HK Robotics Assurance Pool â€" Product Requirements Document (PRD)

Version: v1.0
Date: 2026-03-10 (HK / UTC+8)
Owner: Pool Operator (BVI) with HK deployment members
Scope: B2B-only assurance mutual for robotics deployments in Hong Kong; offshore pool operator (BVI); USDC via Circle sub-accounts as default rails (non-custodial).

> Important framing: This is a private membersâ€™ discretionary mutual. Benefits are discretionary, not guaranteed indemnities. This document is operational/technical, not legal advice.

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1) Problem & Objectives

Modern robotics deployments (AMRs, cobots, service robots, drones) face:
- Slow, uncertain deployment approvals due to perceived operational/third-party risks
- Limited or mismatched risk cover options; opaque pricing
- Long, adversarial claim cycles that delay restoration of service/cash flow

Objectives (12-month targets):
- Deployment approvals: evidencing risk controls to support operator/vendor onboarding decisions within â‰¤ 3 business days (P80), via telemetry-backed attestations
- Loss ratio discipline: pooled net loss ratio target 45â€"65% across cohorts; stop-gates when cohort LR > 75% (rolling 90d) or solvency floor risk breached
- Payout TAT: straight-through, parametric-eligible claims paid T+2 business days (P80); evidence-based claims committee decisions â‰¤ 10 business days (P80)

Non-goals (v1): consumer/retail participation; onshore public offerings; guaranteed indemnity language; speculative token issuance

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2) Users & Roles

- Pool Admin (Operator â€" BVI entity)
  - Full system administration; policy/rule versioning; committee coordination; member lifecycle; capital ledger; distributions
- Operator Member (HK robotics operator; also "Member")
  - Onboarding/KYB; register fleets/deployments; link telemetry; set contribution schedule; file claims; receive payouts and surplus distributions
- Capital Provider / LP
  - Commit external capital into participating notes/LP tranche; view reserves, waterfalls, and distributions; receive statements and payouts
- Underwriter Function (risk analyst)
  - Define/maintain coverage rails; set pricing tiers; review telemetry; approve/reject cohort participation
- Adjuster Function (claims analyst)
  - Claims triage; evidence requests; prepare decisions for committee; apply parametric rules when eligible
- Auditor (internal/external)
  - Read-only access to immutable audit trail, rule versions, reserve movements, and committee minutes

Role-based access control (RBAC) is mandatory. Privileged actions require 2FA + multi-party approval (threshold: 2 of 3 committee signers where defined).

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3) Business Model & Mechanics

Structure: BVI-based Private Membersâ€™ Discretionary Mutual (PMDM)
- Membership: HK robotics operators admitted per cohort rules; membership agreements include discretionary benefit framework and telemetry participation
- Contributions: members contribute per exposure (robot-hours, task-hours, or replacement value) mapped to risk tier; contributions fund pooled reserve
- Reserves: maintained in USDC (Circle sub-accounts) with fiat fallback; accounting buckets: Member Contributions, Earned/Unearned, Claims Paid, IBNER/IBNR-equivalents, Operating Costs, Surplus
- Governance Committee: minimum 3 members (Operator + 2 independents). Approves rule versions, cohort entries, non-parametric claim decisions, capital calls, and distributions
- External Capital: optional participating notes or LP tranche (no public offering). Subordinate to member claims but senior to operator fees; waterfall defined in Capital section
- Surplus Distribution: annual or semi-annual; first to restore solvency buffer; then member refunds pro-rata by earned contribution and loss performance; capital providers per tranche terms
- Solvency Floor: maintain Eligible Reserve â‰¥ 1.2 Ã— 99% VaR (12-month horizon) at cohort and pool levels; automated stop-gates on new risks and distributions when breached
- Rebalancing: quarterly contribution recalibration by telemetry score drift and observed loss emergence; intra-quarter stop-gates when adverse deviation > threshold

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4) Coverage Rails (Assurance Framework)

Day-1 discretionary benefits (insurance-like, but discretionary):
- Physical damage to covered robotic units during approved operations (excludes wear/tear; discretionary caps per unit and per event)

- Third-party harm/property damage arising from covered operations within defined venues/routes (requires operational compliance evidence)
- Business interruption assurance for robotics downtime from covered physical damage events (time and amount caps)

Assurance telemetry rail:
- Mandatory telemetry linkage (heartbeat + event streams) from approved providers
- Parametric triggers permitted where telemetry supports objective thresholds (e.g., tilt/impact beyond X; geofence breach; inactive > Y minutes under operating state)
- Evidence pack auto-assembly (pre/post telemetry windows, logs, photos where available)

Exclusions (illustrative):
- Unauthorized operating modes/locations; gross negligence; regulatory non-compliance; deliberate acts; unsupported firmware; crypto mining

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5) Risk & Pricing

Telemetry score â†' tiers:
- Each deployment receives a Telemetry Risk Score (0â€"100). Tiers map to base rates: T1 (80â€"100, low), T2 (60â€"79), T3 (40â€"59), T4 (0â€"39, high/conditional)

Exposure units:
- Primary: robot-hours or task-hours (depending on modality). Alternative: replacement value when hours not reliable

Contribution calculation (per period):
- Contribution = (Exposure Units Ã— Base Rate_tier) Ã— Modifiers
  - Modifiers: venue factor, operating window factor, incident history factor, deductible selection, sensor completeness factor

Rebalancing and stop-gates:
- Quarterly repricing by latest 90-day telemetry and incident experience
- Stop-gates: auto-suspend new exposure acceptance for a cohort when: rolling 90-day LR > 75%, or solvency buffer < 1.2 Ã— 99% VaR, or telemetry completeness < 95%

Illustrative ranges (non-binding):
- Deductibles: 1â€"10% of claim amount; per-event caps set by cohort
- Rate corridors per tier maintained to avoid adverse selection

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6) Claims

Lifecycle:
1) Notice: Member files claim (or system auto-detects parametric-eligible event); T+0 acknowledgement
2) Triage matrix: classify as Parametric-Eligible, Evidence-Light, or Evidence-Heavy
3) Evidence: system assembles telemetry and artifacts; member uploads invoices/photos as needed
4) Decision: parametric â†' straight-through rules; others â†' committee decision (majority) with discretionary rationale recorded
5) Payout: USDC to member Circle sub-account default; fiat fallback; target T+2 BD for parametric; â‰¤ 10 BD for others (P80)

Triage criteria (examples):
- Parametric: impact > threshold within approved route/time; device health normal pre-event; no exclusion flags
- Evidence-Light: minor third-party property harm with CCTV/log corroboration
- Evidence-Heavy: bodily injury, major property harm, or ambiguous telemetry

Dispute handling:
- Single appeal to committee with new evidence; final and binding within the mutualâ€™s discretion

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7) Capital & Wallets

Rails:
- Default: USDC via Circle sub-accounts (member-level segregation; operator-controlled programmatic disbursement; non-custodial)
- Fallback: fiat bank transfers for members unable to hold USDC

Ledger structure (double-entry):
- Assets: Circle Master, Circle Sub-accounts (per member, per capital tranche), Fiat Account
- Liabilities: Unearned Contributions, Reported Not Settled, IBNER/IBNR-like, Capital Notes Payable
- Equity/Surplus: Member Surplus, Capital Provider Equity
- Income/Expense: Earned Contributions, Claims Paid, Change in Reserves, OpEx, FX/Fees

Flows:
- Member contribution: Member Sub-acct â†' Pool Reserve (intra-Circle transfer); journal: Cashâ†' / Unearnedâ†', then Earned over exposure
- Claim payout: Reserve â†' Member Sub-acct; journal: Claims Paidâ†' / Cashâ†" (with reserve release)
- Surplus distribution: Reserve â†' Member Sub-acct and Capital Provider acct per waterfall

Capital providers:
- Instruments: participating notes or LP tranche (no public marketing); commitments called to Capital Sub-account; statements monthly; distributions per waterfall

- Waterfall (illustrative): 1) Maintain solvency floor; 2) OpEx cap; 3) Claims; 4) Capital preferred return (if any); 5) Surplus split between Members and Capital per agreed ratio

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8) Governance

- Committee composition and quorum rules stored as active Rule Version
- Proposals: JSON-structured objects with type (pricing, cohort admission, claim decision, distribution), rationale, attachments, and expiry
- Approvals: threshold signatures (2/3) recorded; effective timestamps; reversal procedures
- Rule versioning: semantic versioned; each decision executed under explicit rule version
- Audit trail: append-only event log with tamper-evident hash chain; periodic offsite snapshot; auditor read-only portal

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9) Data Model (high-level)

Core entities:
- Member, User, Role
- RobotAsset, Deployment, Venue/Route, TelemetryProvider, TelemetryStream, TelemetryScore
- ExposureUnit, ContributionSchedule, Invoice, Payment
- Claim, IncidentEvent, EvidencePack, Decision, Payout
- Wallet (Circle Account/Sub-account), JournalEntry, LedgerAccount
- Proposal, RuleVersion, AuditEvent, CommitteeMember
- CapitalProvider, Commitment, Tranche, WaterfallPayout

PII boundaries:
- Member KYB: legal entity data, officer IDs (minimal retention per AML)
- Operational data: robot IDs, telemetry summaries; raw telemetry stored time-limited; sensitive personal data (faces/plates) not retained beyond evidence windows

Retention:
- Audit and ledger: 7 years minimum
- Telemetry raw: 90 days rolling; summaries and scores retained 7 years
- Claims evidence: 7 years; anonymize where feasible post-closure

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10) Integrations

- Telemetry providers: HTTPS/WebSocket ingestion; OAuth/API key; signed payloads; clock sync requirement (±2s)
- Payment rails (Circle): account/sub-account management, allow lists, internal transfers, USDC mint/redeem, fiat fallback via partner bank
- Notifications: email (transactional), Slack/MS Teams (ops), optional WhatsApp/SMS for status updates
- Document store: S3-compatible bucket with KMS; virus scan on upload; content-addressed URLs in audit log

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11) Compliance Appendix (BVI-first)

- Mutual vs insurance framing: private members' discretionary mutual; benefits are discretionary; no guarantee of indemnity; no retail policy sales
- Membership gating: B2B entities only; KYB/KYC/AML at onboarding; sanctions screening; ongoing monitoring
- Marketing: no public solicitation; offshore offers only; no Hong Kong retail marketing
- Funds flow: member contributions and payouts via Circle sub-accounts; operator does not take custody beyond programmatic control; fiat fallback via regulated channels
- Crypto/VASP avoidance: no exchange/custody for third parties outside Circle program; no on-platform token trading; USDC used strictly as settlement medium
- Records: maintain committee minutes, rule versions, ledger, and audits per BVI requirements
- Disclaimer: this PRD is not legal advice; counsel review required before launch

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12) Non-functional Requirements

Security:
- SSO + MFA; least-privilege RBAC; IP allow lists for admin; HSM-managed keys; encrypted at rest and in transit
- Secrets management: Vault or KMS; key rotation 90 days

Observability:
- Structured audit/event logs; metrics for LR, solvency, TAT; alerting to on-call

Availability & Resilience:
- Portal SLO: 99.9% monthly; Claims/Payout API SLO: 99.95%
- Backups daily; RPO ≤ 4h; RTO ≤ 8h

Privacy:
- Data minimization; regional storage per member contracts; DPIAs where needed

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13) Roadmap

- v0.2: capital flows (Circle sub-accounts), claims triage engine, USDC payouts (parametric), basic governance proposals
- v0.3: LP/capital portal, tranche accounting, automated waterfalls, solvency and VaR dashboard, quarterly repricing workflow
- v0.4: optional tokenization of member surplus receipts/capital notes (subject to counsel approval); expanded telemetry providers; enhanced parametric catalogs

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14) Acceptance Criteria (selected flows)

Onboarding & Accounts
- A user (Member Admin) can complete KYB/KYC and be approved or rejected with reasons
- A user can create Circle member sub-accounts and set allow lists for their wallets

Telemetry & Exposure
- A user can link an approved telemetry provider and see real-time telemetry health ≥ 95%
- A user can register deployments and accrue exposure units (robot-hours/task-hours) daily

Pricing & Contributions
- A user can view their current tier and contribution rate; simulate impact of telemetry score changes
- A user can fund contributions in USDC and receive invoice/receipt; earning recognized over exposure

Claims
- A user can file a claim with automated evidence pack; see triage class and SLA timer
- A user can receive straight-through parametric payout T+2 BD when eligible

Governance
- A user (Committee) can create a proposal, collect threshold approvals, and publish a Rule Version
- A user (Auditor) can export an immutable audit log segment and verify its hash chain

Capital & Distributions
- A user (Capital Provider) can commit/check balance and view waterfall statements
- A user (Member) can receive surplus distribution with breakdown and rationale

Stop-gates & Solvency
- The system auto-suspends new exposures for a cohort when solvency < 1.2 × 99% VaR and notifies stakeholders

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15) Assumptions & Open Questions

- BVI counsel will validate PMDM structure, documents, and marketing constraints
- Circle program permits required sub-account granularity and programmatic controls for this use case
- Initial telemetry providers: list to be confirmed; parametric catalogs scoped with them
- Data residency: default HK/Singapore; confirm member-specific constraints
- Preferred return for capital tranches and surplus split percentages to be finalized