SOLID.AI Framework

A Formal Specification for Strategic, Organized, Layered, Intelligent, Data-Driven Artificial Intelligence

Whitepaper v1.0 — Stable

Published: December 2025

A comprehensive architectural specification for building AI-native organizations that scale human intelligence through structured collaboration between people and artificial intelligence. This whitepaper provides the complete technical specification, architectural patterns, and governance principles required to implement production-ready AI-native systems.

Abstract

Status: Version: 1.0

Citation

If you use SOLID.AI in your research or project, please cite:

```
@dataset{solidai_zenodo_2025,
  title        = {SOLID.AI Framework — Whitepaper v1.0},
  author       = {Freitas, Gustavo},
  year         = 2025,
  month        = december,
  publisher    = {Zenodo},
  doi          = 10.5281/zenodo.17765515,
  url          = https://zenodo.org/records/17765515
}
```

APA:

```
Freitas, G. (2025). SOLID.AI Framework — Whitepaper v1.0 [Dataset]. Zenodo.
https://doi.org/10.5281/zenodo.17765515
```

IEEE:

```
G. Freitas, "SOLID.AI Framework — Whitepaper v1.0," Zenodo, Dec. 2025.
doi: 10.5281/zenodo.17765515
```

Document Information

| Attribute | Value |

|-----------|-------|

| Version | 1.0.0 |

| Date | December 2025 |

| Status | Published |

| Author | Gustavo Freitas |

| DOI | 10.5281/zenodo.17765515 |

| License | MIT License |

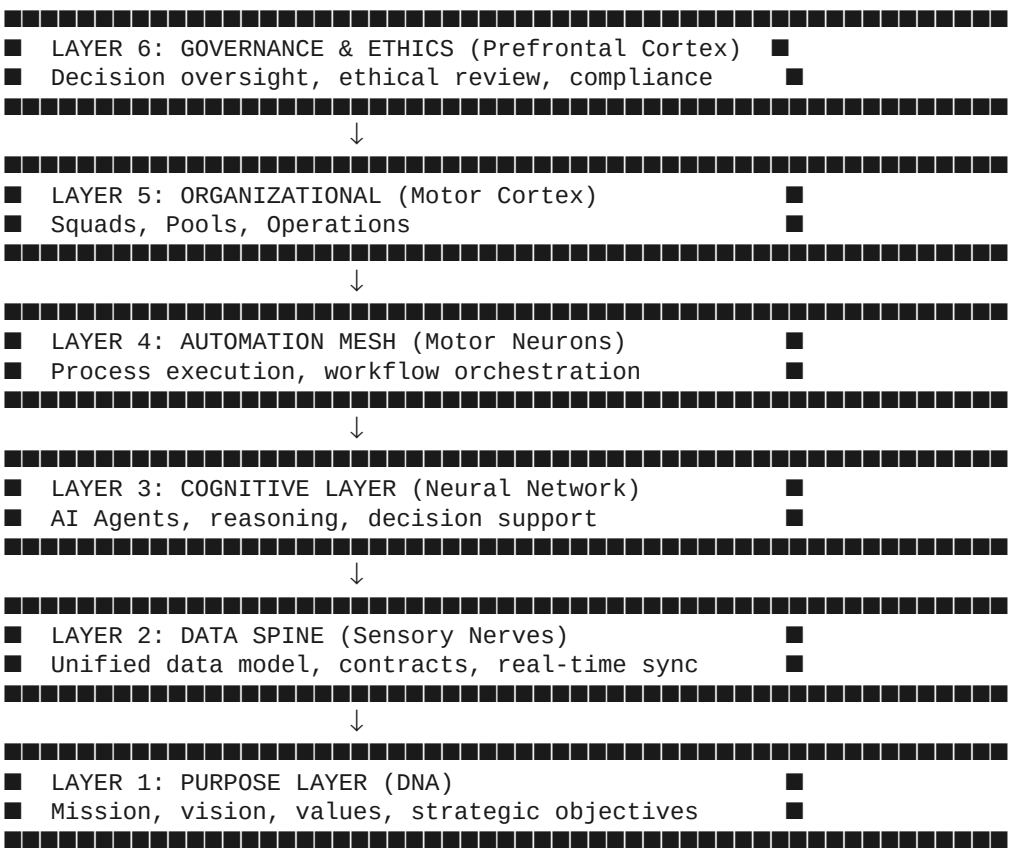
| Repository | github.com/gusafr/midora-solid-ai |

Architecture

Status: Version: 1.0

Six-Layer Architecture

As shown in Figure 1 (see Diagrams), SOLID.AI employs a biological-inspired architecture analogous to an organizational nervous system:



See: Figure 1 — Six-Layer Architecture for detailed visualization

Layer 1: Purpose Layer (DNA)

Biological Analogy: DNA encoding the organism's fundamental blueprint

Function: Defines the organization's immutable core identity and strategic direction

Components:

- Mission statement
- Vision and strategic goals
- Core values and principles
- Success metrics (OKRs)
- Ethical boundaries

Key Characteristics:

- Rarely changes (only through formal RFC process)
- Informs all decisions across layers
- Accessible to all humans and AI agents
- Machine-readable format (YAML/JSON)

Layer 2: Data Spine (Sensory Nerves)

Biological Analogy: Sensory nervous system transmitting information to the brain

Function: Unified, real-time data infrastructure serving as single source of truth

As shown in Figure 3 (see Diagrams), the Data Spine is designed to meet stringent Service Level Objectives: P95 latency < 5s, availability >= 99.9%, data freshness < 60s (target specification).

Components:

- Canonical data models
- Data contracts between systems
- Event-driven synchronization
- Data quality monitoring
- Analytics and metrics dashboards

Key Characteristics:

- Schema-first design with strict contracts
- Real-time propagation (P95 latency < 5s)
- Immutable event logs (audit trail)
- Bi-directional sync across all systems

> ***Architectural Foundation:*** *The Data Spine implements data mesh principles defined by Dehghani: data as a product, domain ownership, self-serve data platform, and federated computational governance. Systematic research validates distributed data backbones with federated governance as essential for modern organizational data infrastructure, functioning as SOLID.AI's "organizational nervous system."*

See: Specification → Data Spine | Data Spine Topology Diagram

Layer 3: Cognitive Layer (Neural Network)

Biological Analogy: Brain processing information and generating insights

Function: AI agents providing reasoning, decision support, and autonomous actions

Components:

- AI Agent definitions (capabilities, constraints, interfaces)
- Reasoning engines (LLM orchestration)
- Context management (memory, session state)
- Decision logs (transparency)

Agent Types:

- **Analytical Agents:** Data analysis, pattern recognition, forecasting
- **Operational Agents:** Process execution, workflow orchestration
- **Advisory Agents:** Strategic recommendations, risk assessment
- **Collaborative Agents:** Team coordination, meeting facilitation

> ***Research Validation:*** *MIT Sloan research demonstrates AI tends to complement rather than replace human work, with deployment strategy (augmentation vs. replacement) being a strategic leadership decision. Harvard Business Review identifies hybrid human-AI teams as generating greatest value when processes and roles are redesigned for collaboration, not replacement—the foundation of SOLID.AI's Human-AI Collaboration Loop (Figure 4).*

See: Specification → Cognitive Layer

Layer 4: Automation Mesh (Motor Neurons)

Biological Analogy: Motor nervous system executing coordinated movements

Function: Process execution layer translating decisions into actions

Figure 2 — Automation Mesh Execution Model

As shown in Figure 2 (see Diagrams), the Automation Mesh coordinates all AI-driven actions through event-driven orchestration connecting agents, business services, and external systems.

Components:

- SIPOC process definitions
- Workflow orchestration (temporal.io, Airflow)
- Integration adapters (APIs, webhooks)
- Monitoring and observability

Key Patterns:

- **SIPOC Automation:** Supplier → Input → Process → Output → Customer
- **Event-Driven Workflows:** Trigger → Validate → Execute → Verify
- **Human-in-the-Loop:** Approval gates for critical decisions

> ***Orchestration Pattern:*** *SOLID.AI combines centralized orchestration with event-based choreography, leveraging event-driven architecture for service decoupling, resilience, and scalability—enabling the Automation Mesh to coordinate AI agents, business services, and human workflows without brittle point-to-point integrations.*

See: Specification → Automation Mesh | Automation Mesh Diagram

Layer 5: Organizational Layer (Motor Cortex)

Biological Analogy: Motor cortex coordinating complex movements

Function: Human team structures optimized for AI-native collaboration

Organizational Patterns:

1. Squads

- **Purpose:** Cross-functional product/feature teams
- **Size:** 5-9 people (Dunbar's limit for tight collaboration)

- **Structure:** Product Manager, Engineers, Designer, Data Analyst
- **AI Integration:** Embedded agents for specific squad functions
- **Ownership:** Business service accountability (P&L responsibility)
- **Lifecycle:** Persistent teams aligned to long-term product areas

2. Pools

- **Purpose:** Flexible specialist communities supporting multiple squads
- **Examples:** Data Science Pool, Security Pool, UX Research Pool
- **Model:** Pull-based engagement (squads request support)
- **AI Integration:** Pool-specific specialized agents
- **Governance:** Community lead coordinates allocation

3. Operations

- **Purpose:** Stable, repeatable business processes
- **Examples:** Payroll, Compliance, Customer Support
- **Model:** High automation (80%+ AI-driven)
- **Human Role:** Exception handling, oversight, continuous improvement
- **Metrics:** Throughput, error rate, cycle time

See: Specification → Organizational Layer

Layer 6: Governance & Ethics (Prefrontal Cortex)

Biological Analogy: Prefrontal cortex providing judgment and ethical reasoning

Function: Decision oversight ensuring alignment with values and compliance

Components:

- RFC (Request for Comments) process for major decisions
- ADR (Architecture Decision Records) documenting choices
- Ethical review board (human + AI advisors)
- Compliance monitoring (SOC2, GDPR, HIPAA, etc.)
- Incident response protocols

Key Mechanisms:

- **Impact Analysis:** Assess risks before changes
- **Approval Workflows:** Tiered authorization based on risk
- **Audit Trails:** Complete decision lineage
- **Feedback Loops:** Retrospectives driving improvement

> ***Governance Research Validation:***
>
> *SOLID.AI's governance approach aligns with emerging AI governance frameworks. Eisenberg et al. (2025) demonstrate systematic approaches to AI oversight across industries. Deloitte research (2024) highlights the critical need for transparent, auditable AI systems with human oversight for high-stakes decisions. The Governance Institute (2024) emphasizes that effective AI governance requires both automated compliance monitoring and human judgment for ethical boundaries—exactly the hybrid model SOLID.AI implements through Layer 6.*

See: Governance → Implementation

Nine Core Principles

1. Purpose-Driven Design

Every process, agent, and organizational structure traces back to strategic purpose. No "AI for AI's sake."

2. Data-Centric Operations

Single source of truth (Data Spine) as foundation. Data quality = system reliability.

3. Intelligent Agents as Peers

AI agents are organizational members with defined roles, not tools. Accountability and transparency required.

4. Human-AI Collaboration

Complementary strengths: humans for judgment/creativity, AI for speed/scale. Clear role hierarchy.

5. Adaptive Scalability

Growth through AI multiplication, not linear headcount. Projected economic model: 500-person output with 50-person team.

6. Ethical Governance

Non-negotiable ethical boundaries. Automated compliance monitoring. Human oversight for high-stakes decisions.

7. Transparency & Auditability

Every AI decision logged and explainable. Regulatory compliance built-in (SOC2, GDPR, HIPAA).

8. Continuous Learning

Feedback loops at all levels. Retrospectives driving architectural evolution.

9. Whole-Organization Scope

Transformation across ALL functions (not just IT). Sales, Finance, HR, Marketing, Operations, Legal.

Organizational Scalability Model

> ***Implementation Note:*** *The scalability projections below are based on the* ***Midora business plan thesis****, where SOLID.AI is being applied from founding to validate this organizational model. These are strategic projections, not measured results. Midora is building the company from absolute zero using this framework, and actual performance data will be published as the implementation matures.*

SOLID.AI targets exponential growth through AI multiplication:

```
Traditional Organization (Reference Model):
  Revenue: 10M → 50M (+400%)
  Headcount: 100 → 500 people (+400%)
  Ratio: 1:1 scaling

AI-Native Organization (Projected SOLID.AI Model):
```

```
Revenue: 10M → 50M (+400%)
Headcount: 100 → 150 people (+50%)
AI Agents: 0 → 350 equivalent roles
Ratio: 1:0.5 scaling (humans), 1:3.5 (AI multiplication)
```

Projected Economic Case:

- **Traditional 50M Company:** 500 employees × 100K = 50M payroll (100% of revenue)
- **AI-Native 50M Company (Target):** 150 employees × 100K = 15M payroll (30% of revenue)
- **Projected Savings:** 35M/year reallocated to R&D, market expansion, or profit
- **Quality Targets:** Error rates <1% (vs. 5-10% traditional), faster time-to-market

Scalability Comparison Table

| Metric | Traditional Org | SOLID.AI (Projected) | Difference |

|--------|----------------|----------------------|------------|

| **Revenue Growth** | 10M → 50M (+400%) | 10M → 50M (+400%) | Same growth target |

| **Headcount Growth** | 100 → 500 people (+400%) | 100 → 150 people (+50%) | **-70% headcount** |

| **AI Agent Roles** | 0 agents | 350 equivalent roles | **+350 AI roles** |

| **Payroll Cost** | 50M (100% of revenue) | 15M (30% of revenue) | **-35M savings** |

| **Cost Efficiency** | 1:1 revenue-to-payroll | 3.3:1 revenue-to-payroll | **3.3x improvement** |

| **Error Rate** | 5-10% (manual processes) | <1% (automated quality) | **5-10x improvement** |

| **Time-to-Market** | Months (waterfall cycles) | Weeks (AI-accelerated) | **4-10x faster** |

| **Scaling Ratio** | Linear (1:1) | Exponential (1:3.5 AI multiplication) | **Sublinear scaling** |

> ***Note:*** *These projections represent the Midora business plan thesis targets. Actual metrics will be published as the implementation matures in production.*

> ***Research Evidence:*** *McKinsey Global Institute projects 2.9 trillion in value creation through redesigning work around human-AI skill partnerships, not isolated task automation. EY research explicitly validates "decoupling growth from headcount" and "non-linear productivity" through systematic AI integration—providing economic foundation for SOLID.AI's scalability model. McKinsey further estimates 4.4 trillion in productivity gains when work is redesigned around "superagency" (humans supported by AI agents and automation).*

Technology Stack

While SOLID.AI is technology-agnostic, reference implementations use:

Data Spine:

- PostgreSQL (canonical data store)
- Apache Kafka (event streaming)
- dbt (data transformation)
- Great Expectations (data quality)

Cognitive Layer:

- OpenAI API / Claude / Gemini (LLM providers)
- LangChain / LlamaIndex (orchestration)
- ChromaDB / Pinecone (vector storage)

Automation Mesh:

- Temporal.io (workflow engine)
- Apache Airflow (batch orchestration)
- n8n (low-code automation)

Governance:

- GitHub (RFC/ADR version control)
- Backstage (developer portal)
- Custom dashboards (observability)

Specification

Status: Version: 1.0

1. Core Entities

1.1 Actor

Definition: A human participant with decision-making authority and accountability within the system.

Attributes:

- `actor_id`: Unique identifier (UUID)
- `role`: Organizational role (e.g., Product Manager, Compliance Officer)
- `authority_level`: Decision boundary scope (tactical, strategic, governance)
- `authentication_context`: Identity verification state
- `session_metadata`: Active context and preferences

Constraints:

- MUST have unique identity across all system boundaries
- MUST be traceable through audit logs
- MUST operate within defined authority boundaries
- MAY delegate execution to AI Agents but CANNOT delegate accountability

Example:

```
actor:
  actor_id: "a7f3c8b1-4e5d-6f7a-8b9c-0d1e2f3a4b5c"
  role: "Product Manager"
  authority_level: "strategic"
  authentication_context:
    method: "SSO"
    verified_at: "2025-11-29T14:30:00Z"
  session_metadata:
    workspace: "Q4-Planning"
    active_context: ["sales-analysis", "budget-review"]
```

1.2 AI Agent

Definition: An autonomous software entity that performs tasks, analyzes data, and generates recommendations within defined constraints.

Attributes:

- `agent_id`: Unique identifier (UUID)
- `agent_type`: Classification (cognitive, analytical, orchestration, execution)
- `capabilities`: List of supported operations
- `model_reference`: Underlying AI model (e.g., GPT-4, Claude-3.5)
- `trust_boundary`: Operational constraints and approval requirements
- `performance_metrics`: SLA targets and actual performance

Constraints:

- MUST operate within trust boundaries
- MUST log all actions to audit trail
- MUST request human approval for actions exceeding trust boundary
- MUST provide explainability for recommendations
- MAY be composed into agent networks

Example:

```
ai_agent:
  agent_id: "agent-sales-analyst-001"
  agent_type: "cognitive"
  capabilities:
    - "sales-forecasting"
    - "trend-analysis"
    - "recommendation-generation"
  model_reference:
    provider: "OpenAI"
    model: "gpt-4o"
    version: "2024-11"
  trust_boundary:
    autonomy_level: "supervised"
    approval_required_for: ["budget-allocation", "pricing-changes"]
  performance_metrics:
    target_latency_p95: "5 seconds"
    accuracy_target: "0.95"
```

1.3 Event

Definition: A state change or occurrence within the system that triggers downstream processing.

Attributes:

- `event_id`: Unique identifier (UUID)
- `event_type`: Classification (business, system, governance, audit)
- `timestamp`: ISO 8601 timestamp with timezone
- `source`: Originating entity (Actor, AI Agent, External System)
- `payload`: Event data conforming to schema
- `correlation_id`: Parent event or transaction identifier
- `causation_chain`: Full lineage of triggering events

Constraints:

- MUST be immutable after creation
- MUST include complete causation chain
- MUST be persisted to event store
- MUST propagate through Automation Mesh
- MAY trigger zero or more downstream Actions

Example:

```
event:
  event_id: "evt-2025-11-29-14-30-001"
  event_type: "business"
  timestamp: "2025-11-29T14:30:15.234Z"
  source:
    type: "external_system"
    system_id: "salesforce-prod"
  payload:
    event_name: "opportunity_closed_won"
    opportunity_id: "opp-2025-Q4-1234"
    amount: 250000
    customer_id: "cust-enterprise-456"
  correlation_id: "txn-2025-11-29-001"
  causation_chain:
    - "evt-2025-11-29-14-25-001" # opportunity_updated
    - "evt-2025-11-29-14-28-003" # approval_granted
```

1.4 Action

Definition: A concrete operation executed by an AI Agent or Actor in response to Events.

Attributes:

- `action_id`: Unique identifier (UUID)
- `action_type`: Classification (query, command, notification, approval_request)
- `executor`: Entity performing the action (Actor or AI Agent)
- `target`: System, API, or resource affected
- `parameters`: Action-specific configuration
- `status`: Current state (pending, in_progress, completed, failed, cancelled)
- `result`: Outcome data upon completion

Constraints:

- MUST be traceable to triggering Event
- MUST respect trust boundaries
- MUST be idempotent where possible
- MUST record execution metadata
- MAY require human approval based on Policy

Example:

```
action:
  action_id: "act-2025-11-29-14-30-002"
  action_type: "command"
  executor:
    type: "ai_agent"
    agent_id: "agent-sales-analyst-001"
  target:
    system: "revenue-forecasting-service"
    endpoint: "/api/v1/forecasts"
  parameters:
    method: "POST"
    body:
      opportunity_id: "opp-2025-Q4-1234"
      amount: 250000
      close_date: "2025-11-29"
      confidence: "high"
  status: "completed"
  result:
    forecast_updated: true
    new_q4_forecast: 2450000
    variance_from_target: -50000
```

1.5 Policy

Definition: A declarative rule that governs system behavior, access control, and decision-making.

Attributes:

- `policy_id`: Unique identifier (UUID)
- `policy_name`: Human-readable name
- `policy_type`: Classification (access_control, approval_workflow, data_governance, compliance)
- `scope`: Applicability (global, domain-specific, agent-specific)
- `conditions`: Logical expressions for policy activation
- `enforcement_action`: Required behavior when policy triggers
- `priority`: Execution order when multiple policies apply

Constraints:

- MUST be versioned
- MUST be auditable
- MUST support conflict resolution via priority
- MAY be overridden by governance layer
- MUST be evaluated before action execution

Example:

```
policy:
  policy_id: "pol-budget-approval-001"
  policy_name: "Budget Allocation Approval Workflow"
  policy_type: "approval_workflow"
  scope:
    domain: "finance"
    applies_to: ["budget-allocation", "cost-center-transfer"]
  conditions:
    - "action.amount > 50000"
    - "action.executor.type == 'ai_agent'"
  enforcement_action:
    type: "require_human_approval"
    approver_roles: ["CFO", "Finance Director"]
    timeout: "4h"
  priority: 100
```

1.6 Boundary

Definition: A logical or physical demarcation defining trust, security, or organizational scope.

Attributes:

- `boundary_id`: Unique identifier (UUID)
- `boundary_type`: Classification (trust, security, organizational, data_residency)
- `scope`: Entities and resources within boundary
- `ingress_rules`: Permitted entry conditions
- `egress_rules`: Permitted exit conditions
- `enforcement_mechanism`: Technical control implementation

Constraints:

- MUST define clear ingress/egress rules
- MUST be enforced at runtime
- MUST log all boundary crossings
- MAY be nested hierarchically
- MUST align with compliance requirements

Example:

```
boundary:
  boundary_id: "bnd-pii-processing-001"
  boundary_type: "data_residency"
  scope:
    data_domains: ["customer_pii", "employee_records"]
    geographic_region: "EU"
  ingress_rules:
    - "source.compliance_validated == true"
    - "source.encryption == 'AES-256'"
  egress_rules:
    - "destination.gdpr_compliant == true"
    - "purpose.legal_basis IN ['consent', 'contract', 'legitimate_interest']"
  enforcement_mechanism:
    type: "api_gateway"
    policy_enforcement_point: "data-spine-ingress"
```

1.7 Data Domain

Definition: A logical grouping of related data entities with consistent governance, ownership, and quality standards.

Attributes:

- `domain_id`: Unique identifier (UUID)
- `domain_name`: Human-readable name
- `owner`: Accountable Actor or team
- `schema_registry`: Data structure definitions
- `quality_requirements`: Validation rules and SLAs
- `access_control`: Authorization policies
- `lineage_tracking`: Data provenance metadata

Constraints:

- MUST have designated owner
- MUST define schema contracts
- MUST enforce quality requirements
- MUST maintain lineage metadata
- MAY federate across multiple storage systems

Example:

```
data_domain:
  domain_id: "dom-sales-performance-001"
  domain_name: "Sales Performance Analytics"
  owner:
    actor_id: "b9e4d2c5-5f6a-7b8c-9d0e-1f2a3b4c5d6e"
    role: "VP Sales Operations"
  schema_registry:
    - entity: "opportunity"
      version: "v2.1"
      fields: ["id", "amount", "stage", "close_date", "probability"]
    - entity: "sales_forecast"
      version: "v1.3"
      fields: ["period", "amount", "confidence", "updated_at"]
  quality_requirements:
    completeness: '>= 0.98'
    freshness: '<= 60s'
    accuracy: '>= 0.95'
  access_control:
    read: ["sales_team", "executive_team", "agent-sales-analyst-*"]
    write: ["salesforce-prod", "sales_automation_agents"]
```

1.8 Governance Rule

Definition: A high-level constraint that ensures ethical, legal, and organizational compliance across all system operations.

Attributes:

- `rule_id`: Unique identifier (UUID)
- `rule_name`: Human-readable name
- `category`: Classification (ethical, legal, operational, financial)
- `regulation_reference`: External standard or law (e.g., GDPR Article 22)
- `scope`: System-wide or domain-specific
- `validation_logic`: Automated compliance checks
- `violation_action`: Response to non-compliance

Constraints:

- MUST be immutable after activation
- MUST supersede conflicting Policies
- MUST be continuously monitored
- MUST generate audit events on violation
- MAY trigger automatic remediation

Example:

```
governance_rule:
  rule_id: "gov-gdpr-art22-001"
  rule_name: "Automated Decision Transparency"
  category: "legal"
  regulation_reference:
    standard: "GDPR"
    article: "Article 22"
    description: "Right to explanation for automated decisions"
  scope: "global"
  validation_logic:
    - "IF action.affects_individual_rights THEN action.explainability_required = true"
    - "IF action.executor.type == 'ai_agent' AND action.impact == 'high' THEN action.human_
  violation_action:
    type: "block_and_alert"
    notify: ["DPO", "compliance_team"]
    escalation_timeout: "1h"
```

1.9 Service Level Objectives (SLOs)

Consolidated Performance Targets

The following table defines the target Service Level Objectives for SOLID.AI framework components. These are aspirational targets for production implementations.

Component	Metric	Target	Measurement
Data Spine	Latency (P95)	< 5s	95th percentile query r
Data Spine	Availability	>= 99.9%	System uptime over 30-d
Data Spine	Data Freshness	< 60s	Time from source change
AI Agents	Response Latency (P95)	< 5s	95th percentile from re
AI Agents	Accuracy	>= 95%	Correct recommendations
AI Agents	Explainability	100%	All decisions must incl
Automation Mesh	Event Processing (P95)	< 5s	Time from event emissio
Automation Mesh	Throughput	>= 1000 events/sec	Sustained event process
Automation Mesh	Error Rate	< 1%	Failed workflows vs. to
Governance	Audit Log Completeness	100%	All actions logged with
Governance	Override Response Time	< 100ms	Human intervention ackn
Governance	Policy Violation Detection	< 1s	Time to detect and flag

Notes:

- **Latency vs. Freshness**: Latency measures system response time; freshness measures data currency
- **P95**: 95th percentile - 95% of requests complete within target
- **Availability**: Measured as uptime / (uptime + downtime) over rolling 30-day period
- **These are target specifications**: Actual performance depends on implementation architecture and scale

---

2. System Behaviors

2.1 Event Propagation

Description: The mechanism by which Events flow through the Automation Mesh, triggering downstream Actions and maintaining causation chains.

Behavior Specification:

- **Event Publication**
- Event is created with immutable attributes

- Event is published to Automation Mesh event bus (Kafka topic)
- Event correlation_id and causation_chain are preserved

- **Event Routing**
- Automation Mesh evaluates event_type and payload
- Subscribed AI Agents and services receive event notifications
- Routing respects Boundary constraints

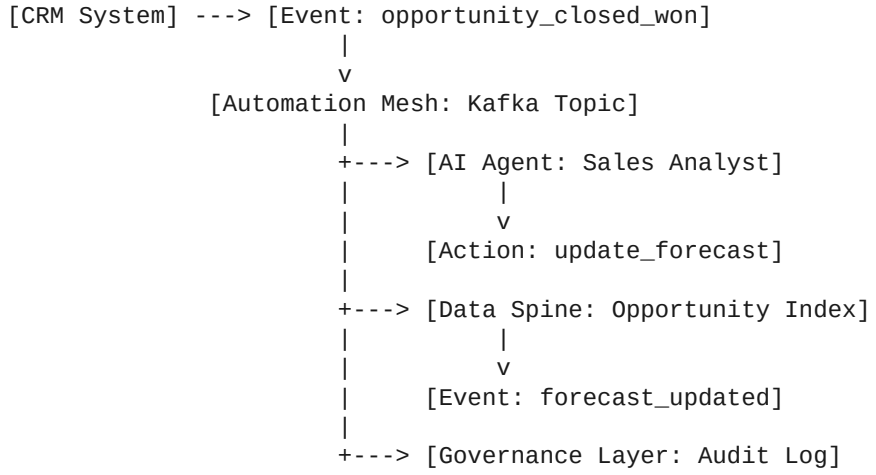
- **Event Processing**
- Consumers process event within SLA targets (P95 < 5s)
- Processing generates new Events and Actions
- Causation chain is extended with new event IDs

- **Event Storage**
- All events persisted to event store (immutable log)
- Events retained per data retention policy
- Events indexed for audit and replay

Guarantees:

- Events are delivered at-least-once
- Event ordering preserved within partition key (correlation_id)
- No event is lost (durability via replication)
- Full causation chain always reconstructable

Example Flow:



2.2 Action Orchestration

Description: The coordination of Actions across multiple systems, respecting dependencies, trust boundaries, and approval workflows.

Behavior Specification:

- **Action Planning**
- AI Agent receives Event
- Agent generates Action plan with dependencies
- Plan evaluated against Policies and trust boundaries
- **Approval Workflow**
- If action exceeds trust boundary, generate approval_request Event
- Route approval_request to appropriate Actor
- Wait for approval_granted or approval_denied Event (with timeout)
- **Action Execution**
- Execute Actions in dependency order
- Log execution start, progress, and completion
- Handle failures with retry and compensation logic
- **Result Propagation**
- Generate completion Event with result payload
- Update Data Spine with outcome
- Notify downstream consumers

Guarantees:

- Actions execute transactionally where possible
- Failed actions trigger compensation or rollback
- All actions traceable to originating Event
- Approval timeouts prevent indefinite blocking

Example Orchestration:

```
orchestration:
  trigger_event: "evt-opportunity-closed-won"
  planned_actions:
```

```
- action_id: "act-001"
  type: "update_forecast"
  executor: "agent-sales-analyst-001"
  requires_approval: false
  dependencies: []

- action_id: "act-002"
  type: "allocate_budget"
  executor: "agent-finance-automation-001"
  requires_approval: true  # Amount > 50k threshold
  dependencies: ["act-001"]
  approval_workflow:
    approver_roles: ["CFO"]
    timeout: "4h"

- action_id: "act-003"
  type: "notify_sales_team"
  executor: "agent-notification-001"
  requires_approval: false
  dependencies: ["act-001", "act-002"]
```

2.3 Human Override

Description: The capability for Actors to intervene in automated workflows, overriding AI Agent recommendations or halting in-progress Actions.

Behavior Specification:

- **Override Trigger**
- Actor issues override_request Event
- Request specifies target Action or decision
- Override reason and justification captured
- **Immediate Halt**
- Target Action transitions to "suspended" status
- Downstream Actions blocked
- System state snapshot captured
- **Actor Decision**
- Actor reviews context, data, and AI recommendation
- Actor approves, modifies, or cancels Action
- Decision rationale recorded in audit log
- **Execution Resume**

- System applies Actor's decision
- Workflow continues with modified parameters
- Override Event propagated to audit and governance layers

Guarantees:

- Human override ALWAYS takes precedence over automation
- Override latency < 100ms (real-time responsiveness)
- Full context preserved for Actor decision-making
- Override logged with Actor identity and justification

Example Override:

```
override_event:
  event_id: "evt-override-2025-11-29-001"
  event_type: "governance"
  timestamp: "2025-11-29T15:45:00Z"
  source:
    type: "actor"
    actor_id: "b9e4d2c5-5f6a-7b8c-9d0e-1f2a3b4c5d6e"
  payload:
    override_type: "action_modification"
    target_action_id: "act-budget-allocation-789"
    original_parameters:
      amount: 250000
      allocation: "Q4-marketing-expansion"
    modified_parameters:
      amount: 200000
      allocation: "Q4-marketing-expansion"
    justification: "Market conditions shifted; reducing spend by 20% to preserve cash reser
  result:
    action_status: "resumed"
    modified_execution: true
```

2.4 Context Alignment

Description: The process of ensuring AI Agents operate with current, accurate context aligned with organizational goals and real-world state.

Behavior Specification:

- **Context Acquisition**
- AI Agent queries Data Spine for relevant data domains
- Agent retrieves organizational objectives from Purpose Layer

- Agent loads applicable Policies and Governance Rules

- **Context Validation**
- Agent verifies data freshness (within SLA: < 60s)
- Agent checks for conflicting policies
- Agent validates against trust boundary constraints

- **Context Application**
- Agent reasoning incorporates context into decision-making
- Agent generates recommendations aligned with current state
- Agent explains how context influenced output

- **Context Drift Detection**
- System monitors for context changes (e.g., policy updates, objective shifts)
- Out-of-date context triggers re-evaluation
- Agent operations suspended if context invalidated

Guarantees:

- AI Agents NEVER operate with stale context
- Context freshness validated before every decision
- Context changes trigger automatic re-alignment
- Full context snapshot logged with every action

Example Context:

```
context_snapshot:
  agent_id: "agent-sales-analyst-001"
  timestamp: "2025-11-29T14:30:00Z"
  data_spine_context:
    - domain: "sales_performance"
      freshness: "12s"
      entities: ["opportunities", "forecasts", "pipeline"]
  purpose_layer_context:
    objectives:
      - "Achieve Q4 revenue target: 2.5M"
      - "Maintain sales cycle < 30 days"
    priorities: ["revenue_growth", "customer_retention"]
  policy_context:
    applicable_policies:
      - "pol-budget-approval-001"
      - "pol-forecast-accuracy-001"
  governance_context:
    active_rules:
      - "gov-gdpr-art22-001"
      - "gov-sox-404-001"
```

2.5 Audit Trail Registration

Description: The comprehensive logging of all system activities, decisions, and state changes for compliance, debugging, and forensic analysis.

Behavior Specification:

- **Event Capture**
- All Events, Actions, Actor interactions logged
- Logs include full context and causation chain
- Logs signed with cryptographic integrity
- **Structured Storage**
- Audit logs stored in immutable append-only log
- Logs partitioned by domain and time
- Logs replicated for durability (3x replication)
- **Retention Management**
- Logs retained per regulatory requirements (e.g., 7 years for SOX)
- Automated archival to cold storage after hot period
- Legal hold capability for litigation
- **Query and Analysis**
- Audit logs queryable via API
- Full-text search and structured filters
- Anomaly detection via ML models

Guarantees:

- 100% of system activities logged (no gaps)
- Log integrity verifiable via cryptographic signatures
- Log retention meets all compliance requirements
- Logs never modified or deleted (immutable)

Example Audit Entry:

```
audit_entry:
  entry_id: "aud-2025-11-29-14-30-001"
  timestamp: "2025-11-29T14:30:15.234Z"
  entry_type: "action_executed"
  actor_or_agent:
    type: "ai_agent"
    agent_id: "agent-sales-analyst-001"
  action:
    action_id: "act-2025-11-29-14-30-002"
    action_type: "update_forecast"
    target: "revenue-forecasting-service"
  context:
    triggering_event: "evt-opportunity-closed-won"
    correlation_id: "txn-2025-11-29-001"
    causation_chain: ["evt-2025-11-29-14-25-001", "evt-2025-11-29-14-28-003"]
  result:
    status: "completed"
    outcome: "forecast_updated"
    duration_ms: 1234
  integrity:
    signature: "sha256:a3f5d8c9b2e1f4a7..."
    previous_entry_hash: "sha256:9f2e4b7c8a3d1..."
```

---

3. System Guarantees

3.1 Deterministic Edges

Guarantee Statement: All decision points and state transitions in the system produce consistent, predictable outcomes given identical inputs.

Specification:

- **Idempotency:** Repeating the same Action with the same parameters produces the same result
- **Reproducibility:** Given the same Event and context, AI Agents generate identical recommendations
- **Predictability:** Policy evaluation produces consistent enforcement actions
- **Testability:** All system behaviors verifiable via automated testing

Implementation Requirements:

- **Deterministic AI Models:**
- Set temperature=0 for reproducible outputs
- Use fixed random seeds in testing
- Version-lock model references

- **Immutable Events:**
- Events never modified after creation
- Event replay produces identical downstream effects
- **Stateless Processing:**
- Actions depend only on inputs and context
- No hidden state or side effects

Verification:

```
# Example deterministic test (values are illustrative, not prescriptive)
def test_forecast_update_deterministic():
    event = Event(type="opportunity_closed_won", payload={"amount": 250000})
    context = Context(q4_target=2500000, current_forecast=2200000)

    agent = SalesAnalystAgent(temperature=0, model="gpt-4o-2024-11")

    result1 = agent.process(event, context)
    result2 = agent.process(event, context)

    assert result1 == result2  # Deterministic output
    assert result1.new_forecast == 2450000  # Illustrative value
```

> ***Note:*** *Values in examples are illustrative and demonstrate determinism principles, not prescriptive forecasting rules. Actual implementations will define domain-specific calculation logic.*

3.2 Traceability

Guarantee Statement: Every system output, decision, and state change is traceable to its originating inputs, context, and reasoning chain.

Specification:

- **Full Lineage:** All Events and Actions linked via causation chains
- **Provenance Tracking:** Data transformations preserve origin metadata
- **Decision Explanation:** AI Agents provide reasoning for recommendations
- **Audit Completeness:** 100% of activities logged to immutable audit trail

Implementation Requirements:

- **Causation Chain Propagation:**
- Every Event includes full ancestry
- Actions reference triggering Events
- Chains preserved across system boundaries
- **Explainability:**
- AI Agents output reasoning alongside recommendations
- Reasoning includes data sources, context factors, and logic
- Explanations human-readable and technically precise
- **Audit Coverage:**
- All Actor interactions logged
- All AI Agent decisions logged
- All system Events logged

Example Trace:

```
trace:
  query: "Why did the Q4 forecast increase to 2.45M?"
  trace_result:
    action_id: "act-2025-11-29-14-30-002"
    action_type: "update_forecast"
    executor: "agent-sales-analyst-001"
    triggering_event:
      event_id: "evt-opportunity-closed-won"
      payload:
        opportunity_id: "opp-2025-Q4-1234"
        amount: 250000
    reasoning:
      - "Opportunity opp-2025-Q4-1234 closed won for 250K"
      - "Current Q4 forecast: 2.2M"
      - "Adding 250K to forecast: 2.2M + 250K = 2.45M"
      - "New forecast within target range (2.3M - 2.7M)"
    data_sources:
      - domain: "sales_performance"
        entity: "opportunities"
        freshness: "12s"
    causation_chain:
      - "evt-2025-11-29-14-25-001" # opportunity_updated
      - "evt-2025-11-29-14-28-003" # approval_granted
      - "evt-2025-11-29-14-30-001" # opportunity_closed_won
```

3.3 Compliance Invariants

Guarantee Statement: The system maintains continuous compliance with all applicable regulations, standards, and organizational policies under all operating conditions.

Specification:

- **Policy Enforcement:** All Policies evaluated before Action execution
- **Governance Supremacy:** Governance Rules override conflicting behaviors
- **Boundary Integrity:** No operations cross Boundaries without authorization
- **Audit Completeness:** All compliance-relevant activities logged

Implementation Requirements:

- **Policy Engine:**
- Centralized policy evaluation before every action
- Policy conflicts resolved via priority
- Policy violations block execution

- **Governance Layer:**
- Continuous monitoring of active Governance Rules
- Real-time violation detection
- Automatic remediation or escalation

- **Compliance Validation:**
- Automated compliance checks (e.g., GDPR, SOX, HIPAA)
- Regular compliance audits via external tooling
- Compliance dashboard for real-time visibility

Supported Regulations:

- **GDPR:** Right to explanation, consent management, data minimization
- **SOX:** Financial controls, audit trails, segregation of duties
- **HIPAA:** PHI access controls, encryption, breach notification
- **ISO 27001:** Information security management
- **FedRAMP:** Cloud security for government data

Example Invariant Check:

```
compliance_check:
  rule_id: "gov-gdpr-art22-001"
  check_time: "2025-11-29T14:30:15Z"
```

```
action_under_review:
  action_id: "act-budget-allocation-789"
  affects_individual_rights: true
  executor: "agent-finance-automation-001"
validation_result:
  compliant: false
  violations:
    - "Action affects individual rights but lacks explainability"
    - "No human review requested (required for high-impact decisions)"
enforcement:
  action_blocked: true
  remediation: "Require human approval from CFO"
  notification_sent_to: ["DPO", "compliance_team"]
```

3.4 Observability Coverage

Guarantee Statement: All system components, behaviors, and performance metrics are observable, measurable, and alertable in real-time.

Specification:

- **Metrics Collection:** Performance, latency, throughput, error rates
- **Logging:** Structured logs for all Events, Actions, and decisions
- **Tracing:** Distributed traces across service boundaries
- **Alerting:** Real-time alerts for SLA violations and anomalies

Implementation Requirements:

- **Metrics Instrumentation:**
- Prometheus metrics for all services
- Custom metrics for AI Agent performance (accuracy, latency)
- SLA tracking (P50, P95, P99 latencies)
- **Distributed Tracing:**
- OpenTelemetry spans for all operations
- Trace IDs propagated across system boundaries
- Trace visualization via Jaeger or Tempo
- **Dashboards:**
- Real-time system health dashboard
- AI Agent performance dashboard

- Compliance and governance dashboard
- **Alerting:**
- SLA breach alerts (e.g., P95 latency > 5s)
- Policy violation alerts
- Anomaly detection via ML models

Key Metrics:

```
Metric                          Target          Alert Threshold
-----------------------------------------------------------------
Event Processing Latency (P95)  < 5 seconds     > 10 seconds
Data Spine Freshness            < 60 seconds    > 120 seconds
AI Agent Accuracy               >= 0.95         < 0.90
System Availability             >= 99.9%        < 99.5%
Audit Log Completeness          100%            < 99.9%
Policy Evaluation Latency (P95) < 100ms         > 500ms
```

Example Observability Stack:

```
observability:
  metrics:
    collector: "Prometheus"
    retention: "90d"
    scrape_interval: "15s"

  logging:
    system: "ELK Stack (Elasticsearch, Logstash, Kibana)"
    structured_format: "JSON"
    retention: "7y" # SOX compliance

  tracing:
    system: "OpenTelemetry + Jaeger"
    sampling_rate: "100%" # Full trace coverage
    retention: "30d"

  dashboards:
    - name: "System Health"
      url: "/dashboards/system-health"
    - name: "AI Agent Performance"
      url: "/dashboards/ai-agents"
    - name: "Compliance Status"
      url: "/dashboards/compliance"

  alerting:
    system: "PagerDuty"
    channels: ["email", "slack", "sms"]
    escalation_policy: "on-call-rotation"
```

4. Conformance Testing

Implementations claiming SOLID.AI compliance MUST pass the following conformance test suite:

4.1 Entity Conformance

- ■ All core entities implement required attributes
- ■ Entity constraints enforced at runtime
- ■ Entity serialization follows specification

4.2 Behavior Conformance

- ■ Event propagation maintains causation chains
- ■ Action orchestration respects trust boundaries
- ■ Human override latency < 100ms
- ■ Context alignment validates freshness
- ■ Audit trail achieves 100% coverage

4.3 Guarantee Conformance

- ■ Deterministic edges verified via automated tests
- ■ Traceability validated end-to-end
- ■ Compliance invariants continuously monitored
- ■ Observability metrics published and alertable

Conformance Certification:

Implementations passing all conformance tests receive **SOLID.AI v1 Certified** designation.

---

5. References

5.1 Related Specifications

- **Architecture** — Six-layer system design
- **Technical Specification** — Component implementation details
- **Governance** — Implementation roadmap and compliance
- **Diagrams** — Visual architecture references

5.2 External Standards

- **GDPR:** General Data Protection Regulation (EU 2016/679)
- **SOX:** Sarbanes-Oxley Act (2002)
- **HIPAA:** Health Insurance Portability and Accountability Act (1996)
- **ISO 27001:** Information Security Management (2013)
- **FedRAMP:** Federal Risk and Authorization Management Program
- **OpenTelemetry:** Cloud-native observability framework

---

6. Version History

| Version | Date | Changes |

| :--- | :--- | :--- |

| 1.0 | 2025-12-05 | Initial stable release |

---

7. License

Implementation Guide

Status: Version: 1.0

This section provides detailed technical specifications for each layer of the SOLID.AI architecture.

Data Spine (Layer 2)

Overview

As shown in Figure 3 (see Diagrams), the Data Spine serves as the organization's unified, real-time data infrastructure—a single source of truth accessible to all humans and AI agents.

Design Principles

- **Schema-First:** All data models defined with strict contracts (JSON Schema, Avro, Protobuf)
- **Event-Driven:** Changes propagated via immutable event logs
- **Real-Time:** P95 latency < 5s for critical data updates
- **Bi-Directional Sync:** Changes flow in all directions (no master/slave)
- **Audit Trail:** Complete history of all data mutations

Core Components

Canonical Data Models

Standard entity definitions across the organization:

```
# Example: Customer entity
Customer:
  id: UUID (immutable)
  created_at: ISO8601 timestamp
  updated_at: ISO8601 timestamp
  attributes:
    name: string (required)
    email: email (unique, required)
```

```
    company: string (optional)
    tier: enum[free, pro, enterprise]
    mrr: decimal (monthly recurring revenue)
  relationships:
    contracts: hasMany(Contract)
    interactions: hasMany(Interaction)
    owner: belongsTo(User, role="account_manager")
```

Data Contracts

Formal agreements between systems defining interfaces:

```
# Contract: CRM → Data Spine
source: salesforce_crm
target: data_spine
entity: Customer
sync_mode: real_time
transformations:
  - map: AccountId → id
  - map: Name → name
  - map: Email → email
  - map: AnnualRevenue / 12 → mrr
validations:
  - required: [id, name, email]
  - format: email matches RFC5322
  - range: mrr >= 0
sla:
  latency_p95: <5s
  availability: 99.9%
  freshness: <60s
```

Event Streaming Architecture

Event Types:

- `entity.created` – New record
- `entity.updated` – Field changes
- `entity.deleted` – Soft delete (immutable log)
- `entity.merged` – Deduplication

Event Schema:

```
{
  "event_id": "uuid",
  "event_type": "customer.updated",
  "timestamp": "2025-11-29T10:30:00Z",
  "source": "crm_api",
  "actor": {"type": "human", "id": "user_123"},
  "entity": {
    "type": "Customer",
    "id": "cust_456",
    "changes": {
```

```
        "tier": {"from": "pro", "to": "enterprise"},
        "mrr": {"from": 500, "to": 2000}
      }
    },
    "metadata": {
      "contract_signed": true,
      "effective_date": "2025-12-01"
    }
  }
```

Data Quality Framework

Automated Validations:

- Schema conformance (type checking)
- Referential integrity (foreign keys)
- Business rules (e.g., MRR ≥ 0)
- Freshness checks (update recency)
- Completeness scores (missing fields)

Quality Metrics:

- **Accuracy:** % records passing validation
- **Completeness:** % required fields populated
- **Consistency:** % cross-system reconciliation matches
- **Timeliness:** P95 latency for updates

Cognitive Layer (Layer 3)

Overview

As shown in Figure 4 (see Diagrams), AI agents operate as organizational members with defined roles, capabilities, and accountability through a continuous collaboration loop with humans.

***See:** Figure 4 — Human-AI Collaboration Loop for complete interaction flow*

Agent Definition Schema

```yaml
agent:
  id: sales_analyst_001
  name: Sales Performance Analyzer
  type: analytical
  version: 2.1.0

  purpose: |
    Analyze sales pipeline data, identify trends, and provide
    actionable recommendations to sales leadership.

  capabilities:
    - pipeline_forecasting
    - deal_risk_assessment
    - win_loss_analysis
    - competitor_intelligence

  data_access:
    read:
      - customers (all)
      - opportunities (all)
      - contracts (all)
      - interactions (type="sales_call")
    write:
      - forecasts (own)
      - recommendations (own)

  interfaces:
    input:
      - slack_channel: "#sales-analytics"
      - api_endpoint: "/agents/sales_analyst"
      - scheduled_triggers: ["daily 8am", "weekly monday"]
    output:
      - slack_notifications: true
      - dashboard_updates: "sales_dashboard"
      - email_reports: sales_leadership@company.com

  constraints:
    execution_time: <60 seconds
    cost_per_run: <0.50
    accuracy_threshold: >95%

  human_oversight:
    approval_required: false
    audit_frequency: weekly
    escalation_conditions:
      - forecast_deviation >20%
      - deal_risk_score >8/10

  ethical_boundaries:
    - no_customer_discrimination
    - transparent_scoring_methodology
    - human_review_for_contract_termination
```

Agent Lifecycle

- **Definition:** RFC process for new agents
- **Development:** Build and test in sandbox

- **Validation:** Human review + test cases
- **Deployment:** Gradual rollout with monitoring
- **Operation:** Continuous execution + logging
- **Evolution:** Feedback-driven improvements
- **Retirement:** Deprecation with migration plan

Reasoning Patterns

Chain-of-Thought:

```
User Query: "Why is Q4 forecast down 15%?"

Agent Reasoning:
1. Retrieve Q4 pipeline data
2. Compare to Q3 pipeline at same point
3. Identify closed-lost deals (reasons)
4. Analyze new deal velocity (slower)
5. Assess stage progression rates (delayed)
6. Synthesize findings into explanation

Output: "Q4 forecast is down 15% due to: (1) 3 large
enterprise deals slipped to Q1 (450K total), (2) new
pipeline generation 20% below target, and (3) slower
progression from Discovery → Proposal (avg 14 days vs.
9 days in Q3). Recommendation: Focus on accelerating
mid-stage deals and launching Q1 demand gen campaign."
```

Human-AI Collaboration Model:

- AI performs analysis (speed, scale)
- Human validates conclusions (judgment)
- AI implements decisions (execution)
- Human monitors outcomes (oversight)

Automation Mesh (Layer 4)

Overview

Process execution layer translating decisions into coordinated actions across systems.

SIPOC Integration

Every process mapped using SIPOC (Supplier, Input, Process, Output, Customer):

Example: Invoice Processing

| Element | Definition |

|---------|------------|

| **Supplier** | Vendor submits invoice (email/portal) |

| **Input** | Invoice PDF, PO number, amount, due date |

| **Process** | 1. OCR extraction
2. PO matching
3. GL coding
4. Approval routing
5. Payment scheduling |

| **Output** | Approved payment, updated ledger, vendor notification |

| **Customer** | Finance team (reporting), Vendor (payment) |

Automation:

- Steps 1-3: 100% AI-driven (seconds)
- Step 4: Human approval if >5K (minutes)
- Step 5: Automated payment execution (hours)

Metrics:

- **Cycle Time:** 72 hours → 4 hours (95% reduction)
- **Error Rate:** 8% → 0.5% (94% improvement)
- **Cost per Invoice:** 15 → 2 (87% reduction)

Workflow Orchestration

Temporal.io Example:

```
@workflow.defn
class InvoiceProcessingWorkflow:
    @workflow.run
    async def run(self, invoice_data: InvoiceData) -> PaymentResult:
        # Step 1: OCR extraction
        extracted = await workflow.execute_activity(
            extract_invoice_data,
            invoice_data.pdf_url,
```

```
            start_to_close_timeout=timedelta(seconds=30)
        )

        # Step 2: PO matching
        po_match = await workflow.execute_activity(
            match_purchase_order,
            extracted.po_number,
            start_to_close_timeout=timedelta(seconds=10)
        )

        # Step 3: Approval if needed
        if extracted.amount > 5000:
            approval = await workflow.execute_activity(
                request_human_approval,
                extracted,
                start_to_close_timeout=timedelta(hours=48)
            )
            if not approval.approved:
                return PaymentResult(status="rejected", reason=approval.reason)

        # Step 4: Schedule payment
        payment = await workflow.execute_activity(
            schedule_payment,
            extracted,
            start_to_close_timeout=timedelta(seconds=20)
        )

        return payment
```

Organizational Layer (Layer 5)

Squad Specification

Charter Template:

```
squad:
  name: Checkout Experience Squad
  mission: Optimize conversion and revenue at checkout

  business_service:
    name: E-Commerce Checkout
    metrics:
      - conversion_rate (current: 68%, target: 75%)
      - cart_abandonment (current: 32%, target: 25%)
      - revenue_per_session (current: 45, target: 55)

  team:
    product_manager: alice_johnson
    tech_lead: bob_chen
    engineers: [carol_lopez, dave_kumar, eve_taylor]
    designer: frank_williams
    data_analyst: grace_martinez
```

```
ai_agents:
  - checkout_optimizer (A/B test orchestration)
  - fraud_detector (transaction risk scoring)
  - personalization_engine (offer recommendations)

dependencies:
  upstream:
    - Product Catalog Squad (inventory data)
    - Pricing Squad (promotional rules)
  downstream:
    - Order Fulfillment Squad (order handoff)
    - Customer Support Squad (checkout issues)

ceremonies:
  sprint_length: 2 weeks
  planning: Monday 9am
  daily_standup: Daily 10am (15 min)
  review: Friday 2pm
  retrospective: Friday 3pm

decision_authority:
  autonomous: [UI changes, A/B tests, bug fixes]
  requires_approval: [pricing strategy, payment provider]
  forbidden: [PCI compliance changes without Security]
```

Governance Layer (Layer 6)

RFC Process

Trigger Conditions:

- New AI agent introduction
- Architecture changes affecting >1 squad
- Data model schema changes
- Policy/compliance modifications

RFC Template:

```
# RFC-XXXX: [Title]

## Metadata
- **Status:** Draft | Review | Approved | Rejected
- **Author:** [Name]
- **Stakeholders:** [List]
- **Date:** YYYY-MM-DD

## Summary
[One paragraph explanation]
```

```
## Motivation
[Why is this change needed?]

## Proposal
[Detailed technical specification]

## Alternatives Considered
[Other approaches evaluated]

## Impact Analysis
- **Technical:** [Systems affected]
- **Organizational:** [Teams impacted]
- **Risk:** [Potential issues]
- **Cost:** [Time/money investment]

## Implementation Plan
- [ ] Phase 1: [Description]
- [ ] Phase 2: [Description]
- [ ] Phase 3: [Description]

## Success Metrics
[How will we measure success?]

## Ethical Review
[Fairness, bias, privacy considerations]
```

ADR Process

When to Create ADR:

- Significant technical decision made
- Trade-offs evaluated
- Long-term implications

ADR Template:

```
# ADR-XXXX: [Title]

## Status
Accepted | Superseded | Deprecated

## Context
[Situation and constraints]

## Decision
[What we decided to do]

## Consequences
**Positive:**
- [Benefit 1]
- [Benefit 2]

**Negative:**
- [Trade-off 1]
- [Trade-off 2]
```

```
**Neutral:**
- [Consideration 1]
```

Governance

Status: Version: 1.0

Implementation Methodology

SOLID.AI transformation follows a phased approach balancing speed with organizational change management. As shown in Figure 1 (see Diagrams), the complete architecture consists of six layers that are built incrementally. While the Purpose Layer (Layer 1) must be defined first to establish organizational identity and strategic direction, practical implementation begins with the Data Spine (Figure 3) and Cognitive Layer (Figure 4), then scales the Automation Mesh (Figure 2) across the organization.

Three-Phase Roadmap

Phase 1: Foundation (Months 1-3)

Objectives:

- Establish Data Spine infrastructure
- Define Purpose Layer (mission, values, OKRs)
- Select pilot business service
- Form first AI-native squad

Deliverables:

- [ ] Canonical data models documented
- [ ] Data contracts between 3+ systems
- [ ] First AI agent deployed (low-risk use case)
- [ ] RFC/ADR governance process established
- [ ] Ethical review board formed

Success Metrics:

- Data Spine operational (availability ≥ 99.9%)
- P95 latency < 5s for data propagation

- Data freshness < 60s for real-time entities
- First agent achieving >90% accuracy
- Zero ethical violations

Pilot Candidates:

- Sales pipeline analysis (low risk, high value)
- Customer support ticket routing
- Invoice processing automation
- Marketing campaign performance analysis

Phase 2: Pilot & Learn (Months 4-9)

Objectives:

- Scale to 3-5 squads across functions
- Deploy 10-15 production AI agents
- Validate organizational patterns
- Refine governance processes

Deliverables:

- [ ] 3 business services AI-native
- [ ] Cross-functional squad coordination proven
- [ ] Agent marketplace established (reusable agents)
- [ ] Observability dashboards operational
- [ ] First retrospective-driven improvements

Success Metrics:

- 50% reduction in cycle time (pilot services)
- 80% automation rate for operational tasks
- Employee satisfaction >4.0/5.0
- Zero compliance incidents

Common Challenges:

- Resistance to change (address with training)
- Data quality issues (invest in cleanup)

- Integration complexity (prioritize key systems)
- Unclear roles (define RACI matrices)

Phase 3: Scale (Months 10-24)

Objectives:

- Whole-organization transformation
- 50+ AI agents in production
- All functions operating AI-native
- Self-sustaining continuous improvement

Deliverables:

- [ ] 100% business services AI-enabled
- [ ] Agent autonomy increasing (80%+ decisions)
- [ ] Organizational scalability demonstrated
- [ ] Documented playbooks for new entrants
- [ ] Open-source contributions to framework

Success Metrics:

- 10x improvement in time-to-market
- Revenue growth without linear headcount scaling
- <1% error rates across processes
- Industry recognition (case studies, awards)

Ethical Framework

As shown in Figure 4 (see Diagrams), SOLID.AI embeds ethical principles throughout the human-AI collaboration loop through explicit human-in-the-loop, human-on-the-loop, and human-outside-the-loop control modes.

Five Ethical Principles

1. Human Dignity & Agency

Principle: AI augments human capabilities; never replaces human judgment on high-stakes decisions.

Implementation:

- Approval gates for: hiring, firing, legal liability, financial risk >10K
- Explainable AI (no "black box" critical decisions)
- Right to appeal AI recommendations

Example:

```
# Hiring Decision Agent
human_oversight:
  decision_type: high_stakes
  approval_required: true
  rationale_required: true
  appeal_process: hr_review_board
```

2. Fairness & Non-Discrimination

Principle: AI systems must not perpetuate or amplify bias based on protected characteristics.

Implementation:

- Bias testing in agent validation
- Demographic parity monitoring (where legal)
- Regular fairness audits

Example:

- Loan approval agent: Test for disparate impact across race, gender, age
- Resume screening agent: Blind review (remove demographic identifiers)

3. Transparency & Explainability

Principle: Stakeholders must understand how AI decisions are made.

Implementation:

- Decision logs with reasoning chain
- Plain-language explanations
- Audit trails accessible to affected parties

Example:

```
User: "Why was my expense report rejected?"

Agent Log:
1. Expense amount: 450 (hotel + meals)
2. Policy check: Hotel rate 350 exceeds city limit (250)
3. Exception request: None submitted
4. Decision: REJECTED (policy violation)
5. Recommendation: Resubmit with exception justification
```

4. Privacy & Data Protection

Principle: Data minimization, purpose limitation, and user consent.

Implementation:

- GDPR/CCPA compliance by design
- Data retention policies (auto-delete after N days)
- Access controls (role-based permissions)
- Encryption at rest and in transit

Example:

- Customer data: Accessible only to assigned account manager + analytics (anonymized)
- Employee data: HR only, agents cannot access without explicit consent

5. Accountability & Oversight

Principle: Clear ownership for AI outcomes; humans ultimately responsible.

Implementation:

- Agent ownership matrix (which squad/person owns each agent)
- Incident response protocols
- Regular ethical audits
- Whistleblower protection

Example:

```
agent: credit_risk_scorer
owner: risk_management_squad
accountability:
  product_manager: jane_doe (strategy)
  tech_lead: john_smith (implementation)
  compliance_officer: maria_garcia (oversight)
  escalation: cto@company.com
```

Compliance Management

Regulatory Frameworks

SOLID.AI supports compliance with:

| Framework | Scope | Key Requirements |

|-----------|-------|-----------------|

| **GDPR** | EU data protection | Consent, data minimization, right to erasure |

| **CCPA** | California privacy | Disclosure, opt-out, non-discrimination |

| **SOC 2** | Security controls | Access control, encryption, audit logs |

| **HIPAA** | Healthcare data | PHI protection, access logging, encryption |

| **ISO 27001** | Information security | Risk assessment, incident response |

| **FedRAMP** | US government cloud | Enhanced security controls, continuous monitoring |

Compliance Architecture

Data Classification:

```
data_classification:
  public:
    examples: [marketing_content, blog_posts]
    encryption: optional
    access: all

  internal:
    examples: [roadmaps, financial_models]
    encryption: required
    access: employees_only

  confidential:
    examples: [customer_contracts, employee_salaries]
    encryption: required (AES-256)
    access: role_based
    audit: all_access_logged

  restricted:
    examples: [PHI, PII, financial_transactions]
    encryption: required (AES-256 + tokenization)
    access: explicit_approval
```

```
    audit: all_access_logged + reviewed
    retention: auto_delete_after_90_days
```

Agent Compliance Controls:

```
agent: customer_support_assistant
compliance:
  data_access:
    - customer_name (public)
    - email (confidential, masked: j***@example.com)
    - order_history (confidential)
    - payment_info (FORBIDDEN - restricted)

  retention:
    conversation_logs: 90_days
    sensitive_data: 30_days
    audit_trail: 7_years

  encryption:
    in_transit: TLS 1.3
    at_rest: AES-256

  monitoring:
    access_logging: enabled
    anomaly_detection: enabled
    compliance_alerts: pii_exposure, unauthorized_access
```

Risk Assessment Framework

Risk Scoring Methodology

Four Dimensions:

- **Impact** (1-5): Potential harm if failure occurs
- **Likelihood** (1-5): Probability of failure
- **Detectability** (1-5): Ease of identifying failure
- **Reversibility** (1-5): Ability to undo damage

Risk Score: Impact × Likelihood × (6 - Detectability) × (6 - Reversibility)

Thresholds:

- **Low Risk (1-50):** Automated approval
- **Medium Risk (51-200):** Manager approval

- **High Risk (201-500):** VP approval + ethical review
- **Critical Risk (>500):** Executive approval + board notification

Example:

```
change: deploy_new_pricing_agent
risk_assessment:
  impact: 5 (revenue-affecting)
  likelihood: 2 (tested in staging)
  detectability: 4 (real-time monitoring)
  reversibility: 3 (24-hour rollback window)

  score: 5 x 2 x 2 x 3 = 60 (Medium Risk)

  approval: vp_product_required
  monitoring: enhanced_alerts_48_hours
  rollback_plan: kill_switch_available
```

Continuous Improvement

Feedback Loops

Agent Performance Review (Weekly):

- Accuracy metrics vs. baseline
- Cost per execution
- User satisfaction ratings
- Error analysis

Squad Retrospective (Biweekly):

- What went well?
- What needs improvement?
- Action items (captured as RFC/ADR)

Organizational Health Check (Quarterly):

- Employee engagement survey
- AI trust metrics
- Ethical incident review

- Scalability assessment

Annual Framework Audit:

- Purpose Layer relevance
- Architecture evolution needs
- Governance effectiveness
- Industry benchmark comparison

Getting Started

Quick Start Checklist

Week 1: Assessment

- [ ] Review current organizational structure
- [ ] Identify bipolar organization symptoms
- [ ] Select pilot business service
- [ ] Form core transformation team

Week 2-4: Foundation

- [ ] Define Purpose Layer (mission, values, OKRs)
- [ ] Map critical data entities
- [ ] Choose technology stack
- [ ] Establish RFC/ADR process

Month 2-3: Pilot

- [ ] Implement Data Spine (1-2 systems)
- [ ] Deploy first AI agent (low-risk)
- [ ] Form first squad
- [ ] Monitor and iterate

Month 4+: Scale

- [ ] Expand to 3-5 squads

- [ ] Deploy 10+ agents
- [ ] Refine governance
- [ ] Document learnings

Resources

Documentation:

- Quick Start Guide
- Adoption Pack
- Playbooks
- Diagrams

Templates:

- Squad Charter
- Agent Definition
- Data Contract
- RFC Template

Community:

- GitHub: gusafr/midora-solid-ai
- Discussions: GitHub Issues
- License: MIT (free for commercial use)

Non-Linear Productivity & Economic Impact

SOLID.AI's scalability projections are grounded in emerging research demonstrating that systematic AI integration enables organizations to decouple revenue growth from headcount expansion—fundamentally changing traditional linear economic models.

McKinsey & Company. (2023). *The Economic Potential of Generative AI: The Next Productivity Frontier.*

https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier

Estimates generative AI could add 2.6-4.4 trillion annually to the global economy, increasing total AI impact by 15-40%. Provides economic validation for SOLID.AI's projection of exponential productivity gains through systematic AI integration.

McKinsey Global Institute. (2025). *Agents, Robots, and Us: Skill Partnerships in the Age of AI.*

https://www.mckinsey.com/mgi/our-research/agents-robots-and-us-skill-partnerships-in-the-age-of-ai

Projects 2.9 trillion in value creation through redesigning work around partnerships between humans, AI agents, and automation—not isolated task automation. Directly supports SOLID.AI's organizational scalability model showing revenue growth decoupled from headcount.

McKinsey & Company. (2025). *Superagency in the Workplace: Empowering People to Unlock AI's Full Potential at Work.*

https://www.mckinsey.com/capabilities/tech-and-ai/our-insights/superagency-in-the-workplace-empowering-people-to-unlock-ais-full-potential-at-work

Introduces the concept of "superagency"—people supported by AI agents and automation—estimating 4.4 trillion in productivity gains when work is redesigned around human-AI collaboration.

EY. (2024). *AI: Ideation to Impact White Paper.*

https://www.ey.com/content/dam/ey-unified-site/ey-com/en-in/insights/ai/documents/ey-ai-deation-to-impact.pdf

Explicitly states AI enables "decoupling growth from headcount" and "non-linear productivity"—the exact economic model underlying SOLID.AI's scalability projections (3.3:1 revenue-to-payroll ratio vs. traditional 1:1).

People Managing People. (2024). *AI Case Studies in Operations and Business Process Outsourcing.*

https://peoplemanagingpeople.com/hr-strategy/examples-of-ai-in-hr/

Provides real-world examples of companies achieving non-linear scaling: maintaining or growing workload without proportional headcount increases through systematic AI integration.

Conclusion

SOLID.AI provides the architectural blueprint for building **Intelligent Hybrid Organizations**—enterprises where humans and AI collaborate as peers under ethical governance. The framework is:

■ **Comprehensive:** Six layers covering purpose → execution

■ **Practical:** Battle-tested patterns and templates

■ **Flexible:** Technology-agnostic, adaptable to any industry

■ **Ethical:** Governance and compliance built-in

■ **Open Source:** MIT license, community-driven evolution

The Transformation Imperative:

> *You cannot compete in the AI-native era with a bipolar organization. Whole-organization transformation is not optional—it's existential.*

Next Steps:

- Read the Quick Start Guide
- Assess your AI maturity using the Maturity Model
- Join the community on GitHub
- Start your pilot (Month 1-3)

License

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Framework.

THE FRAMEWORK IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE FRAMEWORK OR THE USE OR OTHER DEALINGS IN THE FRAMEWORK.

Plain Language Summary:

■ **Commercial Use Allowed:** Use SOLID.AI in for-profit organizations

■ **Modification Allowed:** Adapt to your specific needs

■ **Distribution Allowed:** Share with colleagues, clients, partners

■ **Private Use Allowed:** Internal implementation without disclosure

■■ **Attribution Required:** Credit original authors in derivative works

■■ **No Warranty:** Use at your own risk; authors not liable for outcomes

---

References & Further Reading

This section provides academic and industry research supporting SOLID.AI's architectural decisions, economic projections, and organizational patterns.

AI-Native Organizations

Wile, R., & Wilson, H. J. (2019). *Building the AI-Powered Organization.* Harvard Business Review.

https://hbr.org/2019/07/building-the-ai-powered-organization

> *Demonstrates that organizational structure, data infrastructure, and processes—not technology—are the primary bottlenecks to AI adoption. This directly validates SOLID.AI's focus on Data Spine, Automation Mesh, and Governance as foundational layers.*

Harvard Business School Online. (2025). *How to Architect an AI-Native Business.*

https://online.hbs.edu/blog/post/ai-native

> *Examines companies designed from inception as AI-native, with AI embedded in strategic decisions and operational processes. Aligns with SOLID.AI's concept of the "natively cognitive organization."*

Interloom. (2024). *AI-Native Organizations.*

https://www.interloom.com/en/blog/ai-native-organizations

> *Defines AI-native organizations as those that capture tacit knowledge, embed agents directly into workflows, and enable real-time coordination—an operational description of SOLID.AI's Automation Mesh and Cognitive Layer integration.*

Ema. (2024). *Understanding the Concept of AI Native and its Impact on Business.*

https://www.ema.co/additional-blogs/addition-blogs/understanding-the-concept-of-ai-native-and-its-impact-on-business

> *Defines AI-native as having AI at the center of architecture, decisions, and culture—consistent with SOLID.AI's Purpose Layer and Cognitive Layer design.*

Data Spine & Data Mesh Architecture

Dehghani, Z. (2022). *Data Mesh Principles and Logical Architecture.* Martin Fowler's website.

https://martinfowler.com/articles/data-mesh-principles.html

> *Defines the four foundational principles: data as a product, domain ownership, self-serve data platform, and federated computational governance. Provides the theoretical basis for SOLID.AI's Data Spine implementation with distributed ownership and unified contracts.*

Goedegebuure, A., Burnay, C., & van der Werf, J. M. (2023). *Data Mesh: A Systematic Gray Literature Review.* arXiv:2304.01062.

https://arxiv.org/abs/2304.01062

Consolidates state-of-the-art research on data mesh architecture, reinforcing that modern organizations require distributed data backbones with federated governance—the exact function of SOLID.AI's Data Spine as an "organizational nervous system."

Oracle. (2024). *What is Data Mesh?*

https://www.oracle.com/integration/what-is-data-mesh/

Summarizes data mesh as a distributed architecture connecting data producers, owners, and consumers to improve business outcomes—aligned with the Data Spine concept of enabling <5 second data propagation across the organization.

Event-Driven Automation & Orchestration

Camunda. (2023). *Orchestration vs. Choreography in Microservices.*

https://camunda.com/blog/2023/02/orchestration-vs-choreography/

Explains advantages and tradeoffs of centralized orchestration vs. event-based choreography, and strategies for combining both approaches—precisely what SOLID.AI implements with Automation Mesh as event mesh + orchestration fabric.

Hawkin, T. (2022). *Microservice Orchestration vs Choreography: How Event-Driven Architecture Helps Decouple Your App.* DEV Community.

https://dev.to/thawkin3/microservice-orchestration-vs-choreography-how-event-driven-architecture-helps-decouple-your-app-4a6b

Demonstrates how event-driven architectures decouple services, provide resilience, and enable scalability—the same principles SOLID.AI applies in coupling AI agents, business services, and human workflows through the Automation Mesh.

Human-AI Collaboration

MIT Sloan. (2025). *New MIT Sloan Research Suggests AI is More Likely to Complement, Not Replace, Human Workers.*

https://mitsloan.mit.edu/press/new-mit-sloan-research-suggests-ai-more-likely-to-complement-not-replace-human-workers

> *Research showing AI tends to augment rather than replace human work, and that how organizations deploy AI (augmentation vs. replacement) is a strategic leadership decision—validating SOLID.AI's governance-focused approach to hybrid teams.*

MIT Sloan. (2025). *These Human Capabilities Complement AI's Shortcomings.*

https://mitsloan.mit.edu/ideas-made-to-matter/these-human-capabilities-complement-ais-shortcomings

> *Identifies empathy, ethical judgment, creativity, and contextual understanding as dimensions where humans remain essential—supporting SOLID.AI's framework as designed for Intelligent Hybrid Organizations, not autonomous systems.*

Wilson, H. J., & Daugherty, P. R. (2018). *Collaborative Intelligence: Humans and AI Are Joining Forces.* Harvard Business Review.

https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces

> *Argues that greatest value comes from hybrid human-AI teams with redesigned processes and roles for collaboration, not replacement—directly describes SOLID.AI's Human-AI Collaboration Loop (Figure 4) with human-in-the-loop, human-on-the-loop, and human-outside-the-loop control modes.*

Koehler, J., & Dell'Acqua, F. (2025). *Research: Gen AI Makes People More Productive—and Less Motivated.* Harvard Business Review.

https://hbr.org/2025/05/research-gen-ai-makes-people-more-productive-and-less-motivated

> *Shows generative AI increases performance but can reduce motivation if poorly designed—reinforcing SOLID.AI's emphasis on governance, role design, and organizational layer considerations for sustainable human engagement.*

Deloitte. (2025). *Scaling Your Human Edge.*

https://action.deloitte.com/insight/4740/scaling-your-human-edge

> *Argues competitive advantage comes from investing in the "human edge" while AI scales operations—directly aligned with SOLID.AI's Organizational Layer focus on squads, pools, and human capacity development.*

AI Governance, Risk & Compliance

Eisenberg, D., et al. (2025). *The Unified Control Framework: Establishing a Common Foundation for Enterprise AI Governance, Risk Management and Regulatory Compliance.* arXiv:2503.05937.

https://arxiv.org/abs/2503.05937

> *Proposes a unified framework integrating AI governance, risk management, and compliance into enterprise architecture—validates SOLID.AI's Governance Layer approach with embedded controls, audit trails, and ethical review processes.*

Deeploy, Deloitte, et al. (2025). *AI Governance & Control Framework White Paper.*

https://deeploy.ml/white-paper-ai-governance-control-framework/

> *Defines practical roadmap for implementing governance throughout the AI lifecycle without blocking innovation—reinforces SOLID.AI's integration of governance into Automation Mesh, Data Spine, and agent deployment pipelines.*

Governance Institute of Australia. (2024). *White Paper on AI Governance.*

https://www.governanceinstitute.com.au/app/uploads/2024/09/GovInst-AI-Whitepaper.pdf

> *Emphasizes accountability, transparency, and risk management as fundamental for safe AI adoption at scale—all explicitly addressed in SOLID.AI's RFC/ADR processes, ethical review boards, and compliance monitoring.*

Organizational Design for AI Era

Trans-N. (2024). *Vision: AI-Native Organizations.*

https://trans-n.ai/en/companyprofile/vision/

> *Describes flatter organizational structures, generalist teams with AI support, fluid roles, and continuous AI integration into decision-making—themes embedded in SOLID.AI's Organizational Layer with squads, pools, and adaptive topology.*

How to Cite SOLID.AI

If you use SOLID.AI in your research or project, please cite:

```
@dataset{solidai_zenodo_2025,
  title        = {SOLID.AI Framework — Whitepaper v1.0},
  author       = {Freitas, Gustavo},
  year         = 2025,
  month        = december,
  publisher    = {Zenodo},
  doi          = 10.5281/zenodo.17765515,
  url          = https://zenodo.org/records/17765515
}
```

References

Academic and Industry Research

- **McKinsey Global Institute** (2025). *Agents, Robots, and Us: Skill Partnerships in the Age of AI.* Retrieved from https://www.mckinsey.com/mgi/our-research/agents-robots-and-us-skill-partnerships-in-the-age-of-ai

- **EY** (2024). *AI: Ideation to Impact White Paper.* Retrieved from https://www.ey.com/content/dam/ey-unified-site/ey-com/en-in/insights/ai/documents/ey-ai-deation-to-impact.pdf

- **McKinsey & Company** (2025). *Superagency in the Workplace: Empowering People to Unlock AI's Full Potential at Work.* Retrieved from https://www.mckinsey.com/capabilities/tech-and-ai/our-insights/superagency-in-the-workplace-empowering-people-to-unlock-ais-full-potential-at-work

- **Dehghani, Z.** (2022). *Data Mesh Principles and Logical Architecture.* Martin Fowler's Blog. Retrieved from https://martinfowler.com/articles/data-mesh-principles.html

- **Goedegebuure, A., Burnay, C., & van der Werf, J. M.** (2023). *Data Mesh: A Systematic Gray Literature Review.* arXiv:2304.01062. Retrieved from https://arxiv.org/abs/2304.01062

- **MIT Sloan Management Review** (2025). *New MIT Sloan Research Suggests AI is More Likely to Complement, Not Replace, Human Workers.* Retrieved from https://mitsloan.mit.edu/press/new-mit-sloan-research-suggests-ai-more-likely-to-complement-not-replace-human-workers

- **Wilson, H. J., & Daugherty, P. R.** (2018). *Collaborative Intelligence: Humans and AI Are Joining Forces.* Harvard Business Review. Retrieved from https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces

- **Camunda** (2023). *Orchestration vs. Choreography in Microservices.* Retrieved from https://camunda.com/blog/2023/02/orchestration-vs-choreography/
- **Hawkin, T.** (2022). *Microservice Orchestration vs Choreography: How Event-Driven Architecture Helps Decouple Your App.* DEV Community. Retrieved from https://dev.to/thawkin3/microservice-orchestration-vs-choreography-how-event-driven-architecture-helps-decouple-your-app-4a6b
- **Eisenberg, J. S., Pauwels, E., Guan, J., & Li, B.** (2023). *Evaluation & Monitoring: A Research Blueprint for AI Risk Management in Practice.* arXiv:2308.08700. Retrieved from https://arxiv.org/abs/2308.08700
- **Deloitte & Deeploy** (2024). *Implementing AI Governance: A Practical Guide.* Retrieved from https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-ai-deeploy-report-ai-governance.pdf
- **Governance Institute of Australia** (2024). *AI Oversight: What Directors Need to Know.* Retrieved from https://www.governanceinstitute.com.au/resources/news/2024/ai-oversight-what-directors-need-to-know/

Citation Format

APA:

```
Freitas, G. (2025). SOLID.AI Framework — Whitepaper v1.0 [Dataset]. Zenodo. https://doi.org/10.5281/zenodo.17765515
```

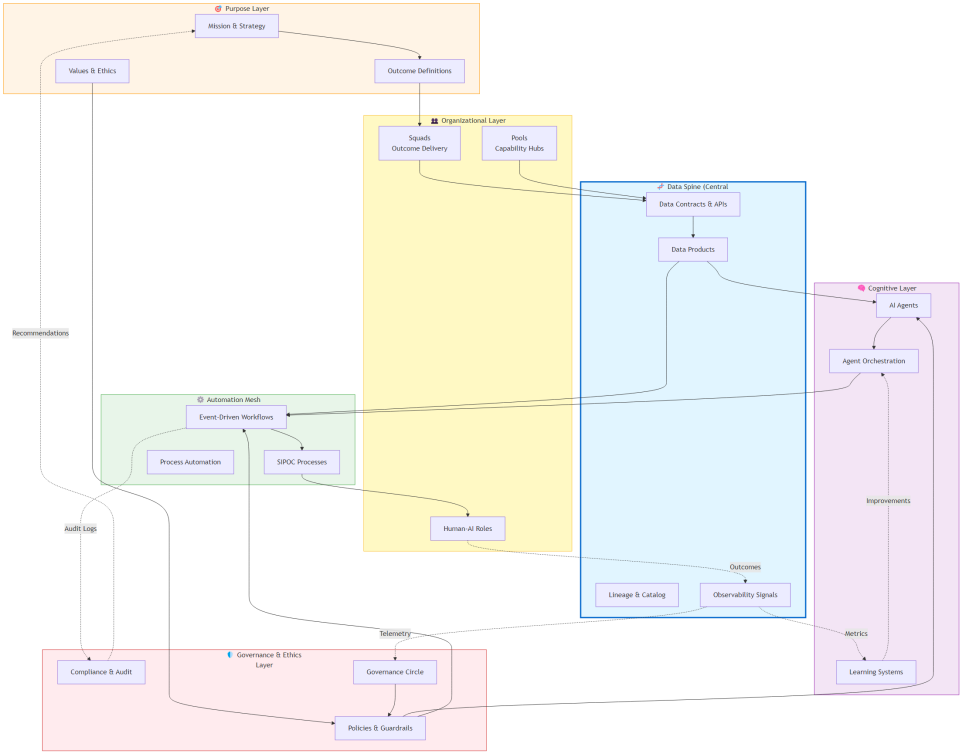
IEEE:

```
G. Freitas, "SOLID.AI Framework — Whitepaper v1.0," Zenodo, Dec. 2025. doi: 10.5281/zenodo.17765515
```

Whitepaper Diagrams

Status: Version: 1.0

1. SOLID.AI Architecture Layer Model



<figure markdown>

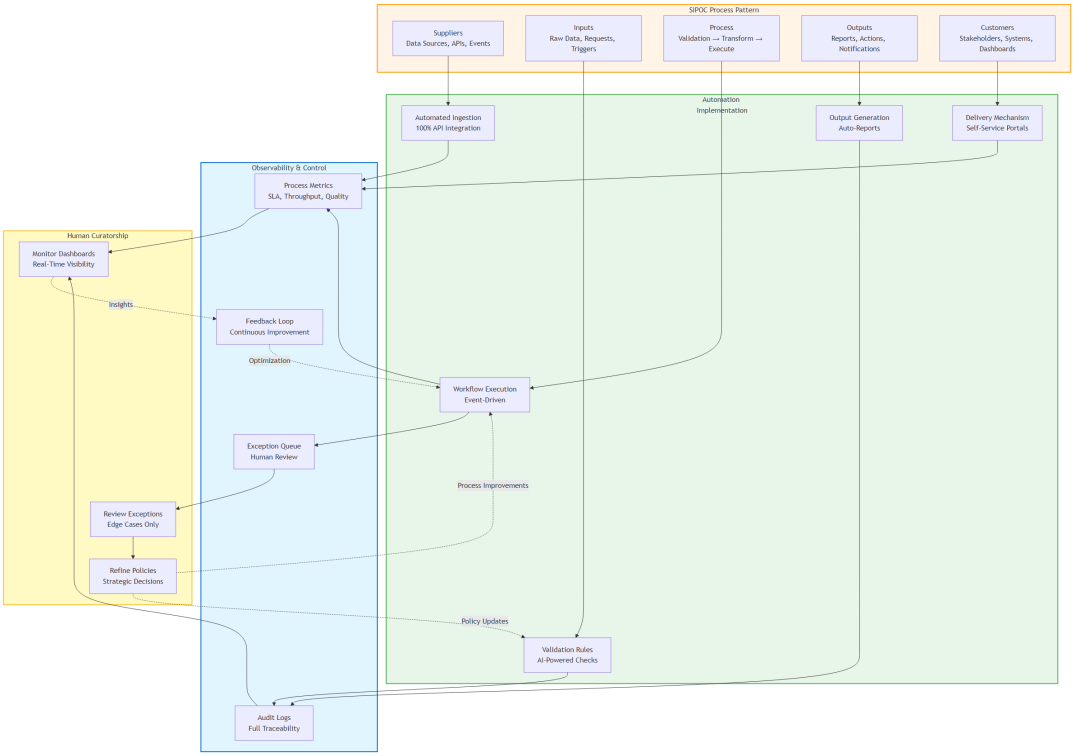
<figcaption>Figure 1 — SOLID.AI Six-Layer Architecture

Overview of the structural layers from alignment to governance, establishing the foundation for hybrid intelligent organizations. The six-layer architecture creates an organizational nervous system where the Purpose Layer (DNA) defines immutable identity, the Data Spine (sensory nerves) provides real-time information, the Cognitive Layer (brain) generates insights, the Automation Mesh (motor neurons) executes processes, the Organizational Layer (motor cortex) coordinates human teams, and the Governance Layer (prefrontal cortex) ensures ethical oversight.</figcaption>

</figure>

Reference Implementation: See Midora Topology (ADR-0003) for a concrete mapping of this diagram into a real AI-native education platform.

2. SOLID.AI Automation Mesh



<figure markdown>

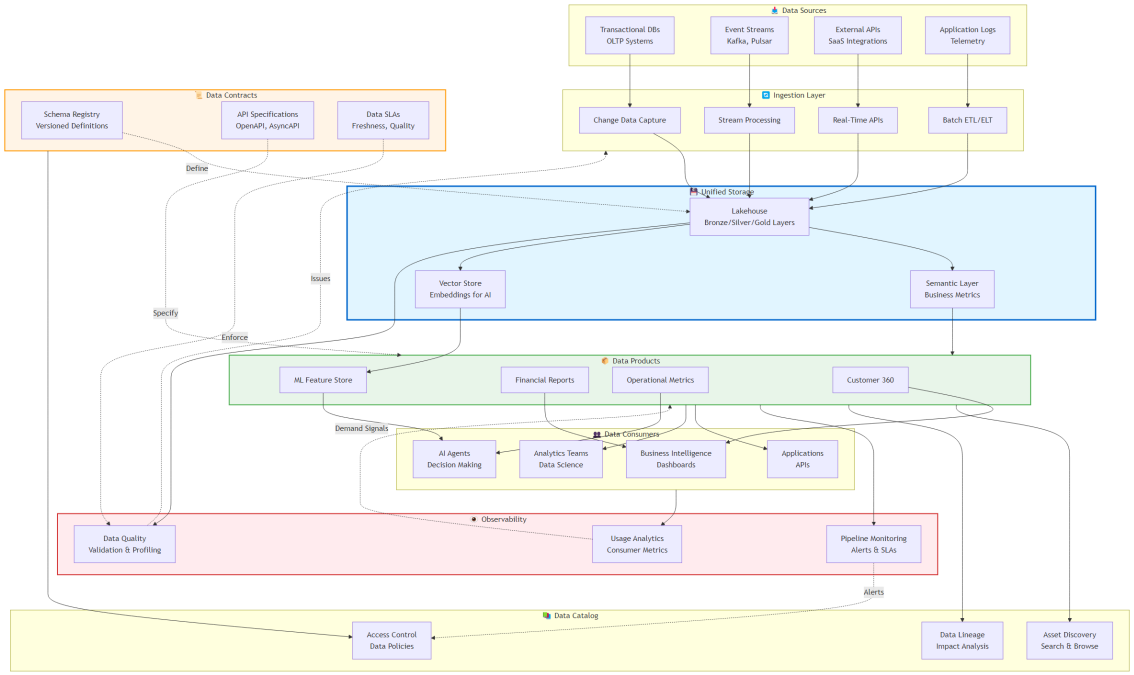
<figcaption>Figure 2 — Automation Mesh Reference Model

Event-driven orchestration fabric connecting AI agents, business services, rule engines, and external systems under compliance boundaries. The Automation Mesh connects external systems (CRM, ERP, Email, Slack, Midora Platform) through integration adapters, orchestrates workflows using engines like Temporal.io, writes to the Data Spine for single source of truth, receives commands from the Cognitive Layer (AI Agents), and maintains comprehensive monitoring for observability.</figcaption>

</figure>

Reference Implementation: See Midora Topology (ADR-0003) for a concrete mapping of this diagram into a real AI-native education platform.

3. SOLID.AI Data Spine Topology



<figure markdown>

<figcaption>Figure 3 — Data Spine Domain Model

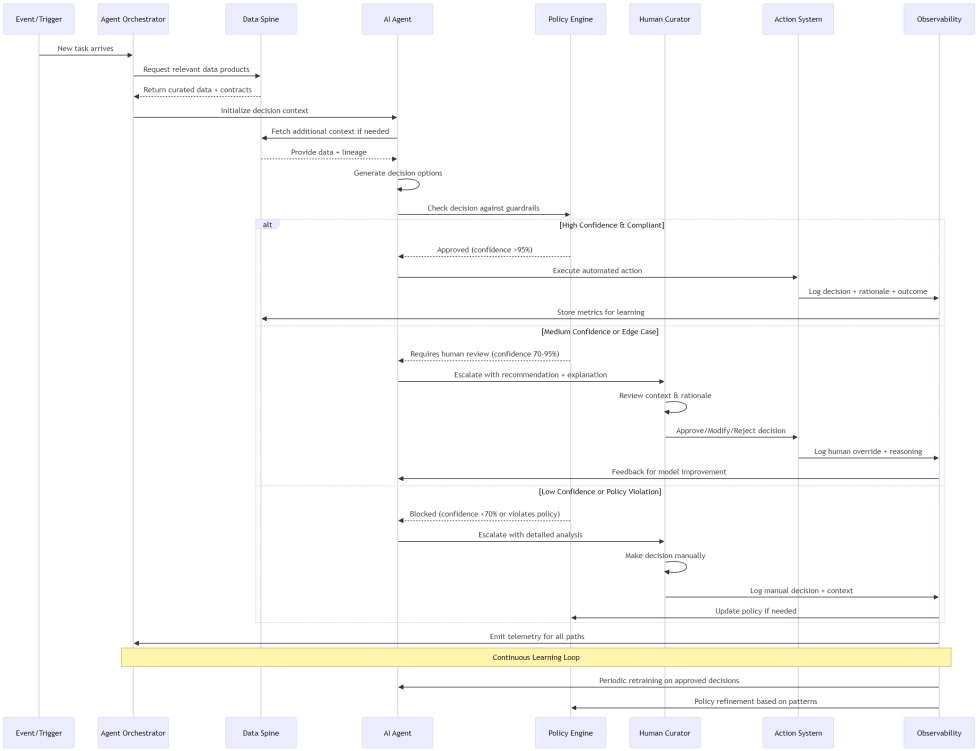
Unified data backbone enabling clean, derived, and real-time data flows across the organization. The Data Spine ingests data from multiple sources (CRM, ERP, Support, Product, HR) via CDC/APIs/webhooks, streams events through Kafka, maps to canonical entity models, validates quality, stores in PostgreSQL (transactional) and Data Warehouse (analytics), and serves all consumers with <5 second latency and 99.9% uptime SLA. Target SLO: P95 latency < 5s, availability >= 99.9%, data freshness < 60s for real-time entities.</figcaption>

</figure>

Reference Implementation: See Midora Topology (ADR-0003) for a concrete mapping of this diagram into a real AI-native education platform.

---

4. SOLID.AI Human-AI Collaboration Loop



<figure markdown>

<figcaption>Figure 4 — Human-AI Collaboration Loop

End-to-end sequence of analysis, recommendation, decision, execution, and learning in hybrid intelligent teams. The Human-AI Collaboration Loop demonstrates the complete decision cycle across three responsible AI control modes: Human-in-the-loop (Phases 1-2) where humans define problems and validate AI analysis in real-time; Human-on-the-loop (Phases 3, 5) where humans provide oversight and approval gates for AI recommendations and monitoring; and Human-outside-the-loop (Phase 4) where AI executes approved workflows autonomously with audit trails. This creates a self-improving organizational system where humans provide judgment and AI provides speed/scale, aligned with responsible AI frameworks (IEEE P7001, ISO/IEC 42001).</figcaption>

</figure>

Reference Implementation: See Midora Topology (ADR-0003) for a concrete mapping of this diagram into a real AI-native education platform.

Diagram Usage Guidelines

In Academic Citations

When referencing these diagrams in papers:

> *"Figure 1 shows the SOLID.AI six-layer architecture (Freitas, 2025), where each layer serves a distinct biological function in the organizational nervous system."*

In Implementation

These diagrams should be used during:

- **Executive presentations** - Use Layer Model to explain transformation scope
- **Technical architecture reviews** - Reference Data Spine and Automation Mesh for infrastructure design
- **Team onboarding** - Show Human-AI Collaboration Loop to clarify roles
- **Vendor evaluations** - Map vendor capabilities to specific layers

Diagram Formats

All diagrams are available in multiple formats:

- **Mermaid (source)** - Editable, version-controlled `.mmd` files
- **SVG (web)** - Rendered automatically in browser, scalable for presentations
- **PNG (print)** - High-resolution exports for documentation and papers
- **PDF (publication)** - Vector format for academic submissions

---