Complete CIE v2.3.2 System Analysis - Full Documentation Summary

Executive Overview

The **Catalog Intelligence Engine (CIE) v2.3.2** is an enterprise product content management system designed to solve three critical problems at scale:

1. **Content effort disconnected from profit** - Staff waste hours on low-margin SKUs while high-margin products languish
2. **No enforceable quality floor** - SOPs and checklists decay; non-compliant content slips through
3. **No AI visibility measurement** - Companies build citation-ready content on faith without proof it works

CIE replaces manual processes with hard-enforced gates, automatic tier-based resource allocation, and a self-healing AI audit loop that measures and fixes content performance automatically.

Part 1: Core Enforcement Framework (v2.3.1)

1.1 The Eight Enforcement Gates

Every SKU must pass ALL applicable gates before publish. System returns HTTP 400 error on failure. **Zero override capability.**

Gate	Rule	Validation	Override
G1: Cluster ID	Valid Cluster_ID from approved semantic contract	Exact match to master list	NONE
G2: Primary Intent	Exactly 1 Primary Intent from locked 9-intent taxonomy	Enum check	NONE
G3: Secondary Intents	Min 1, max 3 Secondary Intents; must differ from Primary	Count + uniqueness	NONE
G4: AI Answer Block	250-300 chars; must contain Primary Intent keyword	Char count + keyword	NONE
G5: Best-For / Not-For	Min 2 Best-For and 1 Not-For entries	Count validation	NONE

G6: SKU Tier Tag	Must be tagged: Hero, Support, Harvest, or Kill	Enum check	NONE
G6.1: Tier-Locked Intents	Intents restricted by tier; fields physically removed from UI	Tier-to-field mapping	NONE
G7: Expert Authority	Hero + Support SKUs require min 1 credentialed statement	Non-empty check	NONE
VECTOR: Similarity	Description cosine similarity ≥ 0.72 vs cluster intent vector	Vector computation	NONE

1.2 The Nine Intent Taxonomy (LOCKED)

These are the ONLY valid intent values. No additions without quarterly taxonomy review.

#	Intent Type	Definition	Example Query
1	Problem-Solving	User has a problem, needs product to solve it	"how to light a low ceiling room"
2	Comparison	User evaluating alternatives	"fabric vs glass lampshade"
3	Compatibility	User confirming fit with existing setup	"will E27 pendant fit B22 bulb"
4	Specification	User needs technical details	"pendant cable max wattage"
5	Installation / How-To	User needs help installing	"how to wire a ceiling pendant"
6	Troubleshooting	User has an issue, needs fix	"pendant light flickering"
7	Inspiration / Style	User browsing for design ideas	"modern pendant ideas for kitchen"
8	Regulatory / Safety	User needs compliance info	"is this pendant bathroom rated"
9	Replacement / Refill	User replacing a component	"replacement glass shade for floor lamp"

1.3 SKU ROI Tiering Matrix

Every SKU is classified into exactly ONE tier. Tier determines content investment, promotion priority, resource allocation, AND which intent fields are available (G6.1).

Tier	Criteria	Content Depth	Effort Cap	Intent Fields Available
HERO	Top 20% margin, high velocity, strategic	Full CIE: all 9 intents, full schema, JSON-LD, Wikidata, E-E-A-T	Unlimited	All 9 enabled
SUPPORT	Positive margin, moderate velocity	Primary + 2 Secondary, Answer Block, Best-For, basic schema	2 hrs/SKU/quarter	Primary + 2 max
HARVEST	Low margin OR declining, still net-positive	Specification only. Maintenance Mode.	30 min/SKU/quarter	Spec + 1 only
KILL	Negative margin, no net value	ZERO. Flag for delisting.	0 hrs = violation	All disabled

Commercial Priority Score Formula:

Score = (Margin% × 0.4) + (1/CPPC × 0.25) + (Velocity × 0.2) + ((1 - Return%) × 0.15)

Tier Assignment:

- Top 20% composite score = Hero
- Middle 50% = Support
- Next 20% = Harvest
- Bottom 10% = Kill

Auto-Promotion Rule: If Harvest SKU velocity increases >30% in any quarter, auto-promotes to Support for full gate treatment.

1.4 Tier-Locked Intent Fields (G6.1)

This gate prevents waste by physically removing intent fields from the UI based on SKU tier.

SKU Tier	Enabled Intent Fields	Disabled Intent Fields	Max Effort
HERO	All 9 intents available	None disabled	Unlimited
SUPPORT	Primary + up to 2 Secondary (any from 9)	Fields 4-9 hidden after 2 Secondaries selected	2 hrs/SKU/quarter
HARVEST	Specification + 1 other (Problem-Solving or Compatibility only)	Fields 2,5,6,7,8,9 removed from UI	30 min/SKU/quarter
KILL	NONE — all intent fields removed	All 9 fields removed from UI	0 hrs. Any edit = violation.

Harvest Maintenance Mode: Ring-fenced gate relaxation for legacy SKUs.

- G4 (Answer Block), G5 (Best-For/Not-For), G7 (Expert Authority) are **SUSPENDED**
- Only G1, G2, G3, G6, G6.1 apply
- Harvest SKU can only ENTER via quarterly tier review (Finance + PH sign-off)
- Cannot be manually moved to Harvest to avoid gate requirements
- If velocity increases >30%, auto-promotes to Support
- Audited monthly: >4 quarters in Harvest without review triggers escalation

1.5 Title Construction Rule (NON-NEGOTIABLE)

Titles derived from: **Intent** → **Cluster** → **Attributes**. NEVER in reverse.

CORRECT:

"Warm Diffused Pendant Lighting for Low Ceilings | Fabric Drum Shade 30cm E27"

WRONG:

"Blue Fabric Drum Lampshade 30cm E27 Pendant"

Rule: First segment must address user's intent/problem. Attributes after pipe separator. Violation = G2 gate failure = publish blocked.

1.6 Answer Block Enforcement (G4)

Rule	Validation
Must be 250-300 characters	System rejects <250 or >300
Must contain Primary Intent keyword	Exact or stemmed match
Must be direct answer to question	Not marketing copy
Must NOT start with brand name	Start with problem/solution

PASS Example:

"For low-ceiling rooms needing warm, diffused light, a fabric drum shade fitted to an E27 pendant cord set spreads illumination evenly without glare. Choose 30-40cm for rooms under 2.4m."

FAIL Example:

"Our beautiful fabric drum shade is available in 6 colours and ships free."

(Marketing, no intent keyword, no problem-solution)

Part 2: AI Visibility Measurement + Self-Healing Loop

2.1 The 20-Question Audit (Per Category)

For each major category, 20 fixed questions representing real customer queries. **Locked for 90 days minimum.** Tested weekly across ChatGPT, Gemini, Perplexity, and Google AI Overview.

Query Family Mapping by Category:

Category	Primary Query Family	Secondary Query Family	Question Distribution	AI KPI Target
Cables	Wiring + Compatibility	Installation	8 Primary, 7 Secondary, 5 Other	>75% citation
Lampshades	Problem-Solving + Style	Comparison + Replacement	8 Primary, 7 Secondary, 5 Other	>70% citation
Bulbs	Compatibility + Specification	Troubleshooting	8 Primary, 7 Secondary, 5 Other	>80% citation
Pendants	Inspiration + Problem-Solving	Regulatory + Installation	8 Primary, 7 Secondary, 5 Other	>70% citation

2.2 Scoring Rubric (0-3)

Score	Label	Definition
0	Not Present	Product/brand not mentioned in AI response
1	Cited	Mentioned as one of several options
2	Summarised	AI summarises our content or recommends with context
3	Selected	AI selects as primary/best recommendation

Pass Bar: Aggregate citation rate (score ≥1) must be ≥70% for Hero SKUs. New categories get 90-day ramp.

2.3 Citation Decay Trigger — The Self-Healing Loop

For any Hero SKU, consecutive weeks of zero citations triggers an automatic escalation path.

Week	Condition	Action	Owner
Week 1	Hero SKU scores 0 on any question where it previously scored ≥1	**FLAG:** Yellow flag in dashboard. No action required yet.	System (automatic)
Week 2	Same SKU scores 0 again on same question(s)	**ALERT:** Notification sent to Content Owner + SEO Governor.	System → Content Owner
Week 3	Third consecutive 0 on same question(s)	**AUTO-BRIEF:** System generates Content Refresh Brief with: failing questions, current Answer Block, competitor answers, 7-day deadline.	System → Content Queue
Week 4	Refresh not completed OR score still 0 after refresh	**ESCALATE:** Revenue risk flag to Commercial Director. SKU added to emergency sprint.	Commercial Director

Auto-Brief Contents (Generated by System at Week 3):

1. SKU ID + Name + Tier + Current Margin
2. Failing question(s) with current score = 0
3. Current AI Answer Block (what the AI engines are NOT picking up)
4. Top 3 competitor answers for the same question (scraped from AI responses)
5. Suggested revision direction (generated by LLM based on gap analysis)
6. Deadline: 7 calendar days from brief generation
7. Success criteria: Score ≥1 on next weekly audit

Part 3: Operating Rules & Pipeline Ownership

3.1 Pipeline Layer Ownership

Every pipeline layer has ONE owner, ONE deliverable, ONE KPI. Mini-CEOs own their layer.

Layer	Owner	Deliverable	KPI
L0: Commercial Triage	Finance + PH	SKU tier tag applied to every active SKU	100% SKUs tiered within 5 days of activation
L1: Semantic Clustering	SEO/AI Governor	Cluster_ID assigned, intent taxonomy locked	0% cluster overrides without Governor sign-off
L2: Schema + Entity	Dev + SEO	JSON-LD, Wikidata sameAs, structured data	100% Hero SKUs with full schema in 14 days
L3: Content Creation	Content Team	Answer Block, Best-For/Not-For, intent-driven titles	G1-G7 pass rate >98%. Time within tier cap.
L4: Authority + E-E-A-T	Product Specialists	Expert Authority, safety certs, credentialed statements	100% Hero/Support with Expert Authority
L5: Channel Deploy	Channel Managers	Per-channel readiness score, feed optimisation	Hero SKUs >85 readiness on primary channels
L6: AI Visibility Audit	AI Ops + Admin	Weekly citation check, question audit, pass/fail	>70% AI citation rate for Hero SKUs in 90 days

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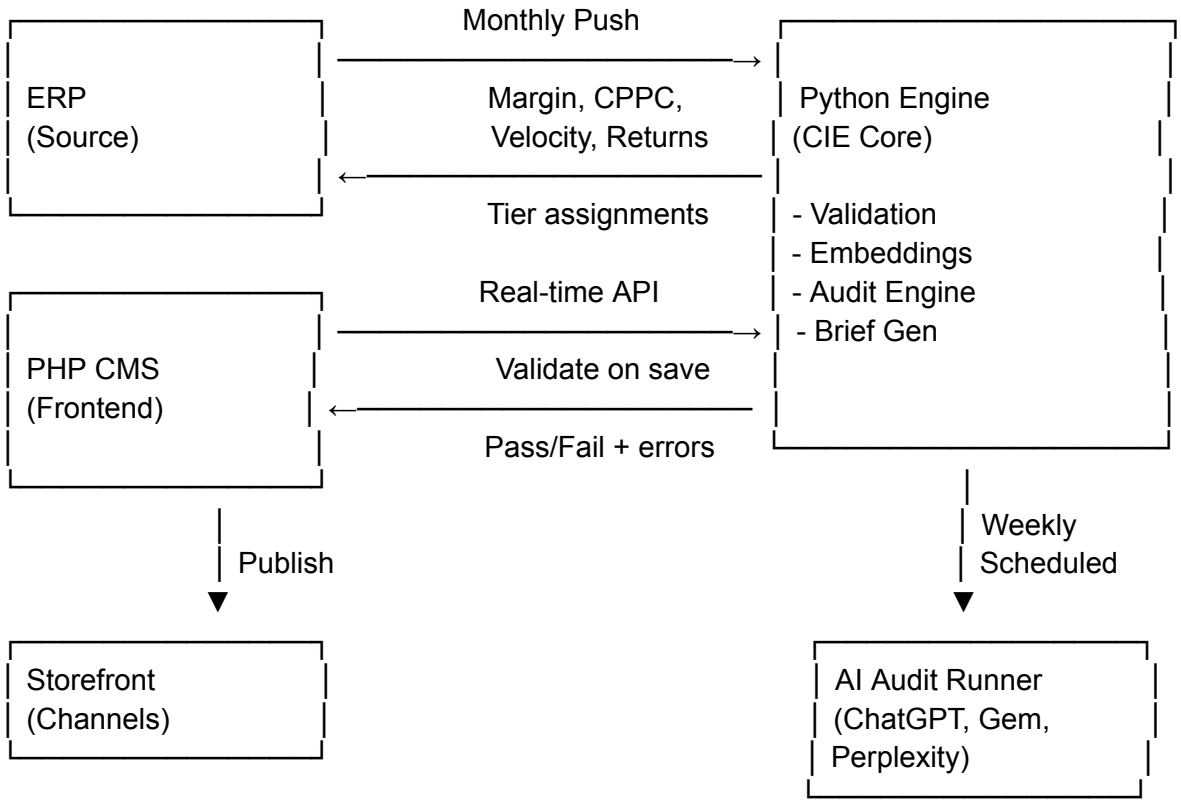
Part 4: Developer Technical Specification

4.1 System Architecture



4.2 Core API Endpoints (OpenAPI 3.0)

Base URL: `https://cie.internal.example.com/api/v1`

Method	Endpoint	Purpose	Service
POST	`/sku/{sku_id}/validate`	Pre-publish validation (G1-G7 + Vector). Returns pass/fail with error codes. Must respond within 500ms.	PHP → Python
POST	`/sku/{sku_id}/publish`	Publish SKU to channels. Only succeeds if all gates pass. Creates audit_log entry.	PHP
POST	`/sku/{sku_id}/embed`	Generate embedding for description text. Returns vector.	PHP → Python
POST	`/sku/{sku_id}/similarity`	Compute cosine similarity between description and cluster intent.	PHP → Python
GET	`/taxonomy/intents?tier=X`	Return locked intent enum list filtered by SKU tier.	Python → PHP

GET	`/clusters`	Return master cluster list with IDs and intent vectors.	Python → PHP
POST	`/audit/run`	Trigger AI citation audit for a category's 20 questions.	Python (scheduled)
GET	`/audit/results/{category}`	Return latest audit scores + decay status per SKU.	Python → PHP
POST	`/brief/generate`	Auto-generate content refresh brief (Week 3 decay trigger).	Python (auto)
GET	`/sku/{id}/readiness`	Return per-channel readiness scores (0-100).	PHP
POST	`/erp/sync`	Receive ERP data push: margin, CPPC, velocity, returns. Recompute tiers.	ERP → Python → PHP

4.3 Pre-Publish Validation Endpoint Detail

Request: `POST /api/v1/sku/validate`

```
{
  "sku_id": "SKU-CABLE-001",
  "cluster_id": "CLU-CABLE-PENDANT-E27",
  "tier": "hero",
  "primary_intent": "compatibility",
  "secondary_intents": ["installation", "specification"],
  "title": "Pendant Cable Set for Ceiling Lights...",
  "description": "A 3-core braided pendant cable...",
  "answer_block": "A 3-core braided pendant cable set...",
  "best_for": ["Standard ceiling pendant installations", "Kitchen island lighting"],
  "not_for": ["Bathroom installations (not IP-rated)"],
  "expert_authority": "Compliant with BS 7671...",
  "action": "publish"
}
```

Response: `200 OK` (All Gates Pass)

```
{
  "status": "pass",
  "gates": {
    "G1_cluster_id": { "status": "pass", "detail": "Cluster ID valid" },
    "G2_primary_intent": { "status": "pass", "detail": "Valid enum value" },
    "G3_secondary_intents": { "status": "pass", "detail": "2 valid, unique, distinct from primary" },
    "G4_answer_block": { "status": "pass", "detail": "287 chars, keyword present" },
    "G5_best_not_for": { "status": "pass", "detail": "2 best-for, 1 not-for" },
    "G6_tier_tag": { "status": "pass", "detail": "hero" },
```

```
    "G6_1_tier_lock": { "status": "pass", "detail": "All intents permitted for hero" },
    "G7_expert_authority": { "status": "pass", "detail": "Non-empty for hero tier" }
  },
  "vector_check": { "cosine_similarity": 0.87, "threshold": 0.72, "status": "pass" },
  "publish_allowed": true
}
```


Response: `400 Bad Request` (Gate Failure)


```
{
  "status": "fail",
  "gates": {
    "G4_answer_block": {
      "status": "fail",
      "error_code": "CIE_G4_CHAR_LIMIT",
      "detail": "Answer block is 312 chars. Must be 250-300.",
      "user_message": "Your AI Answer Block is too long (312 chars). Shorten to 250-300
characters."
    },
    "G6_1_tier_lock": {
      "status": "fail",
      "error_code": "CIE_G6_1_TIER_INTENT_BLOCKED",
      "detail": "Harvest tier SKU attempted troubleshooting intent.",
      "user_message": "This SKU is Harvest tier. Only Specification + 1 other intent allowed."
    }
  },
  "publish_allowed": false
}
```


4.4 Error Code Reference

Error Code	Gate	Description
CIE_G1_INVALID_CLUSTER	G1	Cluster ID not in approved master list
CIE_G2_INVALID_INTENT	G2	Primary intent not in locked 9-intent enum
CIE_G3_SECONDARY_COUNT	G3	Too few (<1) or too many (>3) secondary intents
CIE_G3_SECONDARY_DUPLICATE	G3	Secondary intent same as primary
CIE_G4_CHAR_LIMIT	G4	Answer block outside 250-300 character range
CIE_G4_KEYWORD_MISSING	G4	Answer block missing primary intent keyword

CIE_G5_BESTFOR_COUNT	G5	Fewer than 2 best-for or 0 not-for entries
CIE_G6_MISSING_TIER	G6	SKU has no tier assignment
CIE_G6_1_TIER_INTENT_BLOCKED	G6.1	Intent field not permitted for this SKU's tier
CIE_G6_1_KILL_EDIT_BLOCKED	G6.1	Kill-tier SKU: all edits blocked
CIE_G7_AUTHORITY_MISSING	G7	Hero/Support SKU missing expert authority block
CIE_VEC_SIMILARITY_LOW	Vector	Description cosine similarity below 0.72 threshold

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Part 5: Database Schema

5.1 Core Tables (15+ tables total)

cluster_master - One row per semantic cluster

Field	Type	Nullable	Constraint/Notes
cluster_id	VARCHAR(50)	NO	PK. Format: CLU-{CATEGORY}-{TYPE}-{SUBTYPE}. Immutable.
category	ENUM	NO	Values: cables, lampshades, bulbs, pendants, floor_lamps, ceiling_lights, accessories
intent_statement	VARCHAR(500)	NO	Human-readable intent. e.g. 'Connect and power a pendant light safely and stylishly'
intent_vector	VECTOR(1536)	NO	Embedding of intent_statement. Model: text-embedding-3-small
is_active	BOOLEAN	NO	Soft delete. Inactive clusters block new SKU assignments.
created_at	TIMESTAMP	NO	Immutable
updated_at	TIMESTAMP	NO	Auto-updated on change

sku_master - One row per SKU

Field	Type	Nullable	Constraint/Notes
sku_id	VARCHAR(50)	NO	PK. Format: SKU-{CATEGORY}-{SEQ}. Immutable.
cluster_id	VARCHAR(50)	NO	FK→cluster_master.cluster_id. G1 gate.
tier	ENUM	NO	Values: hero, support, harvest, kill. G6 gate. Set by ERP sync.
primary_intent_id	SMALLINT	NO	FK→intent_taxonomy.intent_id. G2 gate. Must be in tier_access.
status	ENUM	NO	Values: draft, ready, published, archived. Transition to 'published' requires ALL gates pass.
erp_margin_pct	DECIMAL(5,2)	YES	From ERP sync. Used in tier calculation.
erp_cppc	DECIMAL(8,4)	YES	Cost per product click from ERP/Ad platform.
erp_velocity_90d	INTEGER	YES	90-day unit sales from ERP.
erp_return_rate_pct	DECIMAL(5,2)	YES	Return rate from ERP.
commercial_score	DECIMAL(8,4)	YES	Computed: (margin*0.4)+(1/cppc*0.25)+(vel*0.2)+((1-ret)*0.15)
decay_status	ENUM	NO	Values: none, yellow_flag, alert, auto_brief, escalated. Citation decay tracker.
decay_consecutive_zeros	SMALLINT	NO	Count of consecutive weeks with score=0 on any tracked question.
created_at	TIMESTAMP	NO	Immutable
updated_at	TIMESTAMP	NO	Auto-updated

intent_taxonomy - Exactly 9 rows. LOCKED.

Field	Type	Example	Nullable
intent_id	SMALLINT	1	NO (PK, 1-9, Immutable)
intent_key	VARCHAR(30)	problem_solving	NO (Unique, snake_case, used in API)
label	VARCHAR(50)	Problem-Solving	NO (Display label in CMS UI)
definition	VARCHAR(200)	User has a problem...	NO (Shown as tooltip)
tier_access	JSON ARRAY	["hero","support","harvest"]	NO (Which tiers can use this intent. G6.1 enforcement)

sku_secondary_intents - Junction table. 1-3 rows per SKU.

Field	Type	Nullable	Constraint
sku_id	VARCHAR(50)	NO	PK(composite), FK→sku_master.sku_id
intent_id	SMALLINT	NO	PK(composite), FK→intent_taxonomy.intent_id. Must differ from sku_master.primary_intent_id.
ordinal	SMALLINT	NO	1-3. Display order.

Max rows constraint:

- Hero: max 3 secondary intents
- Support: max 2 secondary intents
- Harvest: max 1 secondary intent
- Kill: 0 rows allowed (insert blocked at API level)

sku_content - One row per SKU. All content fields subject to gate validation.

Field	Type	Nullable	Gate	Constraint
sku_id	VARCHAR(50)	NO	-	PK, FK→sku_master.sku_id
title	VARCHAR(250)	NO	G2	Must follow intent→cluster→attributes pattern
description	TEXT	NO	Vector	Cosine similarity ≥ 0.72 vs cluster intent vector
answer_block	VARCHAR(300)	CONDITIONAL	G4	Required for hero/support. 250-300 chars. Must contain primary intent keyword. NULL for harvest/kill.

best_for	JSON ARRAY	CONDITIONAL	G5	Required for hero/support. Min 2 entries.
not_for	JSON ARRAY	CONDITIONAL	G5	Required for hero/support. Min 1 entry.
expert_authority	TEXT	CONDITIONAL	G7	Required for hero/support. Must reference standard/cert. NULL for harvest/kill.
wikidata_uri	VARCHAR(100)	YES	-	Hero SKUs: recommended. Format: https://www.wikidata.org/entity/Q{ID}
material_id	VARCHAR(20)	YES	-	FK→material_wikidata.material_id
vector_similarity	DECIMAL(6,4)	YES	-	Last computed cosine similarity. Updated on every save attempt.
updated_at	TIMESTAMP	NO	-	Auto-updated on content change

sku_gate_status - One row per gate per SKU. Recalculated on every save/publish attempt.

Field	Type	Nullable	Notes
sku_id	VARCHAR(50)	NO	PK(composite), FK→sku_master
gate_code	ENUM	NO	PK(composite). Values: G1,G2,G3,G4,G5,G6,G6_1,G7,VECTOR
status	ENUM	NO	Values: pass, fail, not_applicable, **pending** (v2.3.2)
error_code	VARCHAR(40)	YES	e.g. CIE_G4_CHAR_LIMIT. NULL if pass.
error_message	VARCHAR(500)	YES	User-facing message. NULL if pass.
checked_at	TIMESTAMP	NO	When this gate was last evaluated

audit_log (IMMUTABLE) - Append-only. No UPDATE or DELETE permitted.

Field	Type	Notes
log_id	UUID	PK
entity_type	VARCHAR(30)	sku, cluster, tier, content, gate, audit
entity_id	VARCHAR(50)	The ID of what changed
action	ENUM	create, update, delete, publish, validate, tier_change, gate_pass, gate_fail, audit_run, brief_generated, escalation, login, permission_change
field_name	VARCHAR(50)	Which field changed (NULL for non-field actions)
old_value	TEXT	-
new_value	TEXT	-
actor_id	VARCHAR(100)	User ID or 'SYSTEM'
actor_role	VARCHAR(30)	content_editor, seo_governor, admin, system, etc.
ip_address	VARCHAR(45)	-
user_agent	VARCHAR(300)	-
timestamp	TIMESTAMP	Immutable

Database-level enforcement: `REVOKE UPDATE, DELETE ON audit_log FROM ALL`

ai_audit_runs - One row per weekly audit execution

Field	Type	Notes
run_id	UUID	PK
category	ENUM	cables, lampshades, bulbs, pendants, floor_lamps
run_date	DATE	-
status	ENUM	running, completed, failed
total_questions	SMALLINT	-
aggregate_citation_rate	DECIMAL(5,4)	e.g. 0.7500 = 75%
pass_fail	ENUM	pass, fail, pending
engines_available	SMALLINT	**v2.3.2: number of engines that responded**

quorum_met	BOOLEAN	**v2.3.2: 3/4 minimum for decay advancement**
created_at	TIMESTAMP	-

ai_audit_results - One row per question per engine per run

Field	Type	Notes
result_id	UUID	PK
run_id	UUID	FK→ai_audit_runs(run_id)
question_id	VARCHAR(20)	FK→ai_golden_queries(question_id)
engine	ENUM	chatgpt, gemini, perplexity, google_sge
score	SMALLINT	0-3 CHECK constraint
response_snippet	TEXT	First 500 chars of AI response
cited_sku_id	VARCHAR(50)	FK→sku_master(sku_id)
created_at	TIMESTAMP	-
UNIQUE(run_id, question_id, engine)	-	-

ai_golden_queries - The locked 20-question sets

Field	Type	Notes
question_id	VARCHAR(20)	PK. e.g. CAB-Q01
category	ENUM	cables, lampshades, bulbs, pendants, floor_lamps
question_text	VARCHAR(500)	-
intent_type	SMALLINT	FK→intent_taxonomy(intent_id)
query_family	ENUM	primary, secondary, other
target_tier	ENUM	hero, support
target_skus	JSON	Array of sku_ids
success_criteria	VARCHAR(300)	-
locked_until	DATE	Cannot change before this date
is_active	BOOLEAN	-

material_wikidata - Reference table. Maintained by SEO Governor.

Field	Type	Example	Notes
material_id	VARCHAR(20)	MAT-BORO-GLASS	PK
material_name	VARCHAR(100)	Borosilicate Glass	-
wikidata_qid	VARCHAR(20)	Q190117	-
wikidata_uri	VARCHAR(100)	https://www.wikidata.org/entity/Q190117	-
ai_signal	VARCHAR(300)	Signals heat resistance	Why this matters for AI
is_active	BOOLEAN	true	-

Seed data includes: Borosilicate Glass, Opal Glass, Cotton Fabric, Brass, Polycarbonate

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Part 6: v2.3.2 Hardening Patches

PATCH 1: Fail-Soft Vector Validation

Problem: If OpenAI embedding API goes down, saves get blocked → staff can't work.

Solution:

- New gate status: `pending` (allows save, blocks publish)
- Retry queue processes pending validations every 5 min with exponential backoff
- Staff can continue working; publish unlocks when vector check completes

Implementation:

```
-- Add to sku_gate_status table
ALTER TABLE sku_gate_status
  MODIFY COLUMN status ENUM('pass', 'fail', 'pending', 'not_applicable');

-- Add retry queue table
CREATE TABLE validation_retry_queue (
  id UUID PRIMARY KEY,
  sku_id VARCHAR(50) NOT NULL,
  gate_code VARCHAR(10) NOT NULL,
  retry_count INT DEFAULT 0,
  next_retry_at TIMESTAMP,
  created_at TIMESTAMP DEFAULT NOW()
);
```

API Response Change:

```
{
  "vector_check": {
    "status": "pending",
    "queued_for_retry": true,
    "message": "Embedding API unavailable. Queued for retry in 5 minutes."
  }
}
```

PATCH 2: AI Audit Degradation Rules

Problem: If Perplexity is down, should we still count zeros and trigger decay?

Solution: Minimum 3/4 engine quorum required for audit to advance decay timer.

Engines Available	Decay Behavior
4/4 engines	Normal operation, decay advances
3/4 engines	Minimum quorum met, decay advances
2/4 engines	Scores recorded, decay **PAUSED**
≤1 engine	Run **FAILED**, decay **FROZEN**

Implementation:

```
ALTER TABLE ai_audit_runs
  ADD COLUMN engines_available SMALLINT,
  ADD COLUMN quorum_met BOOLEAN;
```

PATCH 3: Decomposed AI Readiness Scoring

Problem: Single 0-100 readiness score doesn't show what's missing.

Solution: Break "AI Assistants" channel readiness into 6 weighted components:

Component	Weight	Description
Answer Block	25%	G4-compliant, keyword-rich, 250-300 chars
FAQ Coverage	20%	Mandatory FAQs answered (from templates)
Safety Depth	15%	Expert Authority + certifications present

Cross-SKU Comparison	15%	Comparison anchors vs competitors
Structured Data	15%	JSON-LD valid, Wikidata links for Hero
Citation Score	10%	Latest AI audit score (0-3)

API Response:

```
{
  "channels": {
    "ai_assistants": {
      "total_score": 78,
      "components": {
        "answer_block": 25,
        "faq_coverage": 16,
        "safety_depth": 12,
        "comparison": 10,
        "structured_data": 15,
        "citation_score": 0
      }
    }
  }
}
```

PATCH 4: Mandatory FAQ Templates Per Product Class

Problem: FAQs are optional → AI engines have nothing to cite.

Solution:

- Standard FAQ sets per product class
- Hero/Support must answer all required FAQs
- Auto-generate FAQPage schema for Hero SKUs
- Direct citability multiplier (FAQs = easy AI wins)

Implementation:

```
CREATE TABLE faq_templates (
  id UUID PRIMARY KEY,
  product_class VARCHAR(50) NOT NULL,
  question TEXT NOT NULL,
  is_required BOOLEAN DEFAULT true,
  display_order INT
);

CREATE TABLE sku_faqs (
  id UUID PRIMARY KEY,
  sku_id VARCHAR(50) NOT NULL,
  template_id UUID REFERENCES faq_templates(id),
```

```
  answer TEXT NOT NULL,
  approved BOOLEAN DEFAULT false
);
```

Example Template FAQs for "Pendant Cable Sets":

1. "Can I use LED bulbs with this cable?" (required)
2. "What is the maximum wattage?" (required)
3. "Is this suitable for bathroom use?" (required)
4. "How do I wire this to a ceiling rose?" (optional)

PATCH 5: Cluster Governance Playbook

Problem: Clusters proliferate without oversight.

Solution:

- Formal quarterly review process
- Max 15 clusters per category
- Auto-flag if cluster has <3 SKUs after 90 days (orphan cluster)

Implementation:

```
CREATE TABLE cluster_review_log (
  id UUID PRIMARY KEY,
  cluster_id VARCHAR(50) NOT NULL,
  review_date DATE NOT NULL,
  sku_count INT NOT NULL,
  decision ENUM('keep', 'merge', 'archive') NOT NULL,
  reviewed_by VARCHAR(100) NOT NULL,
  notes TEXT
);
```

Auto-flagging logic:

- Weekly cron checks `SELECT cluster_id, COUNT(*) FROM sku_master WHERE created_at < NOW() - INTERVAL 90 DAY GROUP BY cluster_id HAVING COUNT(*) < 3`
- Flags orphan clusters for quarterly review

PATCH 6: Tier-Mode UX Copy & Banners

Problem: Editors don't understand why fields are hidden.

Solution:

- Contextual banners explaining each tier
- Tooltips on hidden fields
- Kill-tier: Clear messaging

Banner Examples:

Tier	Banner Text
Hero	🏆 **Hero SKU** - Full CIE treatment enabled. All 9 intents available. Unlimited effort budget.
Support	💼 **Support SKU** - Primary + 2 secondary intents max. Basic schema. 2 hrs/quarter budget.
Harvest	🌾 **Harvest SKU** - Maintenance Mode. Specification + 1 intent only. 30 min/quarter budget. Some gates suspended.
Kill	🚫 **Kill SKU** - Flagged for delisting. All content fields disabled. Contact Finance to reactivate.

Tooltip Example (on hidden field):

"This field is disabled for Support-tier SKUs. Only Hero SKUs can add more than 2 secondary intents."

Part 7: Integration Specifications

7.1 ERP Integration

Purpose: ERP system is the single source of truth for commercial data (margin, CPPC, velocity, returns). CIE consumes this data to calculate SKU tiers.

Supported Methods:

Method	Trigger	Format	When to Use
REST API Pull	Cron: daily at 02:00 UTC	JSON GET /api/v1/products?fields=sku,margin,cppc,velocity,returns	Primary method. ERP has API.
Webhook Push	ERP pushes on price/cost change	JSON POST to CIE /api/webhooks/erp-update	Real-time updates between syncs.
CSV Import	Manual upload or SFTP drop	CSV: sku_code, margin_pct, cppc, velocity_90d, return_rate_pct, price, cost	Fallback when no API.
Database View	Direct SQL read from ERP DB	SQL query against read-only replica	Legacy systems with DB access only.

ERP Data Contract:

Field	Type	Required	Validation	If Missing
sku_code	string	YES	Must match CIE SKU exactly	Row skipped, logged as orphan
contribution_margin_pct	decimal	YES	Range: -100 to 100	SKU flagged, tier = null, alert
cppc	decimal	YES	Range: 0.01 to 100.00	Default to 1.00 (neutral), flag
velocity_90d	integer	YES	Range: 0 to 999999	Default to 0, flag as 'no sales data'
return_rate_pct	decimal	YES	Range: 0 to 100	Default to 5% (industry avg), flag
price_gbp	decimal	Optional	Range: 0.01+	Not used in tier calc

cost_gbp	decimal	Optional	Range: 0.01+	Not used in tier calc
last_updated	datetime	Optional	ISO 8601	Use sync timestamp

Tier Calculation (PHP Implementation):

```
// Laravel Service: TierCalculationService.php
public function calculateCompositeScore(array $erpData): float
{
    // Normalise inputs to 0-100 scale
    $marginScore = max(0, min(100, $erpData['contribution_margin_pct']));
    $cppcScore = max(0, min(100, (1 / max(0.01, $erpData['cppc'])) * 10));
    $velocityScore = max(0, min(100, log10(max(1, $erpData['velocity_90d'])) * 25));
    $returnScore = max(0, min(100, (1 - $erpData['return_rate_pct'] / 100) * 100));

    return ($marginScore * 0.40)
        + ($cppcScore * 0.25)
        + ($velocityScore * 0.20)
        + ($returnScore * 0.15);
}

public function assignTier(float $compositeScore, array $allScores): string
{
    $percentile = $this->calculatePercentile($compositeScore, $allScores);

    if ($percentile >= 80) return 'Hero';    // Top 20%
    if ($percentile >= 30) return 'Support'; // Middle 50%
    if ($percentile >= 10) return 'Harvest'; // Next 20%
    return 'Kill';                           // Bottom 10%
}
```

Error Handling:

Error	Handling	Alert
ERP API timeout (>30s)	Retry 3x with exponential backoff (30s, 60s, 120s). If all fail, mark sync as FAILED. Retain previous data.	Email to Admin + Slack #cie-alerts
SKU in ERP but not in CIE	Log as 'orphan_erp_sku'. Do not auto-create in CIE. Include in daily report.	Daily orphan report to PH
SKU in CIE but not in ERP	Mark commercial data as 'stale'. If stale >30 days, auto-flag for review. Do NOT auto-delete.	Weekly stale data report
Invalid data (e.g. margin=999)	Skip row. Log validation error with field + value. Keep previous valid data.	Immediate alert to Admin
Partial sync (50% of SKUs)	Accept partial. Flag missing SKUs. Do NOT recalculate tiers until next full sync.	Warning to Admin: partial sync

7.2 N8N Workflow Definitions

N8N is the orchestration layer between PHP (Laravel) and Python (FastAPI). Each workflow is a discrete, testable unit.

Workflow Registry:

#	Workflow Name	Trigger	Phase	Service Chain
W1	ERP Sync & Tier Calc	Cron (daily 02:00)	Phase 1 (Week 1-2)	ERP API → PHP Tier Calc → DB Update → Notifications
W2	Vision AI Extract	Image uploaded to SKU	Phase 2 (Week 3-4)	PHP (image) → Python /vision/extract → PHP (save attributes)
W3	Semantic Embed & Cluster	Identity fields saved	Phase 2 (Week 3-4)	PHP (text) → Python /nlp/embed → PHP (cluster match) → DB
W4	Content Draft Generation	Brief generated	Phase 3 (Week 5-6)	PHP (canonical data) → Python /content/draft_blocks → PHP (save drafts)
W5	Gate Validation (Server)	Submit for Review click	Phase 1 (Week 1-2)	PHP (run G1-G7) → Python (vector check) → PHP (result + queue)

W6	Channel Deploy	Content approved	Phase 4 (Week 7-8)	PHP → Shopify API → Google MC Feed → Amazon Feed → DB (deployed)
W7	Decay Check	Cron (daily 06:00)	Phase 4 (Week 7-8)	PHP (scan >90d) → Flag decayed → Notifications → Decay queue
W8	AI Audit Scheduler	Cron (weekly Mon 09:00)	Phase 4 (Week 7-8)	PHP (load questions) → AI API calls → PHP (score + store + alert)

W1: ERP Sync Workflow (Detailed Steps):

1. N8N Cron trigger fires at 02:00 UTC daily
2. HTTP Request: `GET {ERP_BASE_URL}/api/v1/products?fields=sku,margin,cppc,velocity,returns`
3. IF response.status != 200: retry 3x (30s, 60s, 120s). If all fail: POST to PHP `/api/admin/sync-failed`. END.
4. Function node: validate each row against data contract. Split into valid[] and invalid[].
5. HTTP Request: POST valid[] to PHP `/api/admin/erp-sync-batch` (chunks of 100)
6. PHP calculates composite scores for all valid SKUs
7. PHP assigns tiers using percentile boundaries
8. PHP compares new tiers to previous tiers. For any change: creates tier_change_log entry
9. PHP triggers notifications: email to PH for tier downgrades, Slack to #cie-alerts for any Kill changes
10. HTTP Request: POST invalid[] to PHP `/api/admin/erp-sync-errors`
11. Final: POST to PHP `/api/admin/sync-complete` with summary

W6: Channel Deploy (Detailed Steps):

1. Trigger: Webhook from PHP when content status changes to 'Approved'
2. Payload: `{ sku_code, tier, approved_content, channel_decisions }`
3. FOR EACH channel where decision = 'COMPETE':
4. IF channel = 'own_website': POST to Shopify Admin API
5. IF channel = 'google_sge': Generate GMC feed entry, write to feed file
6. IF channel = 'amazon': POST to Amazon SP-API
7. IF channel = 'ai_assistants': No direct deploy (depends on website + schema)
8. For each successful deploy: POST to PHP `/api/skus/{sku_code}/channel-deployed`
9. For each failed deploy: POST to PHP `/api/skus/{sku_code}/channel-failed`
10. PHP updates readiness scores per channel. If all active channels deployed: maturity recalculated.

N8N Error Handling Standard:

Pattern	Implementation	Recovery
Timeout	30s default. Retry 3x with backoff.	Log + alert after 3 failures
Auth failure (401/403)	Do NOT retry. Immediate alert to Admin.	Admin rotates credentials
Rate limit (429)	Respect Retry-After header. Queue remaining items. Resume after delay.	Auto-resume
Data validation error	Skip invalid item. Continue processing remaining. Log all skipped items.	Daily error report
Partial batch failure	Process what succeeded. Queue failed items for retry. Report both counts.	Retry queue runs hourly

7.3 Shopify Integration

Purpose: CIE publishes content to Shopify via the Admin API (REST or GraphQL).

Metafield Namespace & Key Mapping:

All CIE data stored in namespace `cie`:

CIE Field	Shopify Metafield Key	Type	Example Value	Tier Required
cluster_id	cie.cluster_id	single_line_text	CLU-CBL-P-E27	All
primary_intent	cie.primary_intent	single_line_text	Compatibility	Hero, Support
secondary_intents	cie.secondary_intents	json	["Installation","Spec"]	Hero, Support
ai_answer_block	cie.ai_answer	multi_line_text	(250-300 char block)	Hero, Support
best_for	cie.best_for	json	["Pendant installs",...]	Hero, Support
not_for	cie.not_for	json	["Bathrooms",...]	Hero, Support
expert_authority	cie.expert_authority	multi_line_text	BS 7671 compliant...	Hero, Support

tier	cie.tier	single_line_text	Hero	All
quotable_facts	cie.quotable_facts	json	["Rated to 3A/60W",...]	Hero
faqs	cie.faqs	json	[{"q":"...","a":"..."}]	Hero, Support
wikidata_entities	cie.wikidata	json	[{"qid":"Q174102"}]	Hero
readiness_scores	cie.readiness	json	{"google":92,"amazon":78}	Hero, Support
json_ld	cie.json_ld	json	(full Product schema)	Hero

Shopify API Call Example:

```
PUT /admin/api/2024-01/products/{product_id}/metafields.json
X-Shopify-Access-Token: {access_token}

{
  "metafield": {
    "namespace": "cie",
    "key": "ai_answer",
    "value": "A 3-core braided pendant cable set with E27 holder...",
    "type": "multi_line_text_field"
  }
}
```

Theme Integration (Liquid):

```
{%- comment -%} CIE JSON-LD Injection - add to product.liquid <head> {%- endcomment -%}
{%- if product.metafields.cie.json_ld -%}
  <script type="application/ld+json">
    {{ product.metafields.cie.json_ld | raw }}
  </script>
{%- endif -%}

{%- comment -%} CIE FAQ Schema {%- endcomment -%}
{%- if product.metafields.cie.faqs -%}
  {%- assign faqs = product.metafields.cie.faqs.value -%}
  <script type="application/ld+json">
    {
      "@context": "https://schema.org",
      "@type": "FAQPage",
      "mainEntity": [
        {%- for faq in faqs -%}
          { "@type": "Question", "name": "{{ faq.q }}",
```

```
          "acceptedAnswer": { "@type": "Answer", "text": "{{ faq.a }}" } }
        {%- unless forloop.last -%},{%- endunless -%}
      {%- endfor -%}
    ]
  }
 </script>
{%- endif -%}
```

7.4 Google Merchant Center Feed

Purpose: CIE generates a supplemental feed that enriches the base product feed with CIE-specific attributes.

Feed Field Mapping:

CIE Field	GMC Attribute	Format	Notes
feed_title	title	Max 150 chars	Intent-first title (NOT Shopify title)
meta_description	description	Max 5000 chars	AI Answer Block + expanded description
product_class	product_type	Breadcrumb format	Home > Lighting > Cables > Pendant Cable Sets
material_primary	material	Free text	From controlled vocabulary
colour	color	Free text	From controlled vocabulary
certifications	certification	Repeated field	One per cert (BS 7671, CE, etc.)
ai_answer_block	custom_label_0	Max 100 chars (truncated)	First 100 chars of AI Answer for Shopping ads
tier	custom_label_1	Hero|Support|Harvest	For campaign segmentation in Google Ads
primary_intent	custom_label_2	Intent type name	For ad group alignment

Feed Generation:

- Command: `php artisan cie:generate-gmc-feed`
- Output: `/storage/feeds/gmc_cie_supplemental.xml`
- Upload: Content API for Shopping (preferred) or SFTP to Google
- Schedule: Daily at 04:00 UTC (after ERP sync completes)
- **Kill SKUs:** Excluded from feed entirely

7.5 Amazon Integration

Purpose: CIE publishes to Amazon via SP-API (Selling Partner API).

Backend Search Terms (250 bytes):

```
// AmazonSearchTermGenerator.php
public function generate(array $canonicalData): string
{
    $terms = [];

    // Priority 1: Intent-derived terms
    $terms[] = strtolower($canonicalData['primary_intent']);
    foreach ($canonicalData['secondary_intents'] as $intent) {
        $terms[] = strtolower($intent);
    }

    // Priority 2: Best-For phrases (customer use cases)
    foreach ($canonicalData['best_for'] as $bf) {
        $terms[] = strtolower($bf);
    }

    // Priority 3: Compatibility terms
    $terms[] = $canonicalData['fitting_type'];
    if ($canonicalData['core_count']) $terms[] = $canonicalData['core_count'] . ' core';

    // Priority 4: Material + Style
    $terms[] = strtolower($canonicalData['material_primary']);
    if ($canonicalData['style']) $terms[] = strtolower($canonicalData['style']);

    // Deduplicate, remove brand name, truncate to 250 bytes
    $terms = array_unique($terms);
    $terms = array_filter($terms, fn($t) => !str_contains(strtolower($t), 'brandname'));
    $result = implode(' ', $terms);

    return mb_substr($result, 0, 250);
}
```

A+ Content Module Mapping:

A+ Module	CIE Source	Content Rule	Tier
Standard Company Logo	Brand assets (static)	Logo image. Set once.	All COMPETE
Standard Comparison Chart	comparison_anchors	Our product vs competitor. Max 5 products.	Hero only

Standard Four Image/Text	best_for + images	4 use cases from best_for with lifestyle images.	Hero only
Standard Single Image	expert_authority	Certification badge + authority statement.	Hero, Support
Standard Text Block	ai_answer_block	AI Answer Block as product story. Problem-solution format.	Hero, Support

Bullet Points (5 bullets, priority order):

1. **Bullet 1:** Primary intent + AI Answer Block (first sentence). Problem-solution lead.
2. **Bullet 2:** Compatibility statement. Fitting type, what it works with, what it doesn't.
3. **Bullet 3:** Best-For use cases (top 2-3 from list).
4. **Bullet 4:** Expert Authority / Safety statement. Certification reference.
5. **Bullet 5:** Specification summary. Key technical specs in one line.

7.6 API Keys & Configuration

All external service credentials stored in environment variables, never in code.

Service	Env Variable	Where Configured	Rotation Cadence
ERP API	ERP_API_URL, ERP_API_KEY	.env + Config screen S8	Quarterly
Shopify Admin API	SHOPIFY_STORE, SHOPIFY_TOKEN	.env	Annual
Google Merchant Center	GMC_MERCHANT_ID, GMC_SERVICE_ACCOUNT	.env + JSON keyfile	Annual
Amazon SP-API	AMAZON_CLIENT_ID, AMAZON_CLIENT_SECRET, AMAZON_REFRESH_TOKEN	.env	Quarterly
OpenAI / Anthropic (AI Services)	AI_PROVIDER, AI_API_KEY, AI_MODEL	.env + Config screen	Monthly
N8N Webhook Secrets	N8N_WEBHOOK_SECRET	.env	Quarterly

Security Rules:

- All API calls use HTTPS
- No plaintext credentials in logs
- API keys never returned in API responses
- Webhook payloads verified with HMAC signatures

Rate Limits:

- Shopify: 2 calls/sec
- GMC Content API: 50 calls/min
- Amazon SP-API: varies by endpoint
- N8N workflows must respect these limits with built-in throttling

---

Part 8: Canonical Schema (Excel Workbook Structure)

8.1 Sheet Guide

The Excel workbook contains **8 sheets** representing the complete data model:

1. CANONICAL SCHEMA

- Master product data + CIE enforcement fields
- Identity: sku_code, cluster_id, product_class
- Physical: core_count, length, fitting_type, colour, material
- Commercial: margin, CPPC, velocity, tier
- CIE: gate_status, decay_status, readiness_scores

2. AI MAPPING

- AI Answer Block (250-300 chars, G4 gate)
- Quotable Facts (for AI citation)
- Comparison Anchors (vs competitors)
- Query family alignment per cluster

3. CHANNEL GOVERNOR

- COMPETE/SKIP decisions per channel
- Readiness scores (0-100) for: own_website, google_sge, amazon, ai_assistants

4. CONTENT OUTPUT

- Generated content per channel:
    - Shopify title/description
    - Google Shopping feed
    - Amazon search terms/bullets
    - PPC ad copy

5. CONTROLLED VOCAB

- Locked enums (9 intents, 4 tiers)
- Gate error codes
- Material vocabulary
- Fitting type list
- Colour palette

6. MATURITY TRACKER

- Per-SKU gate status (G1-G7 + G6.1 + VECTOR)
- Citation decay tracking (consecutive_zero_weeks)
- Effort allocation by tier
- Last updated timestamps

7. SEMANTIC CLUSTERS

- Cluster definitions with intent statements
- Query family mapping (Primary/Secondary/Other)
- Intent vectors (embeddings)

8. AI EVALUATION SET

- 20 locked questions per category
- Weekly scores (0-3) per engine
- Target SKUs per question
- Pass/fail criteria

8.2 Architectural Principle

"Content is a BYPRODUCT of decisions — never the starting point."

Correct sequence:

1. **FIRST:** Resolve identity (what is it physically?)
2. **SECOND:** Calculate commercial value (what's it worth?)
3. **THIRD:** Assign cluster + tier (where does it belong?)
4. **FOURTH:** Determine channel strategy (where should it compete?)
5. **ONLY THEN:** Generate content (what should we say?)

Traditional systems start at step 5. **CIE enforces 1→2→3→4→5 order.**

Part 9: RBAC (Role-Based Access Control)

9.1 Role Definitions

Role	Typical Staff	Purpose
content_editor	Content team (50+)	Creates/edits titles, descriptions, answer blocks, best-for/not-for within assigned SKUs
product_specialist	Product experts (10+)	Adds expert authority blocks, safety certs, compliance data
seo_governor	SEO lead (1-2)	Manages cluster master list, intent taxonomy, approves cluster assignments
channel_manager	Channel leads (4-6)	Manages channel-specific content, feed optimisation, readiness scoring review
ai_ops	AI operations (2-3)	Runs AI audits, manages golden queries, reviews citation decay alerts
portfolio_holder	Category managers (8-12)	Reviews tier assignments, approves SKU status changes, owns category P&L
finance	Finance team (2-3)	Provides ERP data, validates tier calculations, co-approves manual overrides
admin	System admin (1-2)	System configuration, user management, audit log review. Cannot edit SKU content.
system	Automated processes	ERP sync, tier recomputation, decay triggers, readiness scoring. No human actor.

9.2 Permission Matrix

Action	Editor	Prod Spec	SEO Gov	Ch Mgr	AI Ops	PH	Finance	Admin	System
Create/edit content fields	YES	YES*	NO	YES*	NO	NO	NO	NO	NO
Edit expert authority	NO	YES	NO	NO	NO	NO	NO	NO	NO
Assign/change cluster_id	NO	NO	YES	NO	NO	NO	NO	NO	NO
Modify intent taxonomy	NO	NO	REVIEW*	NO	NO	NO	NO	NO	NO
Change SKU tier (manual)	NO	NO	NO	NO	NO	DUAL**	DUAL**	NO	AUTO

Publish SKU	YES	NO	YES	YES	NO	YES	NO	NO	NO
Run AI audit	NO	NO	NO	NO	YES	NO	NO	YES	YES
Manage golden queries	NO	NO	YES	NO	YES	NO	NO	NO	NO
View audit logs	OWN	OWN	ALL	OWN	ALL	CAT	ALL	ALL	N/A
Manage users/roles	NO	NO	NO	NO	NO	NO	NO	YES	NO
ERP sync trigger	NO	NO	NO	NO	NO	NO	YES	YES	YES

Notes:

- * Product Specialist and Channel Manager can edit content ONLY within their assigned categories
- REVIEW* SEO Governor can propose taxonomy changes; requires quarterly review with Commercial Director to activate
- DUAL** Manual tier override requires BOTH Portfolio Holder AND Finance sign-off

9.3 Critical RBAC Rules

1. No 'superuser' role exists. Admin can manage users but CANNOT edit SKU content or bypass gates.
2. Content editors CANNOT change cluster_id, tier, or intent taxonomy.
3. Kill-tier SKUs: ALL edit permissions are revoked system-wide. Only tier change (DUAL approval) can unlock.
4. Every permission check is logged in audit_log with actor_id, role, action, and timestamp.
5. Failed permission attempts (403) are logged and monitored. >5 in 24hrs triggers admin alert.

Part 10: Implementation Timeline (21-Day Sprint)

Phase 1: Foundation (Days 1-7)

Days	Deliverable	Owner	Kill Rule
1-3	G1-G7 + G6.1 publish gates coded and deployed. 400 errors on violation.	Dev Lead	<95% enforcement by day 5 → stop all other work
1-3	All active SKUs tagged Hero/Support/Harvest/Kill from ERP data.	Finance + PH	100% tagged by day 3
4-7	9-intent taxonomy loaded as enum. Cluster master list locked. CMS tier-lock UI deployed.	Dev + SEO Governor	No custom intents

Phase 2: Content Engine (Days 8-14)

Days	Deliverable	Owner	Kill Rule
8-10	Content team trained. 5 Hero SKUs completed as reference through full pipeline.	Content Lead	5 examples must pass all gates
8-10	JSON-LD + Wikidata templates for top 3 materials. Schema validates in Google Rich Results.	Dev + SEO	Rich Results Test passes
11-14	Vector validation service deployed. Cosine similarity checks active on save.	Python Dev	Threshold correctly blocks test cases

Phase 3: AI Audit + Feedback Loop (Days 15-21)

Days	Deliverable	Owner	Kill Rule
15-17	20-question golden query sets created for 4 categories. Baselined.	AI Ops	Questions locked
15-17	N8N citation decay workflow deployed and tested.	AI Ops + Dev	Auto-brief generates correctly
18-21	First full weekly AI audit run. Dashboard live. Results to boardroom.	AI Ops + Admin	Baseline established
18-21	Per-channel readiness scores live. Effort allocation tracking active.	Channel Managers	Dashboard visible to all

---

Part 11: Verification Matrix + KPIs

These numbers go to the boardroom. Reviewed weekly. No narrative.

KPI	Target	Proof	Cadence	Fail Status
Publish gate bypass rate	0%	System logs	Daily	Immediate fix. NEW: incl G6.1
Content hrs on Hero SKUs	>60%	Task logs	Weekly	Rebalance
AI citation rate (Hero)	>70%	AI query audit	Weekly	Decay loop. NEW: auto-heal
Avg CTR Hero SKUs	+10-20 %	GSC / Channel	Monthly	Title review
Staff rework rate	-25%	Task logs	Monthly	Training
SKU tier coverage	100%	ERP sync	Monthly	Escalate
Hero readiness (primary ch.)	>85/100	CIE dashboard	Weekly	Sprint
Kill SKU effort	0 hours	Task logs	Weekly	Violation. NEW: UI block
Decay trigger accuracy	>90%	Brief vs outcome	Monthly	Tune model. NEW

Part 12: Key Non-Negotiables

Absolute Rules (Cannot Be Changed)

1. **Title = Intent → Cluster → Attributes.** NEVER in reverse.
2. **Kill-tier SKUs: ZERO effort.** Any edit = policy violation.
3. **>60% content hours on Hero SKUs.** Measured weekly.
4. **Answer Block: 250-300 chars, must contain primary intent keyword.** No marketing fluff.
5. **No publish without ALL gates passing.** No override. No exceptions.
6. **The 9-intent taxonomy is SEEDED, not user-created.** It must be locked.
7. **Tier assignments come from Finance/ERP sync, not manual entry.**
8. **Every audit_result row must reference a specific question_id + engine + week.**
9. **The clusters table must store the intent vector (embedding) as a JSON/BLOB field.**
10. **audit_log table is IMMUTABLE.** No UPDATE or DELETE permitted at database level.

Conclusion

The **Catalog Intelligence Engine v2.3.2** is a comprehensive, production-hardened system that:

1. **Enforces quality** through 8 hard gates with no override capability
2. **Allocates resources** automatically based on SKU commercial value (tier system)
3. **Measures AI visibility** weekly across 4 engines with 20 locked questions per category
4. **Self-heals** by auto-generating content refresh briefs when Hero SKUs lose citations
5. **Integrates seamlessly** with ERP, Shopify, Google Merchant Center, and Amazon
6. **Orchestrates complexity** through 8 N8N workflows
7. **Enforces governance** through 9-role RBAC with dual sign-off for sensitive changes
8. **Maintains immutability** through append-only audit logging
9. **Degrades gracefully** with fail-soft rules when external services are unavailable
10. **Provides transparency** through decomposed readiness scoring and tier-specific UX

The system is fully specified with database schemas, API contracts, integration mappings, workflow definitions, validation logic, error handling, security rules, and implementation timelines.

The fundamental insight: At scale, good intentions don't work. Systems do. CIE replaces hope with enforcement, guesswork with measurement, and reactive fixes with self-healing loops.