (2025 - 2028), outlining integration across public administration, skills development, and ethics, signaling intent to institutionalize AI across sectors.

5.2 Policy-Demand Mapping

Table 4 illustrates the positioning of Azerbaijan's key sectors within the SINT Policy × Demand space, showing their relative alignment and typical dynamics based on the median cutoffs described in Appendix A.

Table 4: Sectoral Positions of Azerbaijan in the SINT Policy × Demand Space

Sector	Policy Intensity	Societal Demand	Quadrant Position	Interpretation
Public Administration	High	Moderate	Q2 – Mandate Compliance	Centralized e-government programs (e.g., ASAN) were institutionalized before full cross-agency data readiness; multiple bodies continued to keep datasets in separate systems.
Finance & Energy	High	High	Q4 – Convergent Momentum	Card payments and cashless turnover expanded rapidly through 2024–25; SOCAR and partners launched AI/analytics programs (smart-grid, predictive maintenance), indicating operational integration.
Education & Research	Moderate	Moderate	Q1 → Q2 (transition)	New AI curricula and international partnerships are increasing but remain uneven.
Youth & Creative Economy	Low	High	Q3 – Grassroots Pull	Startups, digital design, and content creation are growing faster than formal regulation and funding frameworks.
Agriculture & Tourism	Moderate	Variable	Q2/Q3 Hybrid	The Electronic Agricultural Information System (EAIS / e-Agro) supports digitization of farmer services, though coverage and capability remain uneven outside pilot regions.

Overall, the national field vector trends toward Q4, but equilibrium is fragile: pockets of excellence coexist with zones of inertia.

5.3 AI-Readiness Assessment

Azerbaijan's AI-readiness profile demonstrates strong infrastructural and policy pillars but uneven human-capital and institutional learning layers.

- **Technical Infrastructure:** High broadband penetration, expanding data-center capacity, and early cloud-service adoption create favorable technical foundations.
- **Institutional Infrastructure:** Government agility is moderate; cross-agency data sharing remains constrained by legacy regulations.
- **Human Infrastructure:** Fast growth but shallow depth in AI/ML talent; English, advanced data-science/ML engineering, and emerging soft & hard skills remain bottlenecks. International R&D collaboration is growing yet uneven - scale joint labs, exchanges, and co-supervised programs to close capability gaps.

Under the SINT equation,

$$\textbf{Threshold Velocity} = (\textit{Policy} \times \textit{Demand}) \times \textit{AI-Readiness}$$

Azerbaijan shows strong policy–demand momentum but a sub-optimal AI-readiness multiplier, which reduces conversion efficiency and slows progress toward threshold crossing. The country's UN EGDI 2024 status (Very High EGDI; rank ∼74; EGDI ≈0.761) supports the claim of solid service digitalization even as interoperability and human-capital depth remain primary constraints.

5.4 Cultural Coefficients and CTS Interpretation

Applying the CTS coefficients reveals how cultural endowments both enable and constrain AI-readiness. Table 5 illustrates how these cultural dimensions determine Azerbaijan's AI-readiness patterns and threshold dynamics.

Table 5: CTS Coefficients in Azerbaijan: Expressions and Effects on SINT Threshold Dynamics

CTS Dimension	Azerbaijan's Expression	Effect on Threshold Dynamics
Heritage Adaptability	Reform narratives often framed as modernization of traditional service culture ("digital ASAN ethos").	Enhances policy legitimacy; reduces normative resistance.
Cross-Civilizational Competence	Multilingual orientation (Azeri–Turkish–Russian–English) and experience navigating post-Soviet / global interfaces.	Increases absorptive capacity for imported AI governance models.
Innovation Ethos	High among youth and creative sectors; strong informal digital community.	Drives grassroots demand (Q3 energy) but risks fragmentation without institutional support.
Strategic Determination	Sustained state commitment to modernization and diversification beyond hydrocarbons.	Stabilizes reform trajectory; guards against policy volatility.

Overall, Azerbaijan's cultural coefficients are favorable but unbalanced: innovation ethos and adaptability are high, yet cross-institutional translation of these energies remains partial.

5.5 Early Signs of Threshold Formation

Evidence of incipient threshold crossing in Azerbaijan can be observed across four reinforcing dimensions—operational, normative, institutional, and cultural—each showing early consolidation toward infrastructural dependence.

- **Embeddedness.** Routine machine-learning deployment has moved beyond pilots into day-to-day functions in finance, energy forecasting, and selected urban-service domains. SOCAR's smart-grid and predictive-maintenance initiatives now generate continuous data streams integrated with core operations, while several banks employ ML-based credit-scoring and fraud-detection systems operating under defined service-level agreements. Such integration—accompanied by partial retirement of manual fallback procedures—signals the early irreversibility characteristic of infrastructural embedding.
- **Legitimacy.** Sustained 2023–2025 growth in digital payments and card transactions reflects rising public trust and stable expectations of reliability. According to Central Bank data, the total volume of non-cash transactions has more than doubled since 2022, while merchant acceptance and mobile-payment penetration continue to rise. The normalization of cash-free practices in everyday consumption demonstrates that algorithmic systems now mediate routine economic activity rather than remain optional.
- **Governance.** The establishment of the AI & Data Governance Center (2024), formal approval of the National AI Strategy 2025–2028, and operational expansion of the ASAN Bridge inter-agency data-exchange infrastructure mark the institutionalization of coordination and rule-making. Dedicated budget lines for AI policy, draft data-ethics guidelines, and emerging audit requirements translate policy intent into governing capacity.
- **Cultural normalization.** AI has entered the public imagination as a symbol of progress rather than novelty. Major news outlets now run recurring AI features, and enrolment in university-level AI and data-science programs has risen markedly since 2023. Public digital-service platforms such as ASAN Portals provide tangible, trustworthy AI-mediated

interactions, reinforcing citizens' familiarity and confidence. This diffusion transforms AI from an elite innovation into an expected component of modernization.

Taken together, these developments indicate incipient threshold formation—a stage where AI use is routine, legitimacy and governance are coalescing, and cultural narratives frame intelligent systems as integral to institutional and economic life. Continued strengthening of human-capital depth and interoperability standards will determine the velocity of the full infrastructural crossing projected for the late 2020s.

5.6 Comparative Regional Perspective

Comparative placements follow the P/D/R framework in Appendix A; normalized country values appear in Appendix B. To benchmark Azerbaijan's position, we apply SINT across selected post-Soviet and regional peers using current cross-national indices—GARI 2024, NRI 2024, GII 2025, and UN EGDI 2024 (Oxford Insights, 2024; Portulans Institute, 2024; (WIPO, 2025); (UN DESA, 2024)) — which map to policy intent (GARI), societal demand/market pull (NRI), and AI-readiness (GII, EGDI). These indices are used here illustratively as provisional operational anchors for the Policy, Demand, and AI-Readiness components of SINT, rather than as a definitive or exhaustive measurement system. Table 6 summarizes normalized P/D/R values and resulting SINT quadrant classifications for Azerbaijan and selected regional peers (see Appendices A–B).

5.7 Synthesis

The Azerbaijani case validates SINT's analytical utility. It demonstrates that:

1. **Policy ambition and social enthusiasm are necessary but insufficient** without AI-readiness coherence.

2. **Cultural coefficients condition threshold velocity** — particularly the synergy between innovation ethos and strategic determination.

3. **Sequencing matters:** societies that build feedback loops between policy and demand move faster toward Q4 stability.

In Azerbaijan, continued investment in human capital, interoperable data governance, and trust-building institutions could complete the crossing by the late 2020s. The case exemplifies SINT's diagnostic power for transitional economies where cultural and institutional modernization proceed concurrently.

6 Comparative and Policy Implications

The cross-national variation in AI integration trajectories reveals that the decisive variable is not how much technology a country possesses, but how effectively its institutions and culture synchronize motivation with AI-readiness. The SINT framework provides a comparative lens for diagnosing these synchronization patterns and designing policies that accelerate sustainable threshold crossing.

6.1 Method for Quadrant Classification and Comparative Justification

Quadrant assignments follow Appendix A (P/D/R construction, rank normalization, median cutoffs, transition rule) and Appendix B (country values).

Table 6: Cross-National SINT Mapping: Normalized P/D/R Values and Quadrant Classifications (Azerbaijan and Selected Regional Peers)

Country	SINT Position	Key Data Points (2024–25)	Interpretation within SINT Field
Georgia	Q3 → Q4 (transition)	NRI 2024 rank #68 overall; government promotion of investment in emerging tech #22; ICT services exports #26; strong governance pillar (59.1). GII 2025 mid-60s. EGDI 2024 ≈ High.	A vibrant digital-services sector and entrepreneurial demand (Q3) are now matched by active policy traction on emerging tech and education initiatives. AI-readiness levels support scaling, placing Georgia in a clear transition toward Q4 momentum.
Armenia	Q3 – Grassroots Pull (no transition yet)	NRI 2024 rank #66 overall; public cloud market scale #102; regulation of emerging tech #42; GII 2025 ≈ #73; EGDI 2024 ≈ High middle.	Entrepreneurial and diaspora-driven tech demand remains strong, but institutional support and scaling mechanisms are weaker than Georgia's. Government initiatives are fragmented and not yet systemic; demand outpaces policy, keeping Armenia in Q3.
Kazakhstan	Q3 → Q4 (transition)	GARI 2024 rank ≈ #47; NRI 2024 #56; GII 2025 ≈ #75.	Large-scale state investments and AI-strategy programs drive policy momentum, while expanding private-sector AI adoption indicates rising demand. Strong infrastructure and governance support movement toward Q4.
Uzbekistan	Q2 – Mandate Compliance (no transition yet)	GARI 2024 ≈ #70; NRI 2024 #81; GII 2025 ≈ #79; AI Strategy 2030 approved Oct 2024.	The AI Strategy and tax-free AI/data-center zones show high policy ambition, but grassroots demand and skills development lag. AI integration remains policy-driven (Q2) rather than convergent.
Azerbaijan	Q2/Q3 → Q4 (transition)	GARI 2024 ≈ #71; NRI 2024 #75; GII 2025 #94; EGDI 2024 High.	Balanced policy and societal interest with improving AI-readiness. The AI Strategy (2021–2025) and sectoral pilots indicate an emerging Q4 shift, pending further human-capital and interoperability gains.

6.2 The Policy x Demand Equilibrium as a Governance Objective

Traditional digital strategies measure success through output metrics—projects launched, data processed, or citizens served. SINT reframes the objective as maintaining balance in the Policy–Demand equilibrium. The aim is not only to push adoption but to sustain a balanced, self-correcting relationship between top-down coordination and bottom-up initiative.

To operationalize this, policymakers can monitor three indicators:

1. **Policy Saturation Index** – proportion of regulatory and institutional commitments fulfilled versus adaptive capacity remaining.
2. **Demand Elasticity Index** – responsiveness of civil society and market actors to new AI-enabled services.

3. **AI-Readiness Efficiency Index** – ratio of realized adoption to total investment in digital capability.

Together, these form an AI Threshold-Crossing Dashboard enabling early detection of imbalance (e.g., over-regulation, enthusiasm decay, AI-readiness drag).

6.3 Sequencing Framework for AI-Readiness Amplification

SINT's diagnostic structure supports a sequencing logic for policy design. Threshold crossing unfolds as a three-phase sequence that must be tailored to national AI-readiness profiles:

i. **Stimulation Phase** – Cultivate demand through visibility and experimentation (innovation challenges, open data, startup programs).

ii. **Alignment Phase** – Institutionalize emerging practices, update standards, and connect dispersed actors through data and credentialing frameworks.

iii. **Consolidation Phase** – Entrench human-AI collaboration in curricula, procurement, and civic institutions, ensuring post-threshold legitimacy.

Countries often stall between phases two and three—an interval SINT identifies as the *fragility corridor*. The corridor closes when feedback loops are institutionalized: government monitors adoption outcomes and revises rules iteratively, preventing drift back to compliance or fragmentation quadrants.

6.4 Designing for Cultural Compatibility

Policy transfer alone cannot ensure threshold success. As shown in CTS, cultural-structural fit determines how imported governance models perform locally. A sustainable AI strategy must therefore integrate cultural compatibility design, ensuring that institutional instruments resonate with prevailing social norms.

Four guidelines follow:

i. Translate, don't transplant. Adapt global AI ethics and data governance frameworks to domestic values and communication styles.

ii. Narrativize modernization. Frame AI integration as an extension of national identity ("from service culture to smart governance") to strengthen legitimacy.

iii. Institutionalize trust. Pair automation with transparent grievance mechanisms and civic oversight.

iv. Cultivate cross-civilizational competence. Promote multilingual and intercultural training within public administration to manage foreign partnerships effectively.

These steps transform cultural assets into AI-readiness multipliers rather than sources of friction.

6.5 Sectoral Implications

Applying SINT to sectoral governance yields differentiated strategies. Table 7 distills sector-specific risks and SINT-informed policy priorities. These recommendations convert SINT's abstract quadrants into actionable policy levers.

Table 7: Sectoral Risks and SINT-Guided Policy Priorities

Sector	Primary Risk	SINT-Informed Policy Focus
Public Administration	Legitimacy brittleness	Invest in AI literacy for civil servants; institutionalize citizen feedback.
Finance & Energy	Operational incidents	Strengthen risk governance, data audit, and model oversight functions.
Education & Workforce	AI-readiness lag	Integrate AI fluency across disciplines; build credential ecosystems for lifelong learning.
Creative Economy	Fragmentation	Create regulatory sandboxes to align grassroots innovation with standards.
Agriculture & Tourism	Stagnation	Foster open-data collaborations and capacity-building for regional actors.

6.6 Toward AI-Readiness Diplomacy

A further implication concerns international cooperation. AI thresholds are increasingly shaped by transnational interdependence: cross-border data flows, shared model ecosystems, platform governance regimes, and multinational standards are producing readiness spillovers, through which one country's progress (or bottlenecks) affects others' effective threshold conditions. The SINT approach suggests a new domain of AI-readiness diplomacy—collaboration among states to harmonize AI governance capacities and share learning infrastructures. Rather than competing solely for technological supremacy, nations could cooperate to raise collective AI-readiness, reducing fragility in the global AI ecosystem.

7 Research Agenda and Future Work

AI institutionalization is a dual process. On one hand, AI is becoming a global institution—a shared infrastructure shaping economies, governance, and everyday life across borders. On the other hand, adoption within each society requires crossing a threshold: a point where policy, demand, and readiness align so that AI becomes effective, self-sustaining, and modernization-driving. In this sense, AI carries its own institutional threshold—below it, systems remain experimental; beyond it, AI-enabled services and workflows become load-bearing parts of core economic, administrative, and infrastructural systems, driving system-level change.

7.1 Theoretical Development

The SINT framework opens several avenues for theoretical development, including:

1. **Systemic Dynamics of AI Thresholds.**
   AI threshold crossings can be understood as nonlinear transitions within complex socio-political systems. Future research might examine how political authority, economic incentives, technological capacity, social trust, and cultural values interact to determine when and how societies cross the threshold into sustained AI institutionalization. Such analysis can reveal tipping intervals—moments when small shifts in governance, investment, education, or public perception produce disproportionate transformation across multiple domains.

2. **Comparative Institutional Theory.**
   Integrating SINT with neo-institutional and cultural–cognitive perspectives (Scott, 2014) helps explain how legitimacy and norm diffusion shape AI-readiness. Future research could examine institutional learning cycles across governance types—centralized versus pluralistic, bureaucratic versus networked. In this paper, such differences are treated

as manifestations of broader cultural architectures captured by CTS and are therefore identified as priorities for comparative analysis, rather than developed here as a distinct typology.

3. **Integration with Infrastructure Studies.**
   Extending AI as Public Infrastructure (Ibrahimov, 2025b), scholars can specify a multi-level pathway in which micro behaviors (user uptake, organizational routines) scale into meso structures (sectoral standards, procurement cycles) and culminate in macro consolidation (load-bearing infrastructure). SINT models the threshold-crossing phase; ISI benchmarks stability after crossing, supporting panel or time-series designs of AI evolution.

7.2 Empirical Priorities

To test SINT propositions, a coordinated program of comparative research is needed. Key empirical priorities include:

1. **Operationalizing AI-Readiness Indices.**
   Develop measurable indicators of AI-readiness efficiency—the ratio between AI investment and sustained usage—integrating quantitative (skills, data infrastructure) and qualitative (trust, legitimacy) metrics. These can extend the Infrastructure Status Index (ISI) by adding transitional diagnostics.

2. **Threshold Event Analysis.**
   Identify empirical markers of threshold crossings—e.g., retirement of manual procedures, regulatory codification of AI standards, or irreversible public expectation shifts. Event-history analysis can then estimate median crossing times and variance across regions.

3. **Cross-Cultural Comparative Studies.**
   Use the CTS–SINT composite to map cultural coefficients against AI-readiness outcomes in diverse settings (e.g., Baltics, Gulf States, Central Asia). Mixed-method designs combining surveys, document analysis, and expert interviews can validate how heritage adaptability or innovation ethos translate into measurable differences in adoption stability.

4. **Sectoral Case Studies.**
   Examine specific policy domains—energy, health, education—through the SINT lens to determine how sectoral AI-readiness interacts with national culture. Such micro-to-macro linkages will refine the theory's granularity.

5. **Longitudinal Monitoring and Early-Warning Systems.**
   Develop SINT-informed AI Threshold-Crossing Dashboards for governments and international organizations to track AI-readiness trends and flag fragility (e.g., legitimacy decline, operational incidents). Integrate with the UN E-Government Survey, the OECD Digital Government Index, and related readiness datasets to ensure continuity and comparability.

8 Conclusion

This paper positions SINT as the transitional mechanics linking cultural preconditions (CTS) and infrastructural outcomes (ISI/AIPI). The analysis shows that Policy $\times$ Demand, modulated by AI-readiness, determines threshold velocity—the pace at which societies move from discretionary adoption to infrastructural dependence. The Azerbaijan case demonstrates strong policy intent and social pull moderated by readiness asymmetries, while the regional comparison situates these patterns within broader cultural architectures.

For policy, the central challenge is equilibrium management—stimulate → align → consolidate supported by transparent AI Threshold-Crossing Dashboards that track commitment saturation, demand responsiveness, and readiness conversion. For research, advancing SINT requires comparative datasets, longitudinal indicators, and dynamic models that can explain and anticipate societal transitions.

More broadly, the paper proposes Societal Intelligence Studies as an emerging interdisciplinary field connecting systems theory, AI governance, and cultural sociology. It reframes AI governance as the stewardship of societal learning governing not only technologies but the conditions under which societies learn, adapt, and maintain legitimacy in an algorithmic world.

9 Statements & Declarations

- **Author contributions.** Sole author; responsible for conceptualization, analysis, and writing.
- **Use of AI tools.** ChatGPT (GPT-5) and Claude 4.5 assisted with language editing, literature-scoping (identifying sources), and document consistency. These tools were not credited as authors and did not make independent claims; all analysis, judgments, and final text were reviewed and approved by the author, who takes full responsibility for the content.
- **Data availability.** All indicators used (GARI 2024; NRI 2024; EGDI 2024; GII 2025) are publicly available; normalization rules appear in Appendix A; computed values are shown in Appendix B.

References

Brundage, M., Avin, S., Clark, J., Toner, H., Eckersley, P., Garfinkel, B., & Anderljung, M. (2020). Toward trustworthy AI development: Mechanisms for supporting verifiable claims. *arXiv:2004.07213.*

Central Bank of the Republic of Azerbaijan. (2023–2025). Non-cash transaction statistics and digital payments reports. Baku.

Frischmann, B.M. (2012). *Infrastructure: The social value of shared resources.* Oxford University Press.

Fjeld, J., Achten, N., Hilligoss, H., Nagy, A., & Srikumar, M. (2020). Principled artificial intelligence: Mapping consensus in ethical and rights-based approaches to principles for AI. *SSRN Scholarly Paper No. 3518482*, Social Science Research Network. https://doi.org/10.2139/ssrn.3518482

High-Level Expert Group on Artificial Intelligence (HLEG). (2019). *Ethics guidelines for trustworthy AI.* European Commission.

Ibrahimov, O. (2025a). Cultural technological synergy in the age of AI: A conceptual framework for understanding adaptive modernization in transitional societies. *Journal of Computer Science and Digital Technologies, 1*(2), 5-30, https://doi.org/10.30546/UNECCSDT.2025.02.1008

Ibrahimov, O. (2025b). AI as public infrastructure: A critical review of the transition from tool to societal necessity. *Current Trends in Computing.*

Inglehart, R., Welzel, C. (2005). *Modernization, cultural change, and democracy: The human development sequence.* Cambridge University Press.

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature Machine Intelligence*, *1*(9), 389–399. `https://doi.org/10.1038/s42256-019-0088-2`

Lundvall, B.-Å. (Ed.). (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. London: Pinter Publishers.

Mittelstadt, B.D. (2019). Principles alone cannot guarantee ethical AI. *Nature Machine Intelligence*, *1*(11), 501–507. `https://doi.org/10.1038/s42256-019-0114-4`

Morley, J., Floridi, L., Kinsey, L., & Elhalal, A. (2021). From what to how: An initial review of publicly available AI ethics tools, methods and research to translate principles into practices. *Science and Engineering Ethics*, *27*(4). `https://doi.org/10.1007/s11948-021-00314-8`

Nelson, R.R., Winter, S.G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.

Nelson, R.R., Winter, S.G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.

OECD. (2019). *OECD principles on artificial intelligence*. Paris: OECD Publishing.

OECD Observatory of Public Sector Innovation (OPSI). (2023). *Innovation policy profiles*. OECD.

Oxford Insights. (2024). *Government AI readiness index 2024*. Oxford Insights. Retrieved from `https://www.oxfordinsights.com/ai-readiness-index`

Pierson, P. (2000). Increasing returns, path dependence, and the study of politics. *American Political Science Review*, *94*(2), 251–267.

Plantin, J.-C., Lagoze, C., Edwards, P.N., & Sandvig, C. (2018). Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media & Society*, *20*(1), 293–310.

Portulans Institute. (2024). *Network readiness index 2024*. Retrieved from `https://networkreadinessindex.org/`

Raji, I.D., Smart, A., White, R.N., Mitchell, M., Gebru, T., Hutchinson, B., & Denton, E. (2020). Closing the AI accountability gap: Defining an end-to-end framework for internal algorithmic auditing. In *FAccT '20: Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency* (pp. 33–44).

Republic of Azerbaijan. (2025). *Artificial intelligence strategy 2025–2028*. Baku: Cabinet of Ministers.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Scott, W.R. (2014). *Institutions and organizations: Ideas, interests, and identities*. (4th ed.). SAGE Publications.

SOCAR (State Oil Company of the Republic of Azerbaijan). (2024–2025). Smart grid and predictive maintenance project reports. Baku.

Star, S.L., Ruhleder, K. (1996). Steps toward an ecology of infrastructure: Design and access for large information spaces. *Information Systems Research*, *7*(1), 111–134.

United Nations Department of Economic and Social Affairs (UN DESA). (2024). *E-government development index (EGDI) 2024*. New York: United Nations.

UNESCO. (2021). *Recommendation on the ethics of artificial intelligence*. Paris: UNESCO.

Veale, M., Borgesius, F.Z. (2021). Demystifying the EU Artificial Intelligence Act. *Computer Law Review International*, *22*(4), 97–112.

Weber, M. (2002). *The Protestant ethic and the spirit of capitalism* (T. Parsons, Trans.). New York: Routledge. (Original work published 1905).

WIPO. (2025). *Global innovation index 2025*. Geneva: World Intellectual Property Organization.

World Bank. (2023). *GovTech maturity index and digital governance brief*. Washington, DC.

Appendix A

Table A1. Numerical anchors used for SINT placement

Country	GARI 2024 (Score)	NRI 2024 (Rank)	GII 2025 (Rank)	EGDI 2024 (Rank / EGDI)
Georgia	46.92 (Gov 43.41; Tech 34.53; Data&Infra 62.81)	68	56	69 / 0.779
Armenia	44.51 (Gov 37.97; Tech 32.91; Data&Infra 62.66)	66	59	48 / 0.842
Azerbaijan	39.92 (Gov 35.56; Tech 29.43; Data&Infra 54.78)	75	94	74 / 0.761
Kazakhstan	51.41 (Gov 54.75; Tech 33.54; Data&Infra 65.93)	61	81	24 / 0.901
Uzbekistan	53.45 (Gov 64.71; Tech 33.50; Data&Infra 62.14)	81	79	63 / 0.800

Appendix B.

Methodology for SINT Quadrant Classification

B.1 Objective

The purpose of the SINT (Society–Institution–Need–Technology) quadrant mapping is to determine each country's relative position within a four-quadrant analytical field defined by three key dimensions: *Policy (P)*, *Demand (D)*, and *AI-Readiness (R)*. The classification procedure relies on transparent and reproducible data derived from internationally standardized indicators and global benchmarking datasets.

Each axis represents a necessary component of AI–society integration:

- **Policy (P):** Represents top-down institutional commitment, national strategies, regulatory preparedness, and the overall quality of AI governance mechanisms.
- **Demand (D):** Captures market pull, societal uptake, innovation activity, and the presence of AI-enabled economic or social needs that stimulate deployment.
- **AI-Readiness (R):** Reflects a country's absorptive capacity, digital infrastructure, human-capital depth, and operational ability to integrate AI systems at scale.

These dimensions, when analyzed jointly, provide a structured framework for locating countries within the SINT quadrants, enabling comparative assessment and strategic interpretation.

B.2 Data Sources and Axis Construction

All raw data are taken from annually updated, cross-country datasets (see Table B1).
Notes:

- EGDI scores are already scaled between 0 and 1; other indicators based on rank are normalized as described in Section B.3.

Table B1. Operationalization of SINT Axes: Data Sources and Formulas

Axis	Primary Indicators	Computation	Conceptual Rationale
Policy (P)	Government AI Readiness Index 2024 (Oxford Insights)	$P = \text{GARI}/100$	Reflects national strategic commitment, governance strength, and institutional maturity in AI policy.
Demand (D)	Network Readiness Index 2024 (Portulans Institute) composite: $0.50 \times \text{NRI}^*_{overall}$ $0.25 \times \text{NRI}^*_{ICT\_exports}$ $0.25 \times \text{NRI}^*_{GovPromotion}$	Composite indicator capturing societal digital adoption, innovation-driven demand, and economic pull for AI-enabled transformation.	
AI-Readiness (R)	E-Government Development Index 2024 (UN DESA) and Global Innovation Index 2025 (WIPO)	$R = 0.50 \times \text{EGDI} + 0.50 \times \text{GII}^*$	Represents national absorptive and operational capacity—digital infrastructure, human capital, and innovation ecosystems required for AI scaling.

Table 8: Data sources and computation of axes for SINT quadrant classification.

- If a sub-indicator is unavailable, the remaining components are proportionally reweighted so that weights sum to 1.
- Optionally, an education/skills indicator (e.g., NRI "Internet access in schools") may be added with a weight of approximately 0.10–0.15.

B.3 Rank Normalization

To compare heterogeneous indices on a common 0–1 scale, each rank-based measure is converted using the following transformation:

$$\text{score} = 1 - \frac{(\text{rank} - 1)}{(N - 1)} \tag{1}$$

where:

- rank = the country's position in the index (1 = best),
- N = total number of countries included in the dataset.

This transformation assigns a normalized value of 1 to the best performer and 0 to the lowest performer, ensuring consistent directionality and comparability across all axes used in the SINT framework.

B.4 Quadrant Assignment Rules

Let the regional (or global) medians of the three axes be denoted as P', D', and R'. Table B2 formalizes the median-based rules for assigning SINT quadrants and designating transitions.

Table B2. SINT Quadrant Assignment Rules: Median Cutoffs and Transition Criteria

Quadrant	Rule (based on medians)	Interpretation
Q1 – Dormant Drift	$(P < P')$ and $(D < D')$	Low policy and low demand; minimal AI traction.
Q2 – Mandate Compliance	$(P \geq P')$ and $(D < D')$	Policy ambition exceeds social/market absorption.
Q3 – Grassroots Pull	$(D \geq D')$ and $(P < P')$	Bottom-up innovation outpaces formal policy.
Q4 – Convergent Momentum	$(P \geq P')$, $(D \geq D')$, and $(R \geq R')$	Policy, demand, and AI-readiness aligned; threshold crossed.

Transition designation ("→"):
A country is labeled as *in transition* toward an adjacent quadrant if either of the following conditions holds:

- the country's axis value lies within ±0.05 of the corresponding median, or
- the country's axis value shows a year-over-year increase of at least 0.05.

B.5 Sensitivity and Robustness Checks

To ensure stability of the SINT quadrant results, three robustness checks are applied:

1. **Weight variation:** Demand is recomputed using ±0.10 shifts among sub-weights (e.g., 0.60/0.20/0.20 instead of 0.50/0.25/0.25). If the resulting quadrant remains unchanged, the case is considered *robust.*
2. **Cutoff variation:** Median thresholds are replaced with 10% trimmed means. If the country's placement does not change, the classification is *robust.*
3. **Directionality check:** A case is labeled *borderline* only if *both* adjustments (weight variation and cutoff variation) yield a different quadrant assignment.

B.6 Country-Specific Application

Applying these rules to 2024–2025 data yields the results shown in Table B3.

Table B3. SINT Results by Country (2024–2025)

Country	SINT Quadrant	Empirical Justification (2024–2025)
Georgia	Q3 → Q4 (transition)	GARI 46.9; NRI 68 (overall) with Gov't Promotion #22 and ICT Exports #26. GII 56; EGDI 0.78 (rank 69). High demand and policy traction exceed medians; $R \geq$ median ⇒ transition to Q4.
Armenia	Q3 (no transition)	GARI 44.5; NRI 66 (Cloud Market #102; Regulation #42). GII 59; EGDI 0.84 (rank 48). Demand strong, but policy below median and stagnant ⇒ Q3.
Kazakhstan	Q3 → Q4 (transition)	GARI 51.4; NRI 61; GII 81; EGDI 0.90 (rank 24). Policy slightly above median, demand ≥ median, very high AI-readiness ⇒ likely Q4 transition.
Uzbekistan	Q2 (no transition)	GARI 53.5 (rank 70); NRI 81 (low People pillar #91). GII 79; EGDI 0.80 (rank 63). Policy ≥ median, but demand < median ⇒ Q2 mandate-led.
Azerbaijan	Q2/Q3 → Q4 (transition)	GARI 39.9 (rank 71); NRI 75; GII 94; EGDI 0.76 (rank 74). Indicators suggest movement from Q2/Q3 toward Q4.

B.7 Normalized Values and Quadrant Placement

Table B4 reports the normalized P/D/R values and resulting SINT quadrant placements.

Table B4. Normalized P/D/R Values and SINT Quadrant Placements

Country	GARI	NRI	ICT Exp. Rank	GovPromo Rank	EGDI	GII Rank	P	D	R	Quadrant
Georgia	46.9	68	26	22	0.779	56	0.47	0.60	0.67	Q3 → Q4 (transition)
Armenia	44.5	66	–	42	0.842	59	0.45	0.53	0.64	Q3 (no transition)
Kazakhstan	51.4	61	40	37	0.901	81	0.51	0.55	0.62	Q3 → Q4 (transition)
Uzbekistan	53.5	81	90	86	0.800	79	0.54	0.40	0.58	Q2 (no transition)
Azerbaijan	39.9	75	70	60	0.761	94	0.40	0.45	0.56	Q2/Q3 → Q4 (transition)