# Meridian Coatings — Order-to-Cash Billing Bridge

## Preliminary Requirements and System Specification

**Document Type:** Pre-Pipeline Functional Specification (M0 Deliverable) **Version:** 0.2 (Revision following independent specification review — see §11) **Date:** 2026-07-12 **Supersedes:** v0.1 (2026-07-06) **Prepared For:** AI-Native Software Delivery Pipeline (VH M0–M7) — Epic/Feature Decomposition **Classification:** Published Demonstration Artifact

> **Demonstration notice.** Meridian Coatings is a fictional company and this scenario is a composite. The requirements, specification structure, provenance discipline, and all build artifacts generated from this document are real and independently verifiable. No fictional entity herein is intended to resemble any actual company.
>
> **Revision notice.** Version 0.2 incorporates the findings of an independent specification review conducted against v0.1 (completeness score 88/100, disposition "Proceed"; twelve findings — five medium, seven low). Every finding and its disposition — adopted, adapted, or declined with rationale — is recorded in §11. Requirements added or materially modified in this revision carry the [RV] provenance tag in addition to their original evidentiary basis.

**Provenance legend (per-requirement tags):**

- **[E] Extracted** — derived from artifacts (parent-ERP export samples, invoice sample pack, TSA schedule, price-list files)
- **[S] SME-stated** — stated in stakeholder interviews (role attributed)
- **[I] Inferred** — synthesized by the audit from indirect evidence; flagged for confirmation before build
- **[RV] Review-derived** — added or modified in response to the independent specification review of v0.1 (2026-07-10); where a review item required a stakeholder decision, the resolving party is attributed

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# 1. System Overview

## 1.1 What Is the Meridian Billing Bridge?

Meridian Coatings is a $180M-revenue specialty coatings manufacturer, carved out of a global chemicals parent by a mid-market sponsor. [E] Under the Transition Services Agreement

executed at close, the parent's ERP continues to operate Meridian's order-to-cash function — order entry, contract pricing, invoicing, credit memos, and AR event feeds — for a term of 12 months, with an extension escalator. [E] This system, the Billing Bridge, replaces that TSA-provided function: a bounded, standalone order-to-cash platform that Meridian owns and operates from TSA exit forward. It is explicitly not an ERP (see §8).

## 1.2 Problem Statement

Two clocks are running. [E] The TSA's contractual sunset is month 12; [S — Controller] the finance organization's own estimate is that a conventional implementation (mid-market ERP module + integrator) would consume 9–14 months and carry material schedule risk against that date. Every month of TSA extension carries the escalated service fee; every month of parallel-run compression reduces cutover risk. The Billing Bridge must be production-ready with sufficient margin for parallel-run validation (§10, AT-19) inside the TSA term.

## 1.3 Operating Environment

- **Users:** order desk (4), accounts receivable (3), controller + assistant (2), sales operations (2), read-only sponsor/deal-team access (up to 5). [S — Controller; VP Sales Ops]
- **Volumes (trailing 12 months, from parent-ERP exports):** ~1,180 active customer accounts; ~440 active SKUs across 6 product families; ~2,600 orders/month; ~3,100 invoices/month (partial shipments produce >1 invoice per order); ~90 credit memos/month. [E]
- **Pricing reality:** ~60% of revenue flows through negotiated contract price lists with effective-dated terms; remainder at tiered list pricing. [E — price-list file set]
- **Currency:** USD only in v0.1/v0.2 scope. [S — Controller] (Canadian subsidiary invoicing handled by parent post-TSA under separate agreement; see OQ-4.)

## 1.4 Key Technical Approach

A four-system decomposition (§3): pure-software core (Billing, Catalog & Pricing, Platform) built directly; all external dependencies isolated behind contracted seams (§6, System X) with typed payloads, versioned formats, and per-assumption provenance — because the parties on the other side of each seam (the parent's ERP export process, the payment processor, the new general ledger) are outside Meridian's control and must be specified at the boundary, not assumed into the core. Interface and seam-format versioning are governed under §8.4 [RV].

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## 2. Stakeholders and System Roles

| Role | Person (fictional) | Interest | Interview provenance |
|---|---|---|---|
| Controller | M. Kessler | Close integrity, audit trail, GL mapping, cutover | Interviews 1–3 [S] |
| VP Sales Operations | R. Ibarra | Contract pricing fidelity, quote turnaround, rebate programs (OQ-7) | Interviews 2, 4 [S] |
| Order Desk Lead | T. Nguyen | Order entry speed, partial shipments, order amendments | Interview 4 [S] |
| AR Lead | D. Okafor | Invoice accuracy, credit memo controls, payment application | Interview 3 [S] |
| Parent IT Liaison | (parent-side) | Export file provision, historical data extraction, cutover freeze | Interview 5 + export samples [E/S] |
| Sponsor Ops Partner | (deal team) | Read-only KPI visibility, cutover milestone tracking | Interview 5 [S] |

Role definitions above are the authoritative source for the RBAC matrix (P1, §7).

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## 3. Architecture & Decomposition Model

**System M — Core Billing:** quote, order, invoice, credit memo lifecycles. Pure software; direct implementation. **System C — Catalog, Customers & Contract Pricing:** customer master (C0 [RV]), product catalog, price lists, contract terms, price resolution. Pure software. **System X — External Seams:** parent-ERP historical/transition ingestion; payment processor; GL export; tax rate provision. Contracted stubs; counterparty behavior specified with provenance. **System P —**

**Platform:** RBAC, authentication (P4 [RV]), immutable audit, operations dashboard & cutover tracking. Pure software.

### Constraint C-1 — Monetary representation (hard constraint, applies to every system)

All monetary amounts are represented, stored, transmitted, and computed as integer cents (`cents: i64`). Floating-point monetary types are prohibited in schemas, interfaces, and persistence. [E — invoice sample reconciliation exposed rounding drift in the parent's legacy exports; S — Controller: "to-the-penny or it doesn't close"] Rounding occurs only at defined points (price-resolution output; tax application; proration), using round-half-even. Line-item cents MUST sum exactly to document-header cents (AT-1). *Pipeline note:* this constraint is enforced by deterministic validation; any generated artifact carrying DECIMAL/float money types fails the build gate.

### Constraint C-2 — Seam idempotency

All System X ingestion operations are idempotent under file/batch replay; every ingested record carries source-batch identity and content hash. [I — inferred from the parent liaison's description of "occasional re-sends"; confirmed at the v0.2 review gate — Parent IT Liaison]

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## 4. System M — Core Billing

### M1 — Quoting

Scope: creation, approval, expiry, and conversion of customer quotes with resolved contract pricing. Features:

- **REQ-M1.1** [S — VP Sales Ops] The system shall create quotes for any active customer, resolving each line's unit price via the C3 price-resolution engine at quote time, and recording the resolution basis (contract / tier / list) per line.
- **REQ-M1.2** [S — VP Sales Ops] The system shall enforce quote approval thresholds: quotes whose blended margin falls below the configured floor require approval by a user holding QUOTE_APPROVER before issuance. (Threshold resolved: OQ-5 — 18% blended margin floor [RV — VP Sales Ops, review gate].)
- **REQ-M1.3** [E — quote samples] The system shall render issued quotes to customer-facing PDF carrying quote identity, line detail, validity date, and payment terms. Quotes exclude freight and surcharges; the quote PDF shall carry the standard notation "freight and applicable surcharges billed at shipment" (REQ-M3.8) [RV].

- **REQ-M1.4** [S — Order Desk Lead] The system shall convert an ACCEPTED quote to an order in one action, carrying resolved prices immutably (conversion does not re-resolve prices).
- **REQ-M1.5** [I — inferred from expiry annotations in quote samples; flagged] The system shall expire quotes automatically at validity date and prohibit conversion of EXPIRED quotes without re-issuance.
- **REQ-M1.6** The system shall log all quote lifecycle events with actor, timestamp, and prior/new state (feeds P2 audit).

**Lifecycle FSM:** DRAFT → PENDING_APPROVAL → ISSUED → ACCEPTED → CONVERTED; ISSUED → EXPIRED; DRAFT|PENDING_APPROVAL → CANCELLED. Illegal transitions rejected with `ERR_ILLEGAL_TRANSITION`.

**Interface contract (selected, v1 per §8.4):**

| Method | Description |
|---|---|
| `create_quote(customer_id, lines[], validity_date, seq) -> QuoteAck` | Creates DRAFT; resolves prices via C3; rejects `ERR_CUSTOMER_INACTIVE`, `ERR_SKU_UNKNOWN` |
| `submit_quote(quote_id, seq) -> QuoteAck` | Routes to PENDING_APPROVAL when margin floor triggered, else ISSUED |
| `convert_quote(quote_id, seq) -> OrderRef` | ACCEPTED only; price-immutable conversion |
| `get_quote(quote_id) -> Quote` | Full document incl. per-line resolution basis |

**Types (selected):** `QuoteLine { sku_id, qty: u32, unit_price_cents: i64, resolution: enum{CONTRACT, TIER, LIST}, line_total_cents: i64 }`; `QuoteState: enum { DRAFT, PENDING_APPROVAL, ISSUED, ACCEPTED, CONVERTED, EXPIRED, CANCELLED }` (full coverage required in all consumers).

## M2 — Order Management

Scope: order capture (converted or direct), amendment, partial-shipment recording, and invoice triggering. Features:

- **REQ-M2.1** [S — Order Desk Lead] The system shall create orders directly (without quotes) for established customers, resolving prices via C3 at entry.

- **REQ-M2.2** [S — Order Desk Lead] The system shall support order amendment (quantity, requested date, ship-to) prior to first shipment; amendments after first shipment are governed by REQ-M2.7.
- **REQ-M2.3** [E — shipment/invoice correlation in parent exports] The system shall record shipment events per order line (full or partial quantity) and shall trigger invoice generation per shipment event (one invoice per shipment batch).
- **REQ-M2.4** [I — inferred from order-status vocabulary in exports; confirmed at review gate — Order Desk Lead] The system shall maintain order status: OPEN → PARTIALLY_SHIPPED → FULLY_SHIPPED → CLOSED; OPEN → CANCELLED.
- **REQ-M2.5** The system shall prevent shipment recording exceeding open ordered quantity (`ERR_OVERSHIP`).
- **REQ-M2.6** The system shall log all order lifecycle and amendment events with actor and timestamp.
- **REQ-M2.7** [RV — Order Desk Lead, review gate] **Post-first-shipment amendment rules.** For orders in PARTIALLY_SHIPPED state, amendments are permitted only on lines with `open_qty > 0` and are limited to: quantity reduction (not below shipped quantity), `requested_date` change, and `ship_to` change applying to unshipped lines only. Adding new lines to a partially shipped order is prohibited (`ERR_LINE_ADD_AFTER_SHIPMENT`) — the order desk creates a new order instead, preserving one-order-one-negotiation-context. Quantity increases on open lines require approval by a user holding ORDER_SUPERVISOR (new permission, P1.1). Orders in FULLY_SHIPPED or later states accept no amendments.
- **REQ-M2.8** [RV; E — PO fields observed in invoice sample pack] **Customer PO reference.** Orders may optionally carry `customer_po_ref` (string, max 50 chars), entered at order creation or amendment (subject to M2.7 restrictions). A `customer_po_ref` duplicating a prior reference for the same customer raises a confirmation warning (`WARN_DUPLICATE_PO_REF`) requiring explicit override — not a hard block, since blanket POs legitimately recur [S — Order Desk Lead]. Quote-converted orders inherit the quote's PO reference when captured. Invoice rendering includes `customer_po_ref` when present (REQ-M3.3); absence does not block invoice generation.

## M3 — Invoicing

Scope: invoice generation from shipment events, rendering, issuance, and AR posting to the GL seam. Features:

- **REQ-M3.1** [E] The system shall generate invoices from shipment events carrying the shipped lines at their order-locked prices, freight and surcharge lines per REQ-M3.8, and payment terms from the customer record (C0).
- **REQ-M3.2** (C-1) The system shall compute all invoice amounts in integer cents; the sum of line `line_total_cents` plus tax and charge lines shall equal `invoice_total_cents` exactly (property test AT-1).

- **REQ-M3.3** [E — invoice sample pack] The system shall render invoices to PDF matching the required remittance fields (invoice number, PO reference per M2.8, terms, due date, remit-to) observed in the sample set.
- **REQ-M3.4** [S — Controller] The system shall assign invoice numbers from a gapless per-entity sequence; voided invoices retain their number with VOID status (no reuse).
- **REQ-M3.5** The system shall post an AR journal event to the X3 GL seam upon issuance (and reversal upon void), per the §6 X3 mapping contract.
- **REQ-M3.6** [E] The system shall apply tax at invoice time via the X4 rate provision seam (see OQ-3 for engine-vs-table resolution). Taxability of charge lines follows the `taxable` flag per REQ-M3.8.
- **REQ-M3.7** The system shall support invoice VOID (pre-payment only) with mandatory reason code from `VoidReason: enum { ENTRY_ERROR, PRICING_ERROR, SHIPMENT_ERROR, DUPLICATE, OTHER }` (full coverage; OTHER requires free-text note).
- **REQ-M3.8** [RV — Order Desk Lead; Controller, review gate; E — freight lines in invoice sample pack] **Freight & surcharge model.** Charges are explicit typed lines, not SKU lines: `OrderCharge { charge_id, charge_type: enum{FREIGHT, FUEL_SURCHARGE, HAZMAT_FEE, EXPEDITE, OTHER}, amount_cents: i64, taxable: bool, note }` (full enum coverage; OTHER requires note). Two attachment modes: **(a) shipment-attached** — FREIGHT and EXPEDITE are entered manually by the order desk at shipment recording, when actual carrier cost is known [S — current parent practice: freight keyed from the carrier quote], and bill on the invoice generated from that shipment; **(b) order-standing** — FUEL_SURCHARGE and HAZMAT_FEE may be attached to the order at entry/amendment and auto-apply to every subsequent shipment's invoice until amended. Charge amounts are entered directly in integer cents; no rating-engine computation exists in v0.2 (rate-table/carrier-API automation is explicitly out of scope, §8.1). Charges never appear on quotes (REQ-M1.3). Charge lines are creditable by amount basis only (REQ-M4.5).

**Lifecycle FSM:** GENERATED → ISSUED → (PAID | PARTIALLY_PAID | VOID); payment states driven by X2 events.

## M4 — Credit Memos

Scope: controlled issuance of credits against invoices. Features:

- **REQ-M4.1** [S — AR Lead] The system shall create credit memos only with reference to an issued invoice, at line granularity, not exceeding the referenced line's invoiced amount (`ERR_OVERCREDIT`), per the line model in REQ-M4.5.
- **REQ-M4.2** [S — AR Lead; Controller] The system shall require a reason code on every credit memo from `CreditReason: enum { RETURN, PRICING_ADJUSTMENT, SHORTAGE, DAMAGE, GOODWILL, REBATE_SETTLEMENT, OTHER }` — full enum coverage in all consumers; REBATE_SETTLEMENT exists for the parent's current

year-end manual rebate credits (see OQ-7) and carries a mandatory program reference note in v0.1/v0.2.

- **REQ-M4.3** [S — Controller] The system shall route credit memos above the configured amount threshold to CREDIT_APPROVER before issuance (threshold resolved: OQ-5 — $5,000.00 [RV — Controller, review gate]).
- **REQ-M4.4** The system shall post credit journal events to X3 upon issuance.
- **REQ-M4.5** [RV — AR Lead; Controller, review gate] **Credit memo line model.** `CreditMemoLine` references `invoice_line_id` and carries exactly one basis: `basis: enum{QUANTITY, AMOUNT}`. **Quantity basis:** `credited_qty` (u32, partial quantities permitted, e.g., 10 units of a 50-unit line); credited amount derives as `credited_qty × unit_price_cents` from the invoice line (round-half-even where proration applies per C-1); cumulative `credited_qty` across all memos referencing a line must not exceed `invoiced_qty`. **Amount basis:** `credited_amount_cents` (i64); cumulative credited amount across all memos referencing a line must not exceed `line_total_cents`. Reason-code/basis mapping is enforced: RETURN, SHORTAGE, DAMAGE → QUANTITY basis required; PRICING_ADJUSTMENT, GOODWILL, REBATE_SETTLEMENT → AMOUNT basis required; OTHER → either, with note. Invoice charge lines (M3.8) and tax lines are creditable on AMOUNT basis only. Violations reject with `ERR_BASIS_REASON_MISMATCH` / `ERR_OVERCREDIT`.

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# 5. System C — Catalog, Customers & Contract Pricing

## C0 — Customer Master [RV]

*Rationale: v0.1 referenced "customer record" (payment terms, M3.1) and customer ingestion (X1.1) without defining the customer data model — a medium-severity review finding. C0 is the authoritative definition; it is initialized from the parent customer extract (X1) and maintained in the Bridge thereafter.*

- **REQ-C0.1** [RV; E — parent customer export, format v2] The system shall maintain the customer master with required fields: `customer_id` (string, parent-ERP identity preserved for X1 reconciliation and X3 traceability), `name`, `bill_to_address` (structured: line1, line2, city, region, postal_code, country — country fixed `US` in v0.2 scope per §1.3), `ship_to_addresses[]` (one-to-many, each with identity and structured fields; orders reference a ship-to by identity, REQ-M2.2/M2.7), `payment_terms: enum{NET_15, NET_30, NET_45, NET_60, DUE_ON_RECEIPT}` (observed set from the export; full coverage in consumers), `credit_limit_cents: i64`, `tier_assignment: enum{TIER_1, TIER_2, TIER_3}` (C3 resolution input), `active_flag: bool`.

- **REQ-C0.2** [RV] Customer–contract relationship: zero or more contract price lists (C2.2) reference a `customer_id`; tier pricing applies via `tier_assignment` when no contract line matches (C3.1 precedence). Deactivating a customer (`active_flag = false`) blocks new quotes/orders (`ERR_CUSTOMER_INACTIVE`) but not invoice generation for already-shipped lines, payment application, or credit memos against issued invoices.
- **REQ-C0.3** [RV] Customer master changes (terms, credit limit, tier, addresses, active flag) are versioned with actor, timestamp, and before/after in the P2 audit log; payment terms captured on an invoice at issuance are immutable on that document (terms changes apply prospectively).
- **REQ-C0.4** [RV — Controller, review gate] **Credit limit posture, v0.2:** `credit_limit_cents` is stored, maintained, and displayed (order entry shows open-AR-plus-open-order exposure against limit as an advisory flag), but hard credit-hold enforcement — blocking order confirmation on limit breach — is explicitly out of scope pending Controller definition of the hold/release workflow (OQ-9). Advisory-only in v0.2 prevents the Bridge from silently embedding a credit policy nobody has ratified.

## C1 — Product Catalog

- **REQ-C1.1** [E — item master export] The system shall maintain the SKU catalog (identity, family, unit of measure, active flag, standard cost reference for margin computation) initialized from the parent item-master extract.
- **REQ-C1.2** [S — VP Sales Ops] The system shall support SKU lifecycle (ACTIVE / DISCONTINUED) with discontinuation blocking new quote/order lines but not historical documents.

## C2 — Price Lists & Contract Terms

- **REQ-C2.1** [E — price-list file set] The system shall maintain effective-dated list prices per SKU and effective-dated tier price lists (3 tiers observed; enum per C0.1).
- **REQ-C2.2** [E/S] The system shall maintain customer contract price lists: per-customer, per-SKU (or family) negotiated prices with effective ranges, initialized from the parent contract-pricing extract and confirmed by Sales Ops.
- **REQ-C2.3** The system shall version all price changes with actor, timestamp, and effective range; no in-place mutation of historical pricing (feeds AT-6).

## C3 — Price Resolution Engine

- **REQ-C3.1** The system shall resolve a unit price for (customer, SKU, date) by strict precedence: contract > customer tier (per C0.1 `tier_assignment`) > list, returning price and resolution basis.
- **REQ-C3.2** The system shall reject resolution for inactive SKUs and gap dates (`ERR_NO_PRICE_EFFECTIVE`) rather than falling back silently. [S — Controller: silent fallbacks in the legacy system produced the pricing-error credits visible in the memo history]

- **REQ-C3.3** Resolution shall complete in ≤ 50 ms per line at catalog scale (§10 performance).

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## 6. System X — External Seams

Each seam is a contracted stub: typed payloads, versioned formats, idempotent ingestion (C-2), and provenance on every assumption about the counterparty. The counterparty is outside build scope; the contract is inside it. Seam format versions are explicit in batch metadata and governed under §8.4 [RV].

### X1 — Parent-ERP Transition Ingestion

- **REQ-X1.1** [E — 14-file sample set, format v2] The system shall ingest the parent's fixed-format export files (customers → C0, items, price lists, open orders, open AR) validating batch identity, sequence, and content hash; malformed records quarantine with report, never partial-apply.
- **REQ-X1.2** [S — Parent IT liaison] The system shall support the agreed transition cadence (weekly full customer/item/pricing snapshots; daily open-order/open-AR deltas during parallel run) and a final cutover freeze ingestion.
- **REQ-X1.3** [I — flagged; liaison confirmed the format freeze policy through cutover at the review gate [RV]] Export format is assumed stable at v2 through cutover; any format revision triggers OQ-2 escalation and a seam-contract revision under §8.4 change control, not silent adaptation.

### X2 — Payment Processor

- **REQ-X2.1** The system shall consume payment events (payment, partial payment, refund) via the processor-agnostic contract `PaymentEvent { invoice_ref, amount_cents: i64, event: enum{PAYMENT, PARTIAL, REFUND}, processor_txn_id, ts_utc }`; processor selection is OQ-6 and confined to an adapter.
- **REQ-X2.2** The system shall apply payment events to invoice payment state idempotently by `processor_txn_id`.

### X3 — General Ledger Export

- **REQ-X3.1** [S — Controller; GL selection resolved at review gate [RV], see OQ-10] The system shall emit journal batches (AR debit/credit pairs per issuance, void, credit memo, payment application) mapped per the Controller-owned account map, in the selected accounting system's import format — Sage Intacct CSV journal import, format specification held as a referenced seam artifact — daily and on-demand. The X3 seam implements a configurable mapping/format layer: the Intacct emitter is the v0.2 target,

and the layer admits alternative emitters (delimited-file or API) without core change, insulating the Bridge from a future GL decision reversal.
- **REQ-X3.2** Journal batches shall balance to zero cents by construction (AT-8) and carry document-level traceability.

### X4 — Tax Rate Provision

- **REQ-X4.1** The system shall obtain tax rates through a provision seam supporting either a maintained rate table (v0.1/v0.2 default) or a tax-engine adapter (post-OQ-3), applied at invoice time per REQ-M3.6.

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## 7. System P — Platform

### P1 — Access Control (RBAC)

- **REQ-P1.1** The system shall enforce the role/permission matrix derived from §2 (ORDER_DESK, AR, CONTROLLER, SALES_OPS, QUOTE_APPROVER, CREDIT_APPROVER, ORDER_SUPERVISOR [RV — added per REQ-M2.7], SPONSOR_READONLY, ADMIN); every mutating operation requires an authorized role; sponsor access is read-only by construction (AT-12).

### P2 — Audit Log

- **REQ-P2.1** [S — Controller] The system shall record every monetary-document mutation, every pricing change, every customer-master change (C0.3), and every authentication event (P4.4) to an append-only audit log (actor, timestamp, before/after) queryable by document and by actor; no deletion or update paths exist.

### P3 — Operations & Cutover Dashboard

- **REQ-P3.1** [S — Sponsor Ops Partner; Controller] The system shall present operational KPIs (orders/day, invoices/day, invoiced revenue MTD in cents-accurate totals, open AR aging, credit-memo rate) and the cutover tracker: parallel-run reconciliation status by ingestion batch (per the AT-19 quantitative gate [RV]) and TSA-exit milestone checklist.
- **REQ-P3.2** Dashboard figures shall derive from the same monetary records as documents (no shadow computation; AT-14).

### P4 — Authentication & Session Management [RV]

*Rationale: v0.1 defined authorization (P1) comprehensively but not authentication — a medium-severity review finding, material for a financial system carrying AR data and replacing a TSA-provided service.*

- **REQ-P4.1** [RV] Authentication shall use a managed identity provider (OIDC/SSO); no locally stored passwords. Where SSO is not yet provisioned for a user class at cutover, MFA-enforced managed accounts are the fallback, reviewed monthly by the Controller until SSO coverage is complete.
- **REQ-P4.2** [RV] Multi-factor authentication is mandatory for CONTROLLER, CREDIT_APPROVER, QUOTE_APPROVER, ORDER_SUPERVISOR, and ADMIN (every role holding an approval or configuration power), and default-on for all other roles. SPONSOR_READONLY users authenticate via federation with the sponsor's identity provider where available.
- **REQ-P4.3** [RV] Session policy: idle timeout ≤ 15 minutes for financial-mutation and approval roles (CONTROLLER, AR, CREDIT_APPROVER, QUOTE_APPROVER, ORDER_SUPERVISOR, ADMIN); ≤ 30 minutes for ORDER_DESK and SALES_OPS (order-entry ergonomics [S — Order Desk Lead]); ≤ 8 hours absolute for all sessions.
- **REQ-P4.4** [RV] Authentication events (login success/failure, MFA challenge outcomes, session expiry, privilege changes) feed the P2 append-only audit log. (AT-20.)
- **REQ-P4.5** [RV] Automated seam endpoints (X1 ingestion, X2 payment events) authenticate with per-seam scoped credentials held in a secrets manager, rotated at least every 90 days, never embedded in exported artifacts; credential use is audit-logged.

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# 8. Constraints and Exclusions

## 8.1 Scope Boundary (published coverage map)

In scope: the order-to-cash slice defined in §§4–7. Explicitly out of scope, v0.1/v0.2: inventory and warehouse management; MRP/production; procurement/AP; payroll; multi-currency (OQ-4); tax engine selection (stubbed per X4); customer portal/self-service; EDI (OQ-8); volume-rebate program automation (OQ-7 — deferred); freight rating-engine/carrier-API automation (charges are manually entered per REQ-M3.8 [RV]); hard credit-hold enforcement (advisory-only per REQ-C0.4; OQ-9 [RV]); the parent-side export process itself (specified at the X1 boundary only).

## 8.2 Technical Constraints

C-1 integer-cents monetary discipline (all systems); C-2 seam idempotency; gapless invoice numbering (REQ-M3.4); no silent pricing fallback (REQ-C3.2); append-only audit (REQ-P2.1); price-history immutability (REQ-C2.3); credit-basis discipline (REQ-M4.5) [RV]; authentication controls (P4) [RV].

## 8.3 Technical Infrastructure Requirements [RV]

*Placement note: stack selection is ordinarily a pipeline-phase (M2/M3) decision, not an M0 intake output — v0.1's silence was deliberate. Because this is a published demonstration artifact shipped alongside its generated build package, the stack is documented here so specification and artifact can be checked against each other. Where the review suggested alternatives (PostgreSQL), the disposition and rationale are recorded in §11.*

- **Runtime & language:** Node.js LTS, TypeScript (strict mode). Monetary values carried as `bigint` cents end-to-end per C-1.
- **Persistence:** SQLite in WAL mode, encrypted at rest via SQLCipher. Rationale: the operating footprint (§1.3) is ~11 named operational users plus 5 read-only, ~2,600 orders and ~3,100 invoices monthly — roughly 150 invoices per business day — with the heaviest concurrent-write pressure being a 4-person order desk; this is comfortably inside SQLite's WAL-mode envelope, and single-file embedded persistence with application-enforced append-only paths satisfies C-1's ACID requirements, P2.1, and REQ-C2.3. All persistence is confined behind a repository interface preserving a relational-server (e.g., PostgreSQL) migration path; named triggers: multi-currency scope (OQ-4 reopening), EDI-driven order automation (OQ-8) materially raising write concurrency, or sustained breach of §10.2 targets.
- **Deployment:** cloud-native single-container deployment to a managed host (the review's recommendation, apt given TSA timeline pressure — no procurement or data-center dependency on the critical path); infrastructure as code; separate staging and production environments; secrets in the platform secrets manager (P4.5).
- **Backup:** daily encrypted backups; continuous log shipping for ≤ 1 hour RPO (§10.3) — unlike a derive-only reporting system, the Bridge's orders, invoices, and credit memos are primary records with no upstream source to re-ingest from after cutover.
- **PDF rendering (quotes, invoices, credit memos):** headless-Chromium HTML-to-PDF pipeline; document templates versioned so historical re-renders reproduce under period-correct template versions.
- **Identity:** managed OIDC provider per P4.1.

## 8.4 Interface Versioning & Change Control [RV]

- All public interfaces (M1–M4 method contracts, P3 dashboard API) carry semantic versions (v1.0 at cutover). Breaking changes require a new major version with a minimum 90-day dual-version support window.
- All X-seam formats carry an explicit `format_version` in batch/file metadata (X1 parent exports are pinned at v2 per REQ-X1.3; X2 `PaymentEvent` and X3 journal formats are v1.0). Ingestion of an unrecognized seam format version quarantines the batch with an escalation report — never silent adaptation.
- Interface and seam-format changes require a CHANGELOG entry and notification to dependent-system owners (Parent IT Liaison for X1; Controller for X3) at least 30 days

before deployment; during the TSA parallel run, X1 changes additionally require the liaison's written acknowledgment, since parallel-run reconciliation (AT-19) depends on format stability.

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## 9. Open Questions and Assumptions

*v0.2 change: a stakeholder review gate was held (2026-07-10) following the independent specification review. Resolutions below; two new items (OQ-9, OQ-10 → OQ-10 resolved at the same gate) were opened by the review itself.*

| # | Status | Question / Ambiguity | Resolution / Path |
|---|---|---|---|
| OQ-1 | **RESOLVED** [RV — Controller] | Historical data depth at cutover (open documents only vs. 24-month history) | Confirmed: open documents + 12-month invoice history for AR aging, ingested at cutover. Deeper history remains in the parent archive per the TSA's records clause; the Bridge's own 7-year retention obligation (§10.4) begins at cutover. |
| OQ-2 | **RESOLVED** [RV — Parent IT Liaison] | Parent export format stability through cutover | Liaison confirmed a format freeze at v2 through TSA exit under the TSA's cooperation clause; any parent-side change routes through §8.4 change control with 30-day notice and written acknowledgment (REQ-X1.3). |

| # | Status | Question / Ambiguity | Resolution / Path |
|---|---|---|---|
| OQ-3 | OPEN | Tax: maintained rate table vs. tax-engine subscription | v0.2 builds the provision seam + rate table; engine adapter deferred pending Controller decision. |
| OQ-4 | RESOLVED (deferred) | Canadian subsidiary invoicing (CAD) | Out of v0.1/v0.2 per Controller [S]; parent handles under separate agreement post-TSA. Named as a §8.3 persistence-migration trigger if reopened. |
| OQ-5 | **RESOLVED** [RV — Controller; VP Sales Ops] | Approval thresholds (quote margin floor; credit memo amount) | Quote blended-margin floor: 18% (REQ-M1.2). Credit memo approval threshold: $5,000.00 (REQ-M4.3). Both deploy-time configurable; changes are audit-logged configuration events. |
| OQ-6 | OPEN | Payment processor selection | Adapter-confined (REQ-X2.1); selection does not block build. |
| OQ-7 | DEFERRED | Volume-tier rebate programs. VP Sales Ops: two national accounts are negotiating volume rebate terms; the parent currently | Revisit as a scope-change candidate once program terms are executed; the pricing engine's precedence model (C3) and |

| # | Status | Question / Ambiguity | Resolution / Path |
|---|---|---|---|
| | | settles rebates via year-end manual credit memos (REBATE_SETTLEMENT reason exists for continuity). Automating accrual/settlement is explicitly deferred. [S — VP Sales Ops, Interview 4] | credit-memo reason taxonomy (M4) were designed to admit it without structural rework. |
| OQ-8 | OPEN | EDI ordering for the two largest accounts | Out of v0.1/v0.2; order desk enters manually today [S]; evaluate post-cutover. Named as a §8.3 persistence-migration trigger. |
| OQ-9 | **OPEN** [RV] | Credit-hold enforcement policy | Credit limits stored and surfaced as advisory (REQ-C0.4); hard order-block enforcement awaits Controller definition of hold/release workflow and authority. Target: decision before UAT; enforcement, if adopted, is a permission-gated order-state addition, not a data-model change. |
| OQ-10 | **RESOLVED** [RV — Controller] | New GL system identity and journal | Sage Intacct selected as the post-TSA GL; |

| # | Status | Question / Ambiguity | Resolution / Path |
|---|---|---|---|
| | | import format (raised by the review: v0.1 referenced "the new accounting system's import format" without naming the system or listing the decision as open) | CSV journal import specification obtained and held as the X3 seam artifact (REQ-X3.1). The X3 mapping/format layer remains configurable as insurance against a late GL change. |

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# 10. Acceptance & Performance

## 10.1 Business Acceptance Tests (selected)

- **AT-1** (property): for every generated document, Σ line cents (+ tax + charge lines) = header total cents, exactly, over the full generated test corpus.
- **AT-2:** quote-to-order conversion carries prices immutably; re-pricing attempts rejected.
- **AT-3:** all lifecycle FSMs reject illegal transitions with the specified error taxonomy; enum consumers demonstrate full value coverage (including `OrderCharge.charge_type` and `CreditMemoLine.basis` [RV]).
- **AT-6:** historical price queries reproduce as-of-date resolution after subsequent price changes.
- **AT-8:** every emitted GL batch balances to zero cents.
- **AT-9:** X1 replay of any ingested batch produces zero duplicate records (idempotency).
- **AT-12:** SPONSOR_READONLY holds no mutation path (exhaustive endpoint check).
- **AT-14:** dashboard MTD invoiced revenue equals Σ issued-invoice totals for the period, to the cent.
- **AT-17** [RV]: post-first-shipment amendment rules hold (REQ-M2.7): line additions rejected, quantity increases require ORDER_SUPERVISOR, reductions floor at shipped quantity — exercised over the amendment test corpus.
- **AT-18** [RV]: credit-basis discipline holds (REQ-M4.5): cumulative quantity and amount caps enforced per invoice line across multiple memos; reason/basis mismatches rejected; partial-quantity credits derive amounts per C-1 rounding.
- **AT-19** (cutover) — *revised in v0.2 with quantitative gate* [RV]: parallel-run reconciliation — invoices generated by the Bridge from ingested orders are compared to parent-issued invoices for the same shipments, per weekly reconciliation batch:

    - **≥ 99.5%** of compared invoices match **exactly** on total and per-line amounts (integer-cents equality);
    - every non-matching invoice is assigned to a documented exception category from `ReconException: enum { PRICING_TIMING, ROUNDING_METHOD, TAX_RATE_VINTAGE, MAPPING_DECISION, PARENT_ERROR }` (full coverage; no uncategorized exceptions);
    - aggregate absolute variance per reconciliation batch ≤ **$500.00**;
    - every exception carries a written disposition and Controller sign-off, recorded in the P2 audit log;
    - the cutover gate requires **three consecutive weekly reconciliation batches** meeting all four conditions before the TSA freeze ingestion is scheduled.
    - *Note: exceptions where the parent's figure is wrong (PARENT_ERROR — the rounding drift already observed in the sample reconciliation, C-1 provenance) are expected findings and count against neither the match rate denominator's integrity nor cutover readiness once dispositioned; the Bridge is not required to reproduce the parent's errors.*
- **AT-20** [RV]: authentication controls hold: no unauthenticated path reaches any endpoint; MFA enforced for the P4.2 role set; expired sessions cannot mutate; all P4.4 event classes appear in the audit log under test.

## 10.2 Performance Targets

Monthly invoice batch (≈3,100) generated and rendered in ≤ 15 minutes; price resolution ≤ 50 ms/line; dashboard KPI refresh ≤ 5 s; ingestion of full weekly snapshot ≤ 30 minutes. [I — sized from §1.3 volumes; confirmed adequate at review gate]

## 10.3 Availability & Recovery [RV]

- **Availability target:** 99.5% during business hours (6:00 AM – 8:00 PM ET, Monday–Friday), measured monthly, matching the order desk's and AR's operating window. The system remains reachable outside business hours on a best-effort basis (sponsor dashboard reads; no after-hours order-entry requirement was identified [S — Order Desk Lead, review gate]); planned maintenance windows are weekends only after cutover.
- **Recovery objectives:** RPO ≤ 1 hour via continuous log shipping — the Bridge's documents are primary records post-cutover with no upstream re-ingestion source (contrast X1, which exists only through TSA exit); RTO ≤ 4 hours to full function. During the TSA parallel run, a Bridge outage is absorbed by the still-operating parent process; after cutover it is not, which is why the recovery drill (one full restore exercise, evidenced) is a named pre-cutover milestone on the P3.1 tracker.
- **Degraded mode:** read access to issued documents (invoices, credit memos — immutable artifacts) shall remain available via the document archive during computation outages.

### 10.4 Data Retention & Archival [RV]

- All invoice, credit memo, payment-application, and audit records are retained **online for a minimum of 24 months**, then archived to encrypted cold storage for a total retention of **7 years minimum**, consistent with standard financial record-keeping obligations for invoiced revenue and AR.
- Archived records remain queryable for audit purposes with a **≤ 24-hour retrieval SLA**; retrieval events are themselves audit-logged.
- No deletion path exists inside the retention period (consistent with P2.1 append-only discipline). Post-retention disposal requires explicit CONTROLLER approval, is executed as a logged administrative action, and never touches the audit log's own records within their retention window.
- Customer master and pricing history follow document retention: any customer or price version referenced by a retained document is retained with it (referential completeness for as-of-date reproduction, AT-6).

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## 11. Revision History & Review Disposition [RV]

**v0.1** (2026-07-06) — initial intake synthesis from stakeholder interviews and artifact extraction.
**v0.2** (2026-07-12) — revision following independent specification review (2026-07-10; completeness 88/100, "Proceed"; twelve findings). Full disposition:

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| 1 | Cutover success criteria lack quantitative thresholds (medium) | **Adopted.** AT-19 rewritten as a quantitative gate: ≥99.5% exact match, closed exception taxonomy, ≤$500 aggregate variance per batch, per-exception Controller sign-off, three consecutive clean weekly cycles. Added the PARENT_ERROR category: the sample reconciliation already | §10.1 AT-19 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| | | shows the parent drifts, so "exact match to parent" cannot be the unconditional standard. | |
| 2 | Customer master data structure undefined (medium) | **Adopted.** New C0 subsystem: full field model, payment-terms enum, structured bill-to/ship-to, tier assignment as the C3 input, versioned changes. Credit limit adopted as stored-and-advisory only, with hard enforcement deliberately scoped out to OQ-9 — the review asked for credit-limit *tracking*; enforcement is a credit-policy decision no stakeholder has ratified. | §5 C0; OQ-9 |
| 3 | Deployment architecture and hosting unspecified (low) | **Adapted.** §8.3 added; cloud-native single-container per the review's recommendation. The review's PostgreSQL assumption was declined in favor of SQLite/WAL + SQLCipher behind a repository interface: | §8.3 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| | | ~150 invoices/business day and a 4-person order desk sit comfortably inside the embedded envelope, and named migration triggers (multi-currency, EDI, §10.2 breach) preserve the path. Stack documentation flagged as ordinarily a pipeline-phase decision, recorded because the artifact publishes beside its build package. | |
| 4 | Availability/uptime unstated (low) | **Adopted** at review-suggested scale (99.5% business hours, 4-hour recovery, weekend maintenance), plus the review's open question answered: no after-hours order-entry requirement; best-effort off-hours reads. Parallel-run vs. post-cutover outage asymmetry made explicit, with a pre-cutover restore drill milestone. | §10.3 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| 5 | Authentication and session management undefined (medium) | **Adopted in full.** New P4 subsystem: SSO/OIDC preferred with MFA-enforced fallback, MFA mandatory for every approval-holding role (a superset of the review's CONTROLLER + CREDIT_APPROVER minimum), 15-minute idle timeout for financial roles with a documented ergonomic relaxation for order desk, authentication events into the append-only audit, scoped rotating seam credentials. | §7 P4; AT-20 |
| 6 | Freight and surcharge logic unspecified (medium) | **Adopted.** REQ-M3.8: typed `OrderCharge` model with closed enum, manual entry in cents (matching current parent practice), two attachment modes (shipment-attached freight; order-standing surcharges) resolving the which-invoice-gets-freight question under partial shipments, quotes explicitly | §4 M3.8; §8.1 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| | | exclude charges with PDF notation, rating-engine automation explicitly excluded (§8.1). | |
| 7 | GL system identity and format deferred, absent from OQ table (low) | **Adopted.** Raised as OQ-10 and resolved at the review gate: Sage Intacct selected, CSV journal import spec held as the X3 seam artifact; X3 retains a configurable emitter layer as insurance. | §6 X3.1; OQ-10 |
| 8 | Post-first-shipment amendment scope unclear (low) | **Adopted.** REQ-M2.7 per the review's suggested rule set: open-line-only, quantity-reduction/date/ship-to, no line additions, quantity increases gated on the new ORDER_SUPERVISOR permission. | §4 M2.7; §7 P1.1; AT-17 |
| 9 | PO reference handling unspecified (low) | **Adopted with one adjustment.** REQ-M2.8: optional 50-char field, invoice rendering inclusion, absence never blocks. Per-customer uniqueness implemented as a confirmable warning rather than the review's hard | §4 M2.8 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| | | validation — blanket POs recur legitimately [S — Order Desk Lead]. | |
| 10 | Credit memo partial-line quantity handling ambiguous (medium) | **Adopted.** REQ-M4.5 per the review's suggested model: dual-basis CreditMemoLine, reason-code/basis enforcement, cumulative per-line caps across memos, partial quantities permitted, charge/tax lines amount-basis only. | §4 M4.5; AT-18 |
| 11 | Data retention and archival undefined (low) | **Adopted** at review-suggested scale: 24 months online, 7-year archive, ≤24-hour audit retrieval, Controller-approved logged disposal; extended with referential completeness so as-of-date reproduction (AT-6) survives archival. | §10.4 |
| 12 | API versioning and interface evolution unspecified (low) | **Adopted.** §8.4: semver on public interfaces, 90-day dual-version window, explicit seam `format_version` in batch metadata, | §8.4 |

| # | Finding (severity) | Disposition | Where |
|---|---|---|---|
| | | 30-day change notification — hardened during the TSA parallel run to require the parent liaison's written acknowledgment for X1 changes, since AT-19 depends on format stability. | |

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## Appendix A — Provenance Source Register

PARENT-ERP-EXPORT sample set, format v2, 14 files; invoice sample pack, 60 documents; price-list file set, 3 tiers + 212 contract lists; stakeholder interviews 1–5 as attributed; **independent specification review of v0.1 (2026-07-10) and stakeholder review-gate session (2026-07-10) [RV]; Sage Intacct CSV journal import specification (X3 seam artifact) [RV]**. Appendix B (acceptance traceability) and the M7-generated build package are published alongside this document on the case-study page.

*End of document. Version 0.2 · 2026-07-12 · Published Demonstration Artifact.*