SCOPE OF WORK: VR BASED JUNIOR LEADERSHIP TRAINING SIMULATOR

1.   Introduction.   The Junior Leadership Training Simulator is a virtual reality (VR) training solution intended to enhance decision making, leadership judgement, and doctrinal awareness in junior leaders. It provides immersive branching narrative experiences and observer-level tactical familiarisation sequences in a controlled, instrumented environment. All development, acceptance, and handover activities shall occur under the oversight of Simulator Development Division (SDD).

2.   Definitions.

2.1.   **Authorised User.**   Person formally listed by SDD as permitted to edit protected configuration parameters.

2.2.   **Branch.** A mutually exclusive narrative path taken at a decision point in a Leadership Story.

2.3.   **Critical / Major / Minor Fault.** Defect classifications defined in Table 1.

2.4.   **Decision Point.** A scripted pause in a Leadership Story where the trainee selects one of the presented actions.

2.5.   **Motion to Photon Latency.** Time from a physical head pose change to corresponding displayed pixels, measured per IEEE 3079-2020.

2.6.   **NPC.** Non-Player Character controlled by artificial intelligence.

2.7.   **Optimum Path.** The branch sequence representing best practice leadership behaviour as validated by SDD.

2.8.   **Roman English.** Hindi rendered in Latin script using ISO 15919 transliteration unless SDD directs otherwise.

2.9.   **Rubric.** Competency matrix mapping decisions to descriptor-based proficiency levels supplied by SDD.

2.10.   **Scenario.** A self-contained Tactical Module episode selectable from the scenario catalogue.

2.11.   **Simulator Sickness Questionnaire (SSQ).** Kennedy et al. 1993 instrument. Subscales: N (Nausea), O (Oculomotor), D (Disorientation). Total Score = $3.74N + 1.52O + 0.77D$.

2.12.   **Story.** A complete Leadership Module narrative (all branches and endings).

2.13.   **CASO.** Cordon and Search Operation.

3.   Project Overview.

3.1.   **Purpose.** Train junior leaders in leadership decision making and doctrinal drills via immersive, repeatable VR experiences.

3.2.   **Key Features.**

3.2.1. Immersive PC VR (Meta Quest 3 wired).

3.2.2. Two modules: Leadership (branching narratives) and Tactical (observer doctrinal familiarisation).

3.2.3. Multi-modal interaction (voice commands, virtual menu, controller input).

3.2.4. Real-time branching without scene reload.

3.2.5. Multilingual support (English, Hindi, Roman English) for UI, subtitles, voice over.

3.2.6. After Action Review (AAR) with decision path visualisation, decision log, rubric scoring, PDF export.

3.2.7. Performance instrumentation (frame time logs, latency traces, SSQ evidence, decision/event logs).

3.2.8. Modular asset library delivered for reuse.

3.2.9. Maintainable codebase with SDLC artefacts and reproducible offline builds.

3.3.   **Use Cases.** Leadership decision training; doctrinal drill familiarisation; remediation/coaching via replay and rubric feedback.

4.   Training Content Categories.

4.1.   Leadership Narrative Stories (branched).

4.2.   Tactical Scenarios (observer).

4.3.   Environmental Variants (mountain, jungle, desert, urban) where relevant.

5.   Scope Partitioning.

5.1.   Part I – General Instructions.

5.2.   Part II – Aim and System Design.

5.3.   Part III – Hardware Design Instructions.

5.4.   Part IV – Software Instructions.

5.5.   Part V – Miscellaneous (methodology, support, testing, deliverables).

PART I: GENERAL INSTRUCTIONS

6.   Any assumption or parameter affecting performance requires prior written SDD approval.

7.   Vendor procures all development tools and specialised hardware; on-site SDD machines used only within premises (no off-site source code development).

8.   All billed licensed software or hardware delivered with perpetual transferable licences at final acceptance.

9.   Vendor shall meet the agreed schedule; a detailed resource and milestone plan is due within seven days of Supply Order.

10.   All IPR (software, source, documentation, 3D assets, audio, motion capture, scripts, branch diagrams, derivatives) vests in SDD.

11.   SDD staff shall be associated during development and trained for maintenance and content extension.

12.   Acceptance contingent on staged functional trials and final user acceptance trials at SDD.

13.   Payment upon final acceptance and deliverable handover.

14.   Eligibility: Vendor not blacklisted; ≥ 12 months relevant VR/simulation experience.

15.   Initial Brief: Architecture and timeline presentation within one week of Supply Order.

PART II: AIM AND SYSTEM DESIGN

16.   **Aim.** Provide branching leadership decision training and doctrinal tactical familiarisation for junior leaders.

17.   **Leadership Module – Scenario Catalogue (10).**

Phase I – Incident & Crisis Response

17.1.   Scenario 1: Ambush on a Military Convoy.

17.2.   Scenario 2: Terrorist Inflicted Incident at a Temporary Operating Base.

17.3.   Scenario 3: Fire Incident on a Post.

17.4.   Scenario 4: Motor Transport (MT) Accident.

17.5.   Scenario 5: Handling a Civilian Mob.

Phase II – Personnel, Welfare & Administrative Leadership

17.6.   Scenario 6: Soldier Struggling with Mental Health Issues.

17.7.   Scenario 7: Food Poisoning at a Peace Location.

17.8.   Scenario 8: Surprise Visit by a Higher Headquarters.

17.9.   Scenario 9: Role of a Junior Leader in an Administrative Inspection.

17.10. Scenario 10: Conduct of a Football Competition by a Junior Leader.

17.11. **Scenario Metrics.** Each scenario documents decision count, branching factor per decision, max depth, optimum path, rubric mapping, language asset list, expected single-playthrough duration and total aggregated branch duration.

17.12. **Duration Targets.** Single playthrough ≈ 15 minutes; total aggregated branch content ≈ 40 minutes.

17.13. **Branch Execution.** Transitions occur without scene reload; interruption < 200 ms.

17.14. **Animation Quality.** Motion capture (optical/inertial) or high-quality keyframe; natural body mechanics, facial expression, lip sync.

17.15. **Multilingual Delivery.**   Voice over + on-screen text (English, Hindi, Roman English); lip sync for English & Hindi at minimum.

17.16. **AAR Outputs.**

17.16.1.   Branch map (trainee vs optimum).

17.16.2.   Time-stamped decision log.

17.16.3.   Rubric scorecard (dimensions + narrative feedback).

17.16.4.   PDF export (map, log, scores).

17.17. **Scenario Details Provision.**   Exact detailed scripts, branch diagrams, dialogue, and rubrics for all ten Leadership scenarios will be provided by SDD post contract.

18.   **Tactical Training Module – Scenario Catalogue (5).**

18.1.   Scenario 11: Patrolling in a Line of Control Environment.

18.2.   Scenario 12: Ambush in a Line of Control Environment.

18.3.   Scenario 13: Attack in Platoon Rod (Mountains and Desert separately).

18.4.   Scenario 14: Defence by a Section (DCB & Mountains separately).

18.5.   Scenario 15: Cordon and Search Operation on a Target Area.

18.6.   **Perspective.** Trainee as embedded observer (no order issuance).

18.7.   **Civilian Presence.** Contextual civilian NPCs per doctrinal script.

8.8.   **AAR Outputs.**   Timeline replay with pause, fast-forward, instructor annotations (no decision log).

18.9. **Scenario Details Provision.**   Exact detailed storyboards and doctrinal reference material for Scenarios 11–15 will be provided by SDD post contract.

19.   **Performance & Comfort Benchmarks (Meta Quest 3 – Wired PC-VR).**

19.1. **Target Refresh Rate.**   Sustain 90 fps per eye; optional 120 Hz mode must sustain ≥ 120 fps or revert gracefully to 90 Hz.

19.2. **Motion to Photon Latency.**   ≤ 20 ms (95th percentile), mean ≤ 17 ms.

19.3. **Frame Time Budget (90 fps).**   GPU mean ≤ 8.0 ms (95th ≤ 10.5 ms); CPU simulation mean ≤ 4.0 ms (95th ≤ 6.0 ms).

19.4. **Frame Time Stability.**   95th percentile frame time jitter ≤ 5 ms (worst-case soak).

19.5. **Dropped / Reprojection Frames.**   ≤ 0.5% over any continuous 10-minute run.

19.6. **Visual Resolution.**   ≥ native 2064 × 2208 per eye; dynamic scaling floor ≥ 80% each dimension.

19.7. **Audio Latency.**   ≤ 30 ms (95th percentile).

19.8. **Comfort (SSQ).**   Mean Total ≤ 30; no individual > 50.

19.9. **Regression Trigger.**   Any revision raising average GPU or CPU frame time > 5%, changing resolution policy, or adding locomotion mode triggers revalidation (19.1–19.8).

20. **Ergonomics & Locomotion.**

20.1 Artificial locomotion shall provide comfort vignette / narrowed FOV option.

20.2 Observer sequences minimise rapid acceleration.

20.3 New locomotion modes or headset profile changes trigger regression testing (para 53).

21. **3D Engine.** Unity or Unreal (LTS/stable); perpetual transferable licences; full project & build scripts for offline deterministic compilation; no outbound telemetry by default.

PART III: HARDWARE DESIGN INSTRUCTIONS

22.   **Classroom Deployment.** Ten classrooms (Annex A). Aggregate seats: 120 (average 12 per classroom unless otherwise distributed by SDD). Each seat: Meta Quest 3 (wired) + local rendering workstation (or optional shared classroom node or one node per multiple classrooms). Seats run independently; no multiplayer sync. Server Room provides shared services (licensing if needed, logging, backups, repository mirror, switching, UPS, environmental monitoring).

23.   **Headset Standard**. Meta Quest 3 only; wired link mode exclusively.

24.   **Rendering Workstation Output Requirement.**   Each seat under worst-case test (para 52) meets para 19 metrics with ≤ 80% sustained GPU utilisation and ≤ 75% system memory utilisation (≥ 20% headroom). Evidence: (a) synthetic VR benchmark; (b) in-engine frame timing capture; (c) 30-minute thermal log (GPU ≤ 80 °C, no throttling).

25.   **Optional Shared Classroom Rendering Node.**   If used, resource isolation prevents cross-seat performance breaches (para 19.1, 19.2). If not adopted this paragraph is non-binding.

26.   **Network & Cabling.**   Structured CAT6A; non-blocking fabric; utilisation ≤ 40% with all 120 seats concurrently launching scenarios, streaming logs, exporting AARs. Headset cables managed overhead or via raceways. No wireless networking required for simulation traffic.

27.   **Server Room Services.**   Repository mirror, central log aggregator, backup scheduler (daily incremental + weekly full), licence server (if needed), core switches, UPS, environmental sensors (temperature, humidity, door contact). Services remain operational during classroom power cycling.

28.   **Environmental Operating Range.**   Classrooms 18–30 °C, RH ≤ 80% non-condensing. Server Room 18–26 °C with MERV 8+ filtration. Headset storage: dust-free shelving, passive ventilation.

29.   **Displays (Instructor/Monitoring).**   Where required, ≥ 24″ 1080p monitors.

30.   **Audio.**   Spatial audio via headset; instructor monitoring via stereo reference headphones.

Note – Exact HW architecture and HW specifications will be given in RFP during bidding.

PART IV: SOFTWARE INSTRUCTIONS

31.   **System Capacity.**   Supports 120 simultaneous independent VR trainees; any seat may run any scenario without breaching para 19 metrics.

32.   **Interaction & UI.**   Voice command latency ≤ 500 ms (95th percentile) from speech end to action; controller menu fallback; optional gaze selection.

33.   **Multilingual & Localisation.**   Externalised UTF-8 strings; per-language subtitle toggle; Roman English transliteration per ISO 15919 unless superseded by SDD guide.

34.   **Data Management.** Local AES-256 encrypted storage (profiles, decision logs, metrics); daily encrypted backup (manual trigger acceptable).

35.   **After Action Review.**   Timeline replay (pause, seek, 0.25×, 0.5×, 1×, 2×). Leadership: branch map + rubric panels. Tactical: timeline + instructor annotations. Exports: PDF (branch map, log, scores) + JSON (metrics).

36.   **Logging & Instrumentation.**   Mandatory events—session start/end, scene load, decision point displayed, decision selected, performance snapshot (every 5 s), voice recognition failure, branch transition timing. Performance Evidence Set: per-seat frame time CSV (worst-case soak), latency distribution (min/mean/50th/90th/95th/99th), GPU utilisation timeline, dynamic resolution scaling timeline (if used) showing ≥ 80% floor.

37.   **Wired Mode Assumption.** All tests executed in wired Quest 3 link mode; profiling overhead documented.

38.   **Asset Library Delivery.**   Characters, modular environments, props, textures, materials, motion capture clips. Formats: FBX 2020+ (glTF optional). Texture limits: character head 2K, body 2K, environment module 2K atlas, standard prop 1K (unless justified). Polygon budgets: hero ≤ 80K; standard NPC ≤ 40K; environment module ≤ 10K (excl. LODs). ≥ 2 additional LOD levels for characters & large props.

39.   **Coding Standards & Maintainability.**   C# 12 (.NET 8) for Unity or C++20 for Unreal; zero Critical static analysis findings; Git main/develop/feature; semantic versioning (MAJOR.MINOR. PATCH); signed annotated tags; deterministic build; dependency manifest with licence inventory; no GPLv3 without approval.

40.   **Security.**   No outbound network calls by default; configuration restricted to Authorised Users; logs exclude personal data beyond trainee ID.

41.   **Quality Gates.**   Unit test coverage ≥ 60% logical branches; integration tests (launch, story traversal, scenario load); automated performance frame time capture.

42.   **Local Configuration Parameters.**   Comfort options (vignette, snap turn angle), language selection, logging verbosity, performance cap (diagnostic).

PART V: MISCELLANEOUS

43. **Development Methodology.** SDLC phases—Requirements, Design, Implementation, Integration, Verification, Acceptance (each gated by SDD approval).

44. **SDLC Artefacts.** SRS; SDD with UML; Asset Technical Specification; STP & ATP; RTM; Risk Register (fortnightly); Release Notes & Change Log; Static Analysis & Coverage Reports.

45. **Warranty Period.** Two years from Final Acceptance.

46. **Warranty Coverage.** Corrective maintenance, performance optimisation (para 19), documentation corrections (new content excluded).

47. **Extended Support.** Five years after warranty expires.

48. **Training.** Train-the-Trainer (2–3 days)—administration, parameter adjustment, AAR usage, performance evidence collection (slides, recordings, quick reference sheets).

49. **Functional Testing.** Module demonstration vs SRS.

50. **Integration Testing.** Combined Leadership & Tactical modules with shared services.

51. **Performance Validation.** Frame time, latency, FOV, audio latency vs paras 19 & 52.

52. **Graphics Soak Performance Test.** Worst-case scenario (max effects, NPC density, environmental effects) runs 60 minutes with all 120 seats active. Acceptance: average ≥ 90 fps each seat; 95th percentile frame time jitter ≤ 5 ms; reprojection ≤ 0.5%; GPU utilisation and memory headroom per para 24; no thermal throttling.

53. **Comfort Validation.** SSQ campaign (para 19.8) with raw subscale & total scores; remediation required if thresholds breached.

54. **Regression Trigger.** Any revision altering average frame time > 5%, adding locomotion mode, or new headset profile mandates revalidation (paras 19 & 52) and SSQ test.

55. **Acceptance.** All RTM entries verified; ATP signed by Vendor and countersigned by SDD.

56. **Performance Evidence (T&E Set).** Raw frame time logs, latency traces, SSQ forms (anonymised), branch transition logs, AAR export samples, static analysis reports, coverage report, asset budget compliance report, GPU utilisation timelines, dynamic resolution scaling logs (if used).

57.   Fault Classification & Service Levels: See Table 1.

Class	Definition	Response Time	Restoration Target	Example
Critical	Simulator inoperable; no workaround	2 business days	5 business days	Application fails to start
Major	Function degraded; workaround exists	5 business days	Next scheduled patch ≤ 30 days	Branch map not rendering
Minor	Cosmetic or documentation issue	Next patch cycle	≤ 60 days	Typographical error

Table 1 – Fault Classes and Service Levels

58.   Documentation Deliverables: SRS; SDD; UML; RTM; STP; ATP; Release Notes; Change Log; static analysis & coverage reports; build scripts; dependency manifest; code comments (standard header).

59.   Asset Library: Source models, textures, materials, motion capture data, audio masters, naming convention document.

60.   User Documentation: User Manual; Administrator Guide; AAR Guide; Troubleshooting Guide.

61.   Training Materials: Slide deck; recorded sessions; quick reference sheets.

62.   Source & Build Deliverables: Full Git repository export (signed tags) on encrypted media + local copy; PDF manifest.

63.   Digitally signed installer(s) for release version.

64.   SHA-256 hash list for all delivered binaries and archives.

65.   Payment: Single payment upon Final Acceptance and delivery of artefacts (58–64) unless a staged schedule is annexed.

66.   **Summary (Non-contractual).**   This SoW defines scenario catalogue, architecture, performance and comfort benchmarks, maintainability standards, and acceptance framework for the VR based Junior Leadership Training Simulator.