

SOL ENGINEERING SERVICES

The Daniel Group LLC

SUPPORTING DOCUMENTATION PACKAGE

ALICE: Adaptive Labor Intelligence and Capacity Engine

SBIR Topic DLA26BZ03-NV011 | Defense Logistics Agency

ARTIFACT 7 OF 11

Traceability Matrix

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Document Control

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Artifact Title	Traceability Matrix
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Status	Draft — Pending Gate-7 stakeholder approval before Artifact 8 is produced
Requirement Count	76 PRD requirements traced (REQ-F, REQ-NF, REQ-SEC, REQ-COMP, REQ-INT, REQ-UX, REQ-ADM)
CONOPS Activities Traced	10 operational activities from TNA Section 26.2
ID Convention	All IDs carried forward from prior approved SDP artifacts without modification.

1. Purpose and Scope

This Traceability Matrix is Artifact 7 of the ALICE Supporting Documentation Package. It is the authoritative linkage document connecting every PRD requirement and every CONOPS operational activity to the architecture elements, data entities, interfaces, risks, and SDP artifacts that implement, govern, or validate them.

The matrix is organized across five sections: Section 2 maps all PRD functional requirements (REQ-F-001 through REQ-F-023); Section 3 maps all PRD non-functional requirements (REQ-NF-001 through REQ-NF-015); Section 4 maps all PRD security, compliance, integration, UX, and administrative requirements; Section 5 maps CONOPS operational activities to architecture elements; and Section 6 provides the gap closure record documenting requirements that were not mapped in TNA Section 26 and the resolution established through the SDP artifact series.

Every PRD requirement ID extracted from the PRD is represented in this matrix. Where a requirement was not traceable to a specific architecture element, the gap is documented with a resolution status. The treatment of REQ-SEC-015 is addressed in Section 6 — it appears in a PRD research table as a cross-reference notation, not as a standalone requirement definition; all actual security requirements in the PRD security section run REQ-SEC-001 through REQ-SEC-011, and REQ-SEC-015 is treated accordingly.

2. Functional Requirements Traceability (REQ-F)

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
REQ-F-001	Ingest de-identified DCPDS extract on schedule.	Must Have	LC-02; LC-03	DE-01; DE-03	INT-01; IF-01; IF-06	ADR-003; ADR-009	RISK-001; RISK-002; RISK-016	ART-03 (LC-02, LC-03); ART-04 (DE-01, DE-03); ART-05 (INT-01, IF-01)	Data load executes on schedule; record counts logged; schema validates; zero PII fields in Processed Zone.
REQ-F-002	Ingest DLA TMS certification and training data.	Must Have	LC-02; LC-03	DE-04; DE-05	INT-02; IF-02; IF-06	ADR-003; ADR-009	RISK-016	ART-03; ART-04 (DE-04, DE-05); ART-05 (INT-02, IF-02)	Certification currency fields populated; training history importable; schema validated.
REQ-F-003	Ingest DPMAP performance calibration data (aggregate only).	Must Have	LC-02; LC-03	DE-03 (performance tier attribute)	INT-03; IF-03; IF-06	ADR-009	RISK-015; RISK-016	ART-03; ART-04 (DE-03); ART-05 (INT-03, IF-03)	Performance tier data loaded; data use documentation in governance record; no individual records present.
REQ-F-004	Ingest EBS workload metrics.	Should Have	LC-02; LC-03	DE-06	INT-04; IF-04; IF-06	ADR-009	RISK-001 (EBS access dependency)	ART-03; ART-04 (DE-06); ART-05 (INT-04, IF-04)	Workload metrics mapped to organizational units; correlation calculable between staffing and throughput.
REQ-F-005	Accept OPM FWD as Phase	Must Have	LC-02; LC-03	DE-01; DE-03	INT-05; IF-	ADR-006	RISK-017;	ART-03;	OPM FWD data

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
	I proxy data source.			(proxy-derived)	05		RISK-018	ART-04 (DE-01, DE-03); ART-05 (INT-05, IF-05)	ingested; proxy flag set on all derived records; Phase I feasibility not blocked by DLA data delays.
REQ-F-006	Detect and reject PII fields at ingestion.	Must Have	LC-02	DE-03; DE-05 (source records pre-de-identification)	IF-06 (zone boundary enforcement)	ADR-002; ADR-001	RISK-016	ART-03 (LC-02); ART-04 (DE-03, DE-05); ART-05 (IF-06)	Automated PII scan of Processed Zone: zero PII records. PII rejection events logged.
REQ-F-007	Maintain organizational ontology with position attributes.	Must Have	LC-04	DE-01; DE-02; DE-04	IF-07; IF-12	ADR-002	RISK-003 (position count dependency)	ART-03 (LC-04); ART-04 (DE-01, DE-02); ART-05 (IF-07)	All pilot sub-component positions represented; attributes populated; minimum 2 DLA SMEs confirm ontology fidelity.
REQ-F-008	Model workflow dependency relationships, including single-point-of-failure conditions.	Must Have	LC-04	DE-02 (workflow dependency attribute)	IF-07	ADR-002	None direct	ART-03 (LC-04); ART-04 (DE-02)	Dependency graph navigable; at least one single-point-of-failure condition identified and SME-confirmed.
REQ-F-009	Compute and maintain readiness indicators per	Must Have	LC-04	DE-07	IF-07; IF-12; IF-13	ADR-002	RISK-005 (performance	ART-03 (LC-04); ART-04	Readiness indicators computed after each

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
	mission function area.						dependency)	(DE-07); ART-05 (IF-12, IF-13)	refresh; values traceable to source attributes; data currency timestamp present.
REQ-F-010	Implement ABM simulation engine capable of executing scenario runs.	Must Have	LC-06	DE-08 (simulation input); DE-09 (output)	IF-10; IF-11	ADR-001; ADR-008	RISK-005	ART-03 (LC-06); ART-04 (DE-08, DE-09); ART-05 (IF-10, IF-11)	ABM engine executes; agents instantiated from synthetic population; scenarios produce time-series outputs.
REQ-F-011	Provide preset scenario library with minimum 5 types.	Must Have	LC-06; LC-10	DE-09	IF-10	ADR-010	RISK-005	ART-03 (LC-06, LC-10); ART-04 (DE-09); ART-05 (IF-10)	All 5 preset scenario types execute successfully within time limits.
REQ-F-012	Execute standard preset scenarios and return results within 5 minutes.	Must Have	LC-06	DE-09; DE-08 (input)	IF-10; IF-11	ADR-001; ADR-008	RISK-005	ART-03 (LC-06); ART-04 (DE-09); ART-05 (IF-10, IF-11)	Timed test: 95th percentile preset execution ≤ 5 minutes under 20 concurrent users.
REQ-F-013	Execute custom scenarios and return results within 15 minutes.	Should Have	LC-06; LC-10	DE-09	IF-10; IF-11	ADR-001; ADR-010	RISK-005	ART-03 (LC-06, LC-10); ART-04 (DE-09)	Timed test: 95th percentile custom scenario execution ≤ 15 minutes.
REQ-F-014	Generate confidence intervals for all scenario outputs via	Must Have	LC-06	DE-09	IF-11	ADR-001	None direct	ART-03 (LC-06); ART-04 (DE-	Confidence intervals displayed on all

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
	Monte Carlo sampling.							09)	time-series forecast charts; sampling count in output metadata.
REQ-F-015	Generate synthetic population with differential privacy (epsilon ≤ 1.0).	Must Have	LC-05	DE-08; DE-12	IF-08; IF-09	ADR-007; ADR-002	RISK-003; RISK-007	ART-03 (LC-05); ART-04 (DE-08, DE-12); ART-05 (IF-08, IF-09)	Epsilon ≤ 1.0 documented in DE-12 and verified; privacy audit report produced.
REQ-F-016	Validate synthetic population fidelity within 5% distributional deviation.	Must Have	LC-05	DE-08; DE-12	IF-09	ADR-007	RISK-003; RISK-007	ART-03 (LC-05); ART-04 (DE-08, DE-12)	KS test and chi-squared test results documented; maximum deviation ≤ 5% across all tracked attributes.
REQ-F-017	Validate synthetic population privacy — membership inference attack success ≤ 50%.	Must Have	LC-05	DE-08; DE-12	IF-09	ADR-007	RISK-007	ART-03 (LC-05); ART-04 (DE-08, DE-12)	Membership inference simulation results documented; attack success rate ≤ 50%.
REQ-F-018	Maintain auditable export log for all synthetic data export events.	Must Have	LC-05; LC-09	DE-10; DE-11	IF-14; IF-15	ADR-005; ADR-007	RISK-010	ART-03 (LC-05, LC-09); ART-04 (DE-10, DE-11); ART-05 (IF-14, IF-15)	All export events appear in immutable log (DE-10); log searchable by requester, date, use case.
REQ-	Provide	Must	LC-07; LC-	DE-07	IF-12	ADR-	RISK-	ART-03	Heat map

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
F-019	enterprise readiness heat map updated on each refresh cycle.	Have	04			002	009	(LC-07, LC-04); ART-04 (DE-07); ART-05 (IF-12)	displays correctly for enterprise-level role; updates within 24 hours of data refresh; ≥ 5 mission function dimensions shown.
REQ-F-020	Provide activity-level position risk register.	Must Have	LC-07; LC-04	DE-01; DE-07	IF-12	ADR-002; ADR-004	RISK-013	ART-03 (LC-07, LC-04); ART-04 (DE-01, DE-07); ART-05 (IF-12)	Risk register displays all positions in user's activity scope; fragility ratings computed; register sortable and filterable.
REQ-F-021	Provide historical analysis view with minimum 12 months of snapshots.	Should Have	LC-04; LC-07	DE-07	IF-12	ADR-002	None direct	ART-03 (LC-04, LC-07); ART-04 (DE-07)	12 months of historical snapshots accessible; comparison view shows predicted vs. actual outcomes.
REQ-F-022	Generate automated threshold-based alerts for readiness indicators.	Should Have	LC-04; LC-11	DE-07	IF-13	ADR-010	None direct	ART-03 (LC-04, LC-11); ART-04 (DE-07); ART-05 (IF-13)	Alert triggers at correct threshold; delivery mechanism tested; alert logged with event details.
REQ-F-023	Allow export of scenario	Must Have	LC-07	DE-09	IF-15 (scenar	ADR-009	None direct	ART-03 (LC-	Export produces

Req ID	Summary	Priority	Logical Components	Data Entities	Interfaces	ADRs	Risks	SDP Artifacts	Acceptance Method
	results in PDF and structured data (CSV or JSON).				io export path)			07); ART-04 (DE-09); ART-05 (IF-15)	valid PDF and structured data file; all charts and tables rendered in PDF; structured data file parseable.

3. Non-Functional Requirements Traceability (REQ-NF)

Req ID	Summary	Priority	Quality Attribute	Logical Components	ADRs	Risks	Acceptance Method
REQ-NF-001	Data refresh cycle ≤ 24 hours from source update.	Must Have	Performance — Data Currency	LC-02; LC-04	ADR-006	RISK-001 (proxy path limits DLA-specific currency)	Timestamp sampling: source extract timestamp vs. twin state update timestamp. Measured daily.
REQ-NF-002	Return preset scenario results within 5 minutes at 95th percentile.	Must Have	Performance — Scenario Execution	LC-06	ADR-001	RISK-005	Timed execution tests of all 5 preset scenario types. 95th percentile ≤ 5 minutes.
REQ-NF-003	Support ≥ 20 concurrent users without degradation.	Should Have	Performance — Concurrency	LC-01; LC-06	ADR-001; ADR-004	RISK-005	Load test with 20 simultaneous users executing preset scenarios. 95th percentile execution time ≤ 5 minutes.
REQ-NF-004	99.5% availability M–F 06:00–22:00	Must Have	Availability	All services; deployment model	ADR-006	RISK-008 (Phase	Monthly availability report:

Req ID	Summary	Priority	Quality Attribute	Logical Components	ADRs	Risks	Acceptance Method
	Eastern.					II hosting model affects HA architecture)	downtime ≤ 0.5% during operational hours.
REQ-NF-005	Synthetic population regeneration completes without data loss or corruption.	Must Have	Reliability	LC-05	ADR-002; ADR-007	RISK-003; RISK-007	Hash verification of synthetic population file after each generation. Zero corrupt or incomplete files.
REQ-NF-006	Scale to support ontology of ≥ 30,000 positions without refresh degradation.	Should Have	Scalability	LC-04	ADR-001	None direct (Phase II target)	Performance test: full ontology refresh with 30,000 synthetic position nodes completes within 24 hours.
REQ-NF-007	Satisfy NIST SP 800-53 Moderate baseline (287 controls per SP 800-53B Release 5.2.0).	Must Have	Security	All services; System Security Plan	ADR-004; ADR-005; ADR-006	RISK-006; RISK-008	RMF assessment by DLA ISSO or independent assessor before Phase II ATO.
REQ-NF-008	No Privacy Act record in analytical, simulation, or reporting layers.	Must Have	Privacy	LC-02; all data zone boundaries	ADR-002; ADR-001	RISK-016	Privacy review: automated scan of Processed, Synthetic, and Analytical Zones for PII fields. Zero PII records.
REQ-NF-009	Obtain RMF ATO at DoD IL4 before processing live DLA workforce data.	Must Have	Compliance	All services; deployment model	ADR-006	RISK-008	ATO issued by DLA Authorizing Official before Phase II operational pilot begins.
REQ-NF-010	Activity Director	Must Have	Usability	LC-07; LC-06	ADR-010	RISK-009	Usability evaluation: ≥

Req ID	Summary	Priority	Quality Attribute	Logical Components	ADRs	Risks	Acceptance Method
	completes preset scenario run within 15 minutes after 30-minute orientation.						3 of 3 test users complete preset scenario run within 15 minutes without researcher assistance.
REQ-NF-011	Section 508 / WCAG 2.1 Level AA compliance for web-based interface.	Must Have	Accessibility	LC-07	ADR-001	None direct	Automated accessibility scan (zero critical failures); manual screen reader test before Phase I demonstration.
REQ-NF-012	Immutable audit logs retained for minimum 7 years.	Must Have	Auditability	LC-09	ADR-005	RISK-014	Audit integrity test: attempt to modify log entry; confirm rejection. Retention test on records aged 3 years.
REQ-NF-013	Validate all ingested data against defined schema before loading.	Must Have	Data Integrity	LC-02; LC-03	ADR-003	RISK-015; RISK-016	Test: inject schema-invalid records; confirm rejection and logging; zero invalid records in Processed Zone.
REQ-NF-014	Use standard data exchange formats (JSON, CSV, or XML) for all integration interfaces.	Should Have	Interoperability	LC-02; LC-03; LC-07	ADR-003; ADR-009	None direct	Integration test: confirm all interfaces produce parseable standard-format output.
REQ-NF-015	System health monitoring with alerts within 5	Should Have	Maintainability	LC-11	ADR-001	RISK-014	Test: simulate ingestion pipeline

Req ID	Summary	Priority	Quality Attribute	Logical Components	ADRs	Risks	Acceptance Method
	minutes of failure detection.						failure; confirm alert delivered within 5 minutes.

4. Security, Compliance, Integration, UX, and Administrative Requirements Traceability

4.1 Security Requirements (REQ-SEC)

Req ID	Summary	Priority	Logical Components	ADRs	NIST 800-53 Controls	Risks	Acceptance Method
REQ-SEC-001	MFA / CAC authentication required for all user access.	Must Have	LC-01; LC-08; INT-06	ADR-004	IA-2; IA-2(1); IA-2(2)	RISK-004	CAC authentication functional; unauthorized access rejected; authentication events logged to LC-09.
REQ-SEC-002	Implement RBAC with four defined roles.	Must Have	LC-01; LC-08	ADR-004	AC-2; AC-3	RISK-013	Four roles provisioned in IAM; role assignments enforced at service boundary; unauthorized role access rejected.
REQ-SEC-003	Enforce least-privilege access for all roles.	Must Have	LC-01; LC-08; LC-04	ADR-004	AC-6	RISK-013	Each role can access only capabilities and data defined for that role; negative test cases pass.
REQ-SEC-004	Enforce activity-scoped data access for Activity Director role.	Must Have	LC-01; LC-04; LC-08	ADR-004	AC-4	RISK-013	Activity Director cannot access data from activities outside assigned scope; scope enforcement confirmed at LC-04 query layer.

Req ID	Summary	Priority	Logical Components	ADRs	NIST 800-53 Controls	Risks	Acceptance Method
REQ-SEC-005	Administrative access restricted to System Administrator; admins cannot access analytical data content.	Must Have	LC-08; LC-01	ADR-004	AC-6(1); AC-5	RISK-013	System Administrator cannot query or view workforce analytical data; administrative actions logged with attribution.
REQ-SEC-006	Encrypt all data in transit using TLS 1.2 or higher.	Must Have	All transport channels between components; LC-01	ADR-004	SC-8	None direct	Security assessment: TLS version verification on all external and inter-service connections.
REQ-SEC-007	Encrypt all data at rest using AES-256 or FIPS 140-3 equivalent.	Must Have	All data zone storage; LC-09 audit log store	ADR-002	SC-28	None direct	Security assessment: verify encryption algorithm compliance across all four data zones and audit log store.
REQ-SEC-008	Manage encryption keys in FIPS 140-3 validated key management system; rotate annually.	Must Have	LC-12	ADR-004	SC-12	RISK-012	Annual rotation test (before Phase II deployment); zero service outage during rotation; rotation events logged.
REQ-SEC-009	Generate immutable audit log for all defined event types.	Must Have	LC-09	ADR-005	AU-2; AU-3; AU-9	RISK-014	Audit log integrity test; all 7 event categories from SDP-ART-02 confirmed logged; no missing events in test cycle.
REQ-SEC-	Retain audit logs for	Must Have	LC-09	ADR-005	AU-11	RISK-014	7-year retention

Req ID	Summary	Priority	Logical Components	ADRs	NIST 800-53 Controls	Risks	Acceptance Method
010	minimum 7 years; accessible to authorized reviewers on demand.						policy configured and enforced by automated policy; log records accessible on demand.
REQ-SEC-011	Obtain RMF authorization at DoD IL4 before processing live DLA workforce data.	Must Have	All services; deployment model	ADR-006	NIST SP 800-37 RMF process; DoDI 8510.01	RISK-008	ATO issued by DLA Authorizing Official. (Same acceptance as REQ-NF-009.)
REQ-SEC-015	[NOTE] This ID appears in a PRD research table as a cross-reference range notation ('REQ-SEC-001 through REQ-SEC-015') in the context of documenting the NIST 800-53 Moderate baseline requirement. No standalone requirement statement is defined at REQ-SEC-015 in the PRD security requirements section, which concludes at REQ-SEC-011. This ID is documented here as an artifact of the PRD research table notation; it does not require separate traceability. See Section 6 (Gap Closure Record) for formal disposition.	N/A	N/A	N/A	N/A	None	N/A

4.2 Compliance Requirements (REQ-COMP)

Req ID	Summary	Priority	Logical Components	Data Entities	ADRs	Risks	Acceptance Method
REQ-COMP-001	Comply with Privacy Act of 1974; no Privacy Act record in simulation, analytical, or reporting layers.	Must Have	LC-02 (de-identification boundary); all data zones	DE-03; DE-05 (source records, not stored as Privacy Act records in ALICE)	ADR-002; ADR-001	RISK-016	Privacy review sign-off; automated PII scan of analytical environment; zero Privacy Act records confirmed.
REQ-COMP-002	DPMAP data use must comply with DoDI 1400.25, Vol. 431; data use documentation maintained.	Must Have	LC-02; LC-03	DE-03 (performance tier attribute)	ADR-009	RISK-015	Data use documentation reference present in governance record (DGR-07); no individual DPMAP records in Processed Zone.
REQ-COMP-003	Achieve CMMC Level 2 C3PAO assessment before processing DLA CUI in non-federal systems.	Must Have	All SOL systems processing DLA CUI	N/A	ADR-006	RISK-006	CMMC Level 2 certificate from accredited C3PAO on file before November 10, 2026.
REQ-COMP-004	Document differential privacy parameters and maintain privacy audit records.	Must Have	LC-05	DE-12 (Generation Metadata)	ADR-007	RISK-007; RISK-010	DE-12 records produced for every generation cycle; epsilon ≤ 1.0 documented; fidelity and privacy audit results present.
REQ-COMP-005	Web interface complies with Section 508 / WCAG 2.1 Level AA.	Must Have	LC-07	N/A	ADR-001	None direct	Same as REQ-NF-011 acceptance method.

4.3 Integration Requirements (REQ-INT)

Req ID	Summary	Priority	Logical Components	Interfaces	ADRs	Risks	Acceptance Method
REQ-INT-001	Integration layer must be abstracted to accommodate DCPDS-to-DCHRMS transition.	Must Have	LC-03	INT-01; IF-01	ADR-003	RISK-002	Schema migration test: update LC-03 DCHRMS mapping; confirm all other services operate without code changes.
REQ-INT-003	DPMAP integration must comply with DoDI 1400.25 data use constraints (aggregate only).	Must Have	LC-02; LC-03	INT-03; IF-03	ADR-009	RISK-015	Data use agreement defines aggregate-only schema; no individual records in INT-03 extract; data structure validation in LC-02 confirms compliance.
REQ-INT-005	[NOTE] REQ-INT-005 appears in the PRD traceability matrix (Section 30) as part of the range 'REQ-INT-001 to REQ-INT-005.' The PRD integration requirements section (Section 19) presents integration requirements by system name without assigning individual REQ-INT numbers. REQ-INT-001 and REQ-INT-003 are the only explicitly numbered integration	N/A	N/A	N/A	N/A	None	N/A

Req ID	Summary	Priority	Logical Components	Interfaces	ADRs	Risks	Acceptance Method
	requirements in the PRD. REQ-INT-005 is treated as a range notation artifact. See Section 6 (Gap Closure Record) for formal disposition.						

4.4 User Experience Requirements (REQ-UX)

Req ID	Summary	Priority	Logical Components	ADRs	Risks	Gap Status (TNA)	Acceptance Method
REQ-UX-001	Primary readiness dashboard requires no configuration; updates automatically on each refresh.	Must Have	LC-07; LC-04	ADR-001; ADR-010	RISK-009	Partial — mapped in TNA as part of REQ-F-019 block; explicit UX trace resolved in this artifact.	Dashboard auto-updates on each ingestion cycle without user action; no configuration required to display current state.
REQ-UX-002	Scenario planning workflow completable using only preset library, without ABM or ontology knowledge.	Must Have	LC-07; LC-06	ADR-001; ADR-010	RISK-009	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Usability evaluation: Activity Director completes preset scenario run without knowledge of ABM model or ontology structure.
REQ-UX-003	Alert notifications delivered on next login if unacknowledged; include type, function, severity, timestamp.	Should Have	LC-07; LC-04; LC-11	ADR-010	None direct	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Alert notification displayed on next login if unacknowledged; all four required fields (type, function, severity, timestamp) present.
REQ-UX-004	All forms and input fields validate inputs in real time with	Must Have	LC-07	ADR-001	None direct	Gap in TNA — not explicitly mapped. Resolved in	UI test: submit invalid inputs on all forms;

Req ID	Summary	Priority	Logical Components	ADRs	Risks	Gap Status (TNA)	Acceptance Method
	actionable error messages.					SDP-ART-07.	confirm real-time validation with clear, jargon-free error messages.
REQ-UX-005	Scenario results display readiness forecast as time-series chart with confidence band, at-risk positions as sortable list, response option comparison as table.	Must Have	LC-07	ADR-001	None direct	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Results validation: time-series chart with confidence band present; at-risk position list sortable; response option comparison table present.
REQ-UX-006	Guided onboarding workflow for first-time users of each role; ≤ 30 minutes to complete.	Should Have	LC-07	ADR-001	RISK-009	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Onboarding test: new user in each role completes onboarding within 30 minutes without assistance.
REQ-UX-007	Decision support interface optimized for desktop (minimum 1280×800 resolution).	Must Have (desktop)	LC-07	ADR-001	None direct	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Display test: confirm correct rendering at 1280×800 resolution; no horizontal scroll or content clipping.
REQ-UX-008	Display data currency timestamp on all readiness indicators.	Must Have	LC-07; LC-04	ADR-001	None direct	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	UI audit: confirm data currency timestamp visible on all readiness indicator displays. No indicator displayed without timestamp.
REQ-UX-009	Export functions accessible within 2 clicks	Should Have	LC-07	ADR-001	None direct	Gap in TNA — not explicitly mapped.	Navigation test: confirm export

Req ID	Summary	Priority	Logical Components	ADRs	Risks	Gap Status (TNA)	Acceptance Method
	from primary result display.					Resolved in SDP-ART-07.	function reachable within 2 user interactions from the primary scenario result view.
REQ-UX-010	Interface complies with WCAG 2.1 Level AA (keyboard navigation, screen reader, color contrast).	Must Have	LC-07	ADR-001	None direct	Partial — mapped in TNA as REQ-NF-011; explicit UX trace resolved here.	Same as REQ-NF-011 acceptance method.

4.5 Administrative Requirements (REQ-ADM)

Req ID	Summary	Priority	Logical Components	ADRs	Gap Status (TNA)	Acceptance Method
REQ-ADM-001	System Administrator can create, modify, suspend, and revoke user accounts and role assignments.	Must Have	LC-08	ADR-004	Mapped in TNA (REQ-ADM-001 → LC-08).	User provisioning test: Administrator creates, modifies, and revokes user account; confirm each action logged to LC-09.
REQ-ADM-002	System Administrator can configure readiness threshold values without modifying application code.	Must Have	LC-10	ADR-010	Mapped in TNA (REQ-ADM-002 → LC-10).	Configuration test: update threshold value via admin interface; confirm readiness alert fires at new threshold; confirm code unchanged.
REQ-ADM-003	System Administrator can initiate and monitor data refresh jobs, view logs, manually trigger refresh.	Must Have	LC-11; LC-10; LC-02	ADR-001; ADR-010	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Admin interface test: Administrator initiates manual refresh; job log visible; refresh executes and completes.
REQ-ADM-004	System Administrator can configure synthetic data export authorization workflow.	Must Have	LC-10; LC-05	ADR-010	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Configuration test: Administrator configures required approver roles and documentation fields; export workflow reflects

Req ID	Summary	Priority	Logical Components	ADRs	Gap Status (TNA)	Acceptance Method
						configuration.
REQ-ADM-005	System Administrator receives automated alerts for defined failure conditions.	Should Have	LC-11	ADR-001	Mapped in TNA (REQ-ADM-005 → LC-11).	Alert test: simulate each defined failure condition; confirm alert delivered to System Administrator within 5 minutes.
REQ-ADM-006	System records all configuration changes with identity, prior value, new value, and timestamp.	Must Have	LC-10; LC-09	ADR-005; ADR-010	Mapped in TNA (REQ-ADM-006 → LC-10).	Configuration change audit: make configuration change; confirm LC-09 log entry contains required fields.
REQ-ADM-007	System supports backup of configuration settings, ontology definitions, and synthetic population generation parameters on weekly scheduled basis and on demand.	Must Have	LC-10; LC-04; LC-05	ADR-010	Gap in TNA — not explicitly mapped. Resolved in SDP-ART-07.	Backup test: execute scheduled backup; confirm all required configuration categories included; execute on-demand backup; confirm immediate execution.

5. CONOPS Operational Activity to Architecture Element Traceability

CONOPS Operational Activity	Architecture Elements	Operational Workflow (OW)	Data Entities	Interfaces	Risks	PRD Requirements	Notes
Data ingestion from DCPDS, DLA TMS, DPMAP, and EBS to maintain the organizational twin.	LC-02 (Data Ingestion); LC-03 (Schema Abstraction); LC-04 (Ontology Update upon completion)	OW-1 (Continuous Organizational Readiness Monitoring)	DE-01; DE-03; DE-04; DE-05; DE-06	INT-01 through INT-05; IF-01 through IF-07	RISK-001; RISK-002; RISK-015; RISK-016	REQ-F-001 through REQ-F-006; REQ-NF-001; REQ-NF-013	Schema abstraction (LC-03) required from Phase I Day 1 for DCHRMS migration resilience (ADR-003).
Construction and maintenance of the	LC-04 (Organizational Ontology Service)	OW-1 (Continuous Monitor	DE-01; DE-02; DE-07	IF-07; IF-12	RISK-003 (position	REQ-F-007; REQ-F-008; REQ-F-009	Historical state archiving required

CONOPS Operational Activity	Architecture Elements	Operational Workflow (OW)	Data Entities	Interfaces	Risks	PRD Requirements	Notes
organizational ontology representing DLA positions, roles, and dependencies.		ing — ontology update stage)			count); RISK-009 (adoption)		for backtesting and trend analysis (Phase I deliverable).
Generation of privacy-preserving synthetic workforce population with differential privacy.	LC-05 (Synthetic Workforce Engine); LC-09 (Audit Log — generation events)	OW-4 (Synthetic Population Regeneration)	DE-08; DE-12	IF-08; IF-09	RISK-003; RISK-007; RISK-010	REQ-F-015; REQ-F-016; REQ-F-017; REQ-F-018	Validation gates (fidelity and privacy) are mandatory before population promotion (ADR-007).
Agent-based simulation of workforce disruption scenarios against the synthetic population.	LC-06 (ABM Simulation Engine); LC-10 (preset scenario library configuration)	OW-2 (Scenario Planning — Key Departure example)	DE-08 (input); DE-09 (output)	IF-10; IF-11	RISK-005; RISK-009	REQ-F-010 through REQ-F-014	Simulation engine reads exclusively from Synthetic Zone (ADR-008). No Processed Zone access.
Role-differentiated decision support interface delivering readiness assessments and scenario outputs.	LC-07 (Decision Support Interface)	OW-1 (readiness display); OW-2 (scenario initiation and results)	DE-07; DE-09	IF-12; IF-13	RISK-009	REQ-F-019 through REQ-F-023; REQ-UX-001 through REQ-UX-010	Section 508 compliance mandatory. Desktop-first design (REQ-UX-007). Data currency timestamp required on all indicators (REQ-UX-008).
Governed synthetic data export with	LC-05 (export workflow); LC-09 (Audit	OW-3 (Synthetic Data	DE-08 (exported); DE-10; DE-	IF-14; IF-15	RISK-010	REQ-F-018	Steward authorization

CONOPS Operational Activity	Architecture Elements	Operational Workflow (OW)	Data Entities	Interfaces	Risks	PRD Requirements	Notes
Data Steward authorization and immutable audit record.	Log — export events)	Export)	12				required for every export. DE-10 governance record non-deletable (ADR-005). CUI marking on all exports (ADR-007).
Privacy Act constraint resolution through de-identification at ingestion boundary.	LC-02 (de-identification function); ADR-002 (Four-Zone Data Architecture)	OW-1 (ingestion stage — Privacy Act enforcement point)	DE-03; DE-05 (source records; de-identified before zone write)	IF-06	RISK-016	REQ-NF-008; REQ-COMP-001; REQ-F-006	Architectural invariant (AP-1): not an application-layer control. De-identification specification document is a required pre-Phase I artifact.
Threshold-based alert generation for readiness degradation.	LC-04 (threshold evaluation); LC-11 (alert delivery)	OW-1 (alert stage)	DE-07	IF-13	None direct	REQ-F-022; REQ-UX-003	Alert delivery mechanism (in-system vs. email) is a configurable parameter (ADR-010). Alert mechanism must be defined before Phase II design.
Historical backtesting for Phase I	LC-04 (historical state	OW-1 (historical	DE-07 (historical snapshots);	IF-07; IF-10; IF-11	RISK-003	REQ-F-021; PRD Section	Phase I deliverable:

CONOPS Operational Activity	Architecture Elements	Operational Workflow (OW)	Data Entities	Interfaces	Risks	PRD Requirements	Notes
validation of readiness forecast accuracy.	archive); LC-06 (backtesting simulation)	snapshot stage) + OW-2 (backtesting runs)	DE-09 (backtesting scenario run)			12.2 (MVP success criteria — ≥ 80% accuracy)	backtesting accuracy report submitted to DLA GTPOC. Minimum 12 months of historical snapshots required.
User authentication via DoD CAC at the system access boundary.	LC-01 (Interface Control); LC-08 (IAM); INT-06 (DoD PKI integration)	All user-initiated workflows (OW-1 through OW-4 where user-initiated)	N/A (identity metadata only)	INT-06	RISK-004	REQ-SEC-001; DoDI 8520.02	CAC integration feasibility in Phase I environment is ASM-008 (assumption). If not available, interim MFA required.

6. Gap Closure Record

This section documents requirements and IDs identified in SDP-ART-01 (Research Log, Section 3.3) as gaps in the TNA traceability matrix, together with their resolution in this artifact. It also documents the formal disposition of ambiguous requirement identifiers.

6.1 PRD Requirement IDs with Ambiguous Status

ID	Nature of Ambiguity	Formal Disposition
REQ-SEC-015	Appears in the PRD research findings table (Section 3) as the upper bound of a range notation: 'REQ-SEC-001 through REQ-SEC-015.' The PRD security requirements section (Section 18) defines requirements from REQ-SEC-001 through REQ-SEC-011 only. No standalone requirement statement is defined at REQ-SEC-015.	Disposition: REQ-SEC-015 is a range notation artifact, not a standalone requirement. The 287 NIST SP 800-53 Moderate baseline controls referenced in the research table notation are fully addressed through REQ-NF-007 and REQ-SEC-011. No additional architecture element is required. Recommend PRD owner confirm this interpretation and, if agreed, annotate Section 3 of the PRD to clarify the notation.
REQ-INT-005	Appears in the PRD traceability matrix (Section 30) as the upper bound of the range 'REQ-INT-001	Disposition: REQ-INT-002, REQ-INT-004, and REQ-INT-005 are not defined as standalone requirements in the PRD. The integration

ID	Nature of Ambiguity	Formal Disposition
	to REQ-INT-005.' The PRD integration requirements section (Section 19) presents integration requirements by system name without assigning individual requirement numbers. Only REQ-INT-001 and REQ-INT-003 are explicitly numbered elsewhere in the PRD.	requirements for DLA TMS (INT-02), EBS (INT-04), and OPM FWD (INT-05) are fully addressed through REQ-F-002, REQ-F-004, and REQ-F-005 respectively, plus the general integration constraints in TNA Section 14.3. No architecture gap exists. Recommend PRD owner annotate Section 30 to clarify the range notation.

6.2 Requirements Not Mapped in TNA Section 26 — Resolved in SDP-ART-07

Requirement ID	Summary	Resolution in SDP-ART-07	Architecture Elements Mapped
REQ-ADM-003	System Administrator initiates and monitors data refresh jobs.	Mapped in Section 4.5 of this artifact.	LC-11 (Observability — job monitoring); LC-10 (Configuration Management — manual trigger configuration); LC-02 (Data Ingestion — execution).
REQ-ADM-004	System Administrator configures synthetic data export authorization workflow.	Mapped in Section 4.5 of this artifact.	LC-10 (Configuration Management — export workflow configuration); LC-05 (export workflow — governed by LC-10 settings).
REQ-COMP-002	DPMAP data use must comply with DoDI 1400.25, Vol. 431.	Mapped in Section 4.2 of this artifact.	LC-02 (ingestion validation); LC-03 (aggregate-only schema translation); INT-03; DE-03 (performance tier attribute); DGR-07.
REQ-INT-003	DPMAP integration must comply with DoDI 1400.25 data use constraints.	Mapped in Section 4.3 of this artifact.	LC-02; LC-03; INT-03; DGR-07.
REQ-UX-002	Scenario planning workflow completable using preset library without ABM or ontology knowledge.	Mapped in Section 4.4 of this artifact.	LC-07 (Decision Support Interface — preset scenario workflow design); LC-06 (Simulation Engine — preset library).
REQ-UX-003	Alert notifications delivered on next login with required fields.	Mapped in Section 4.4 of this artifact.	LC-07 (alert queue display); LC-04 (alert generation); LC-11 (alert delivery); IF-13.
REQ-UX-004	Real-time input validation with actionable error messages.	Mapped in Section 4.4 of this artifact.	LC-07 (Decision Support Interface — input validation in scenario initiation forms).
REQ-UX-005	Scenario results display format	Mapped in Section 4.4 of this artifact.	LC-07 (Decision Support Interface — results rendering); LC-06 (simulation

Requirement ID	Summary	Resolution in SDP-ART-07	Architecture Elements Mapped
	(time-series chart, sortable list, comparison table).		output structure per REQ-F-014).
REQ-UX-006	Guided onboarding workflow ≤ 30 minutes for first-time users.	Mapped in Section 4.4 of this artifact.	LC-07 (onboarding workflow design).
REQ-UX-007	Desktop optimization at minimum 1280×800 resolution.	Mapped in Section 4.4 of this artifact.	LC-07 (Decision Support Interface — responsive design constraint).
REQ-UX-008	Data currency timestamp on all readiness indicators.	Mapped in Section 4.4 of this artifact.	LC-07 (mandatory display element); LC-04 (currency timestamp attribute in DE-07).
REQ-UX-009	Export accessible within 2 clicks from primary result display.	Mapped in Section 4.4 of this artifact.	LC-07 (navigation design constraint for export function).

7. Architecture Principles to Requirement Traceability

The following table confirms that each of the ten architecture principles (AP-1 through AP-10) is grounded in at least one source requirement or operational need, consistent with ISO/IEC/IEEE 42010:2022 and Architecture Principle AP-8 (Traceability from Requirement to Architecture).

Architecture Principle	Source Requirement(s)	Source Basis	ADRs That Apply This Principle
AP-1: Privacy as Architectural Invariant	REQ-NF-008; REQ-COMP-001; 5 U.S.C. § 552a	Privacy Act of 1974; PRD Section 18.3	ADR-002; ADR-007; ADR-008
AP-2: Read-Only External Integration	PRD Section 2.6 (System Boundary); PRD Section 11.2 (Out of Scope)	CONOPS design boundary; CON-002; CON-004	ADR-009
AP-3: Defense-in-Depth with Identity-Centric Controls	REQ-SEC-001 through REQ-SEC-005; OMB M-22-09	NIST SP 800-207 (ZTA); RL-10; RL-17	ADR-004
AP-4: Data Zone Separation	REQ-NF-008; REQ-COMP-001; REQ-SEC-007	5 U.S.C. § 552a; NIST SP 800-160 SSE; RL-11	ADR-002; ADR-008
AP-5: Modular Service Decomposition	PRD Section 11 (phase-gated delivery); REQ-NF-006 (scalability); REQ-NF-002 (performance)	SBIR phase structure; CONOPS OV-1 five-layer architecture	ADR-001
AP-6: Immutable	REQ-NF-012; REQ-	NIST SP 800-53 AU-2,	ADR-005

Architecture Principle	Source Requirement(s)	Source Basis	ADRs That Apply This Principle
Audit by Design	SEC-009; REQ-SEC-010	AU-9, AU-11; RL-08	
AP-7: Configuration Over Customization	REQ-ADM-002; REQ-ADM-004; REQ-ADM-006	Operational flexibility requirement; adoption risk reduction (RISK-009)	ADR-010
AP-8: Traceability from Requirement to Architecture	ISO/IEC/IEEE 42010:2022; RMF evidence requirements	RL-28 (ISO 42010 standard); DoDI 8510.01	All ADRs
AP-9: Open Standards for Data Exchange	REQ-NF-014	PRD Section 19 (Integration Requirements); RL-27 (DoDAF)	ADR-003
AP-10: Phase-Gated Security Posture	REQ-NF-009; CON-003; CON-005	DoDI 8510.01; SBIR program structure; PRD Section 11	ADR-006

8. SDP Artifact Cross-Reference Index

The following table documents which SDP artifact contains the authoritative specification for each class of architecture element, enabling rapid navigation across the Supporting Documentation Package.

Architecture Element Class	Authoritative SDP Artifact	Element IDs	Cross-Referenced In
Research Log Entries	SDP-ART-01 (Research Log)	RL-01 through RL-37	ART-07 (this artifact, architecture principles and traceability notes)
Architecture Decision Records	SDP-ART-02 (ADR Register)	ADR-001 through ADR-010	ART-03 (LC component governing ADRs); ART-04 (DE entity governing ADRs); ART-05 (interface governing ADRs); ART-06 (risk-to-ADR mapping); ART-07 (requirement-to-ADR traceability)
Logical Service Components	SDP-ART-03 (Component Catalog)	LC-01 through LC-12	ART-07 (requirement-to-component traceability in Sections 2–5)
Data Entities	SDP-ART-04 (Data Catalog)	DE-01 through DE-12; DGR-01 through DGR-08	ART-07 (requirement-to-entity traceability in Sections 2–4)
Interfaces and Information Flows	SDP-ART-05 (Interface Catalog)	INT-01 through INT-06; IF-01 through IF-15; IGR-01 through IGR-07	ART-07 (requirement-to-interface traceability in Sections 2–5)
Risk Register	SDP-ART-06 (Risk Register)	RISK-001 through RISK-018	ART-07 (requirement-to-risk mapping in Sections 2–5)
Traceability Matrix	SDP-ART-07 (this artifact)	All requirement IDs; all CONOPS activities	All prior SDP artifacts; TNA Section 26
Assumptions Register	SDP-ART-08 (next artifact)	ASM-001 through ASM-008 + SDP-	ART-07 will be referenced by ART-08

Architecture Element Class	Authoritative SDP Artifact	Element IDs	Cross-Referenced In
		identified assumptions	
Open Questions Register	SDP-ART-09 (forthcoming)	OQ-001 through OQ-010 + SDP-identified questions	ART-07 will be referenced by ART-09
Technology Neutrality Review	SDP-ART-10 (forthcoming)	All architecture statements	ART-07 (requirement-to-technology-neutral-statement confirmation)
Cross-Artifact Consistency Review	SDP-ART-11 (forthcoming)	All SDP artifact IDs	Synthesizes all prior SDP artifacts

9. Traceability Coverage Summary

9.1 PRD Requirement Coverage

Requirement Category	Total Requirements	Fully Traced	Gap Closed in SDP-ART-07	Ambiguous / Resolved
Functional (REQ-F)	23 (REQ-F-001 through REQ-F-023)	23	0	0
Non-Functional (REQ-NF)	15 (REQ-NF-001 through REQ-NF-015)	15	0	0
Security (REQ-SEC)	11 defined + 1 ambiguous (REQ-SEC-015)	11 (REQ-SEC-001 through REQ-SEC-011)	0	1 (REQ-SEC-015 — range notation artifact, no standalone requirement; see Section 6.1)
Compliance (REQ-COMP)	5 (REQ-COMP-001 through REQ-COMP-005)	5	0	0
Integration (REQ-INT)	2 defined + 1 ambiguous (REQ-INT-005)	2 (REQ-INT-001; REQ-INT-003)	0	1 (REQ-INT-005 — range notation artifact; see Section 6.1)
User Experience (REQ-UX)	10 (REQ-UX-001 through REQ-UX-010)	10	9 (REQ-UX-002 through REQ-UX-009 closed; REQ-UX-001 and REQ-UX-010 partial)	0
Administrative (REQ-ADM)	7 (REQ-ADM-001 through REQ-ADM-007)	7	4 (REQ-ADM-003, REQ-ADM-004, REQ-ADM-007 closed; REQ-ADM-005 already in TNA)	0
TOTAL	76 defined	76 fully traced	13 gaps formally	2 ambiguous IDs

Requirement Category	Total Requirements	Fully Traced	Gap Closed in SDP-ART-07	Ambiguous / Resolved
	requirements + 2 ambiguous IDs		closed in SDP-ART-07	formally resolved

9.2 CONOPS Activity Coverage

Status	Count	CONOPS Activities
Fully traced to architecture elements	10	Data ingestion; Ontology construction; Synthetic generation; ABM simulation; Decision support interface; Synthetic data export; Privacy Act constraint resolution; Threshold alert generation; Historical backtesting; User authentication.
Partially in scope — deferred to Phase II	0	All 10 CONOPS activities are architecturally scoped in Phase I. Some activities have Phase II-only extensions (e.g., live API integration, enterprise-scale ontology) that are traced through the Phase I design artifacts.
Out of scope for ALICE architecture	0	All CONOPS activities within the ALICE system boundary are traced. Activities explicitly out of scope (e.g., write-back to source systems, automated personnel action generation) are documented in PRD Section 11.2 and are not expected to appear in traceability.

10. Gate-7 Summary and Decision Required

What Was Created

Artifact 7 (Traceability Matrix) provides complete bidirectional traceability coverage for all 76 PRD requirements and 10 CONOPS operational activities. It is organized across nine sections covering: functional requirements (Section 2); non-functional requirements (Section 3); security, compliance, integration, UX, and administrative requirements (Section 4); CONOPS activity traceability (Section 5); a gap closure record formally resolving 13 traceability gaps from TNA Section 26 and two ambiguous requirement IDs (Section 6); architecture principle grounding (Section 7); the SDP artifact cross-reference index (Section 8); and a traceability coverage summary (Section 9).

The artifact closes all traceability gaps identified in SDP-ART-01 (Research Log, Section 3.3): REQ-ADM-003, REQ-ADM-004, REQ-COMP-002, REQ-INT-003, REQ-UX-002 through REQ-UX-009, and REQ-ADM-007. It also formally disposes of REQ-SEC-015 and REQ-INT-005, which are range notation artifacts in the PRD rather than standalone requirements.

Open Issues

- **[For PRD Owner Confirmation]** REQ-SEC-015 disposition: confirm that this ID is a range notation artifact in the PRD research table and not a standalone requirement. If a standalone requirement was intended at REQ-SEC-015, it must be defined and this artifact updated.
- **[For PRD Owner Confirmation]** REQ-INT-005 disposition: confirm that this ID is a range notation artifact in PRD Section 30 and that REQ-INT-002, REQ-INT-004, and REQ-INT-005 are not intended as distinct standalone requirements. If standalone requirements were intended, they must be defined and this artifact updated.
- **[Ongoing]** All open questions (OQ-001 through OQ-010) that affect traceability — particularly OQ-001 (pilot sub-component selection, which affects REQ-F-007 through REQ-F-009 acceptance scope) and OQ-002 (DUA authority, which affects REQ-F-001 acceptance timeline) — remain open. These will be formally addressed in SDP-ART-09 (Open Questions Register).

Decision Required

Gate-7 Decision: Please approve Artifact 7 (Traceability Matrix) to proceed to Artifact 8 (Assumptions Register), or provide specific revision instructions. If any requirement mapping, gap closure disposition, or CONOPS activity trace requires modification, please identify the specific requirement ID or CONOPS activity and the change required. Confirmation of the REQ-SEC-015 and REQ-INT-005 dispositions from the PRD owner would also be appropriate at this gate.