

# F&B AI Platform — System Design Deep-Dive

**Purpose:** Comprehensive journey maps, technical logic specifications, channel strategy assessment, and innovation benchmarking to inform architecture and stakeholder decisions.

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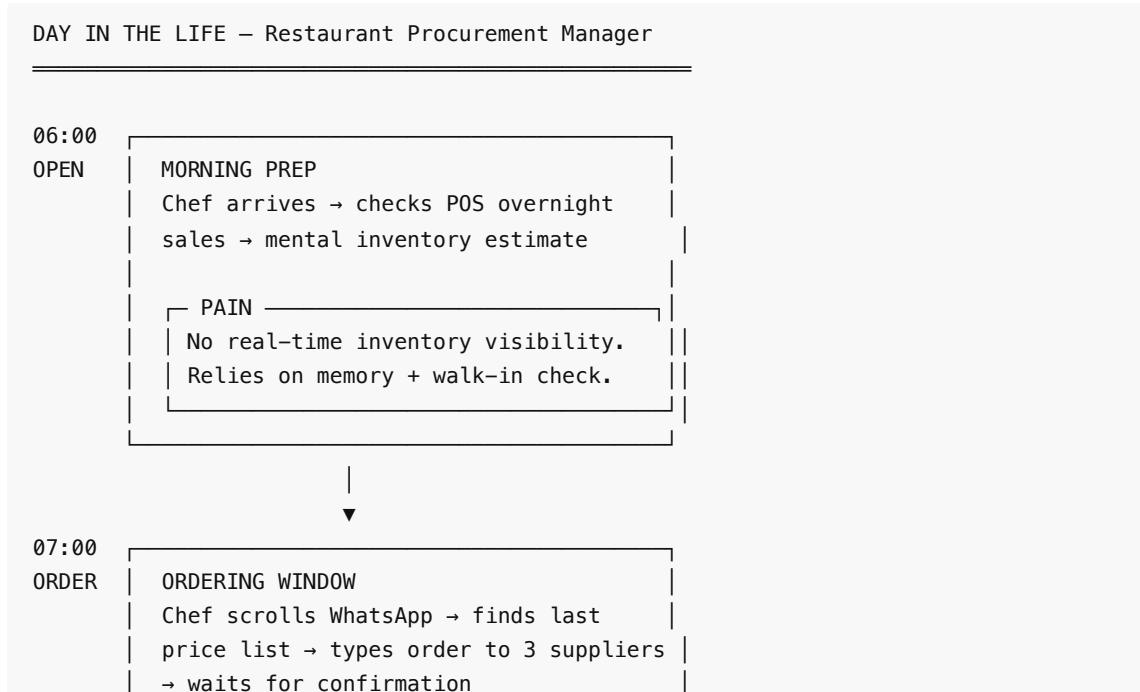
## 1. Journey Mapping & Simulation

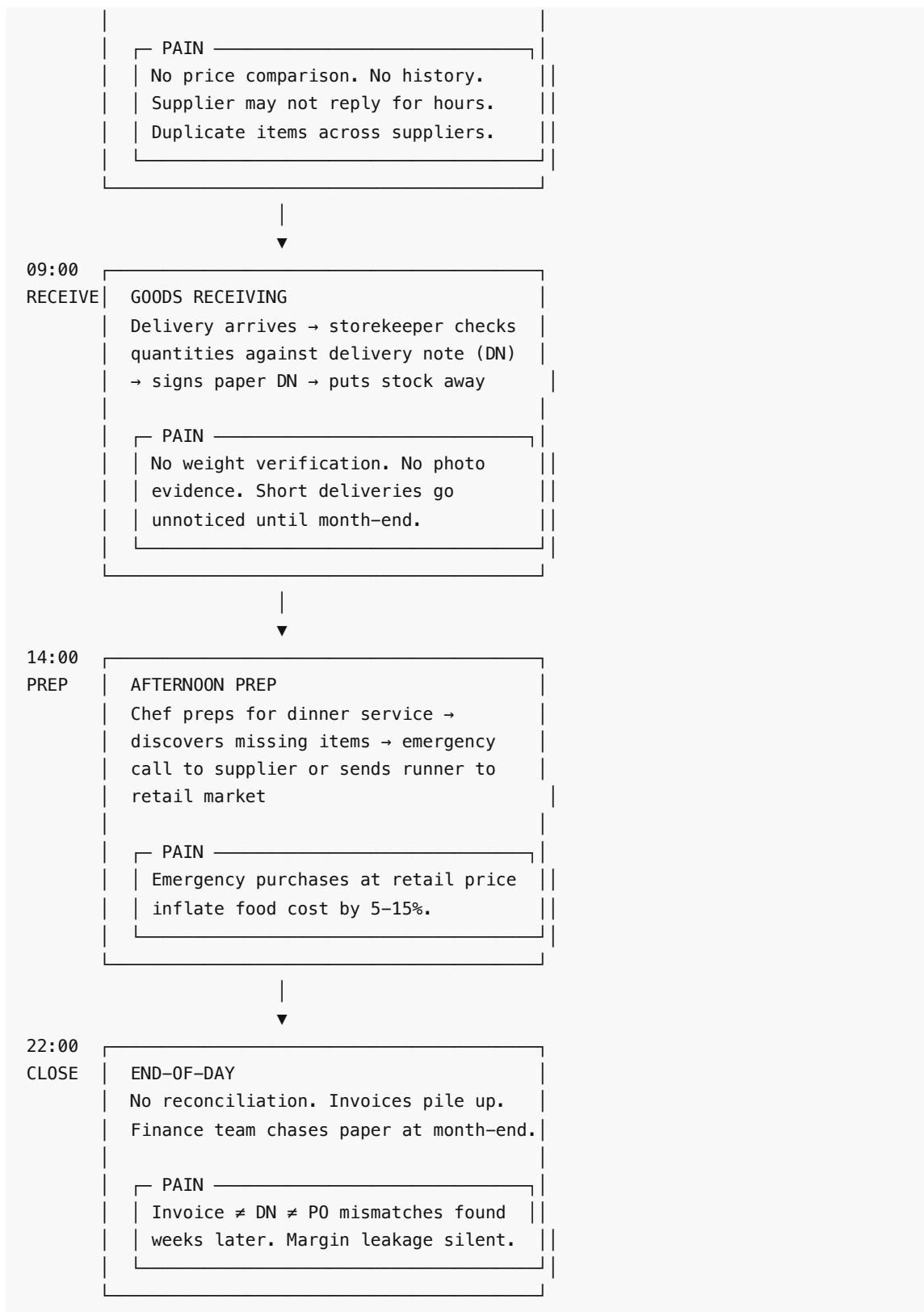
### 1.1 Restaurant Procurement Manager — End-to-End Journey

#### Persona Snapshot

Attribute	Detail
Role	Ops Manager / Head Chef (often the same person in SME restaurants)
Daily Pain	Juggling 5-8 WhatsApp supplier chats, manual stock counts, price guessing
Success Metric	Food cost $\leq$ 30%, zero stockouts during service
Tech Comfort	WhatsApp power-user, basic Excel, POS-literate

#### Journey Map

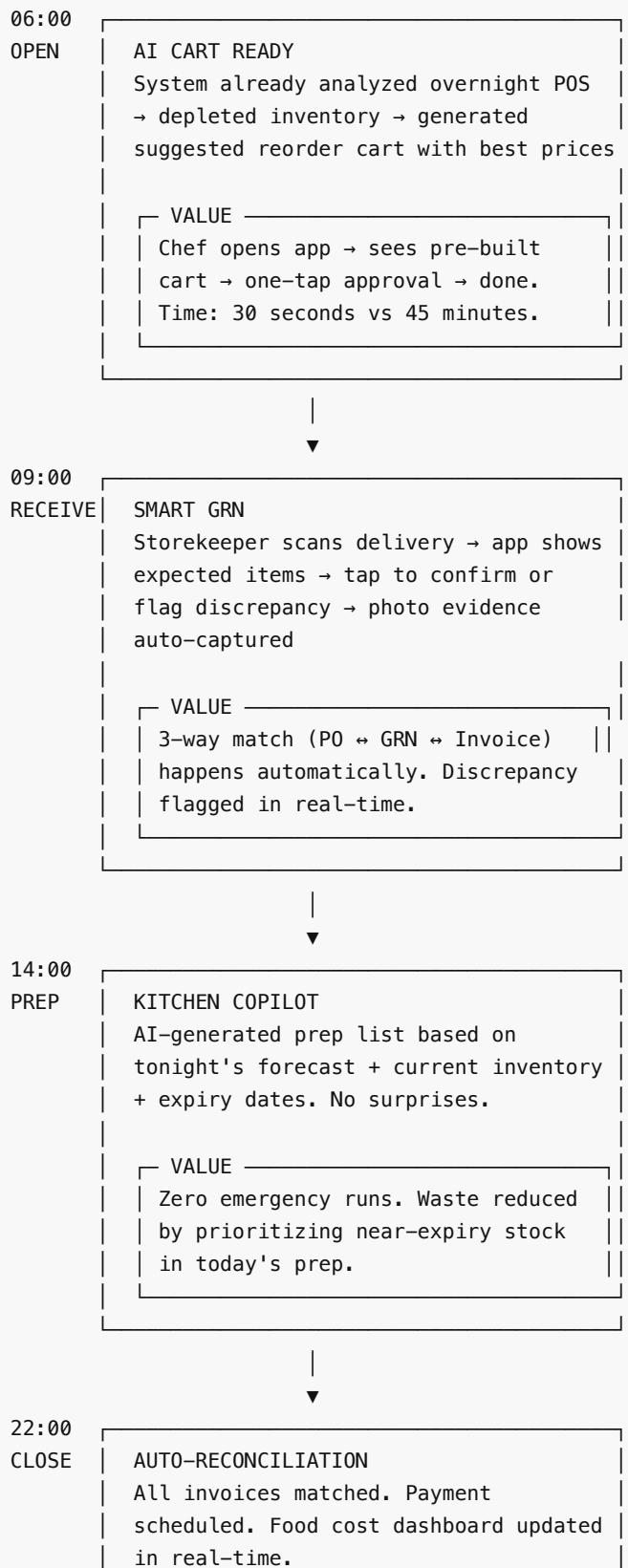


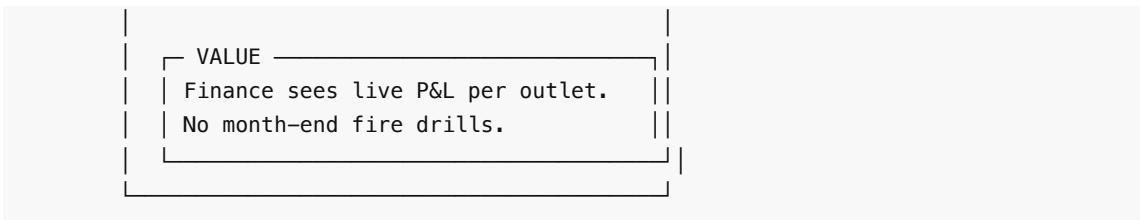


## Platform-Transformed Journey

## DAY IN THE LIFE – WITH PLATFORM

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## Key Touchpoint Metrics

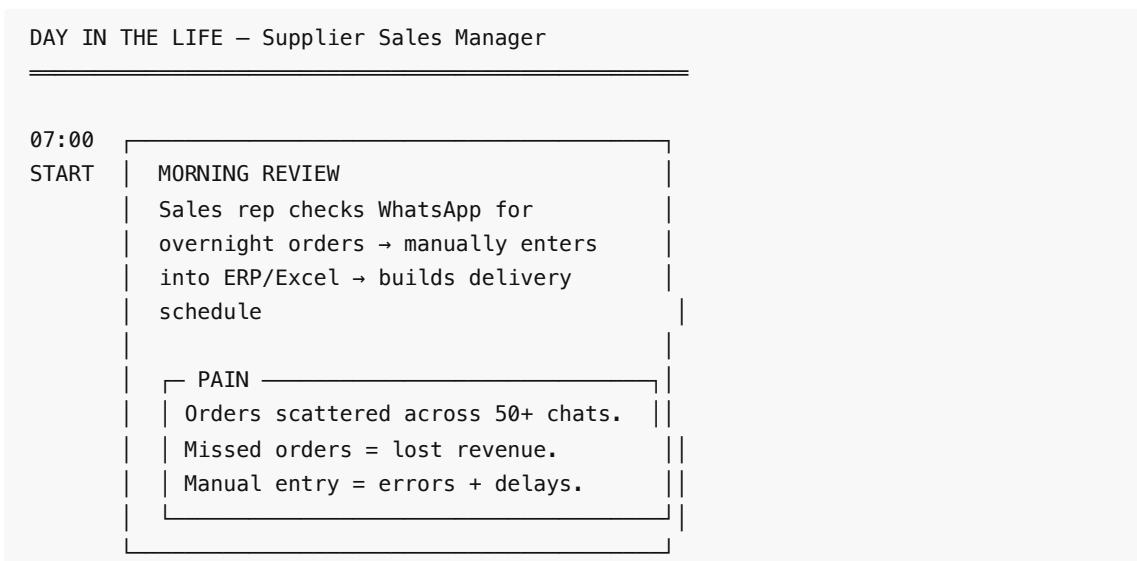
Touchpoint	Before Platform	With Platform	Improvement
Order Creation	45 min/day	30 sec (AI cart approval)	<b>98% time saved</b>
Price Comparison	Not done	Automatic (normalized SKUs)	$\infty \rightarrow \text{real-time}$
GRN Accuracy	~70% (manual)	~99% (digital + photo)	<b>+29pp</b>
Invoice Reconciliation	5 days/month	Real-time auto-match	<b>5 days → 0</b>
Emergency Purchases	3-4x/week	Near-zero (predictive)	<b>~95% reduction</b>

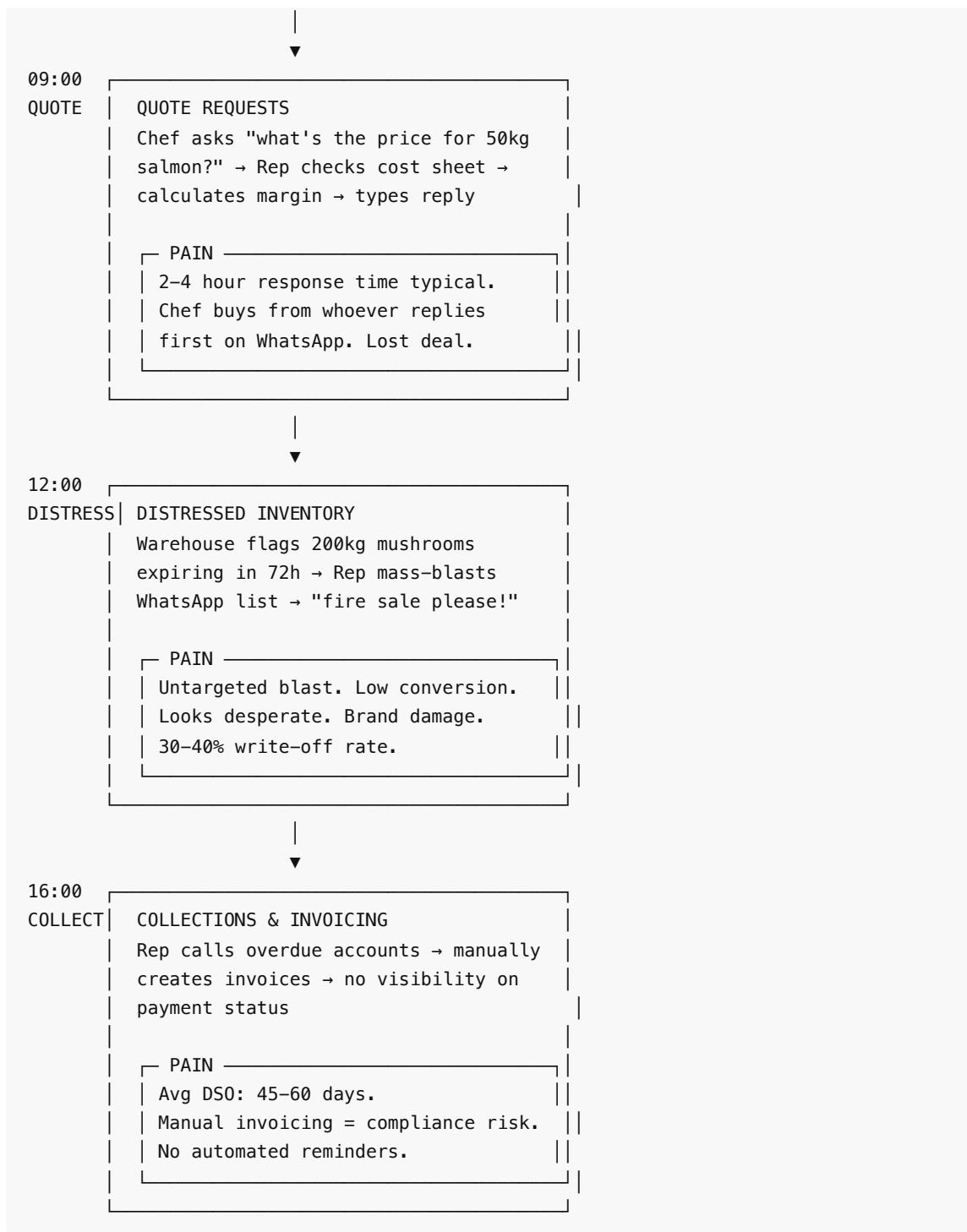
## 1.2 Supplier Sales Manager — End-to-End Journey

### Persona Snapshot

Attribute	Detail
<b>Role</b>	Sales Rep / Owner-Operator managing 50-200 restaurant accounts
<b>Daily Pain</b>	Chasing orders via WhatsApp, manual quote creation, distressed stock write-offs
<b>Success Metric</b>	Revenue growth, customer retention, margin preservation
<b>Tech Comfort</b>	WhatsApp-native, reluctant ERP user

### Journey Map





## Platform-Transformed Journey

### DAY IN THE LIFE – SUPPLIER WITH PLATFORM

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**07:00**

**START**

ORDERS PRE-LOADED  
AI Cart orders from restaurants auto-

converted to POs in supplier dashboard  
→ delivery schedule auto-generated

— VALUE —

Zero manual entry. Zero missed orders. 150 restaurants serviced by AI vs 50 by human rep.

09:00

QUOTE

INSTANT-CLOSE AGENT  
Chef requests quote → AI Agent responds in <3 seconds with binding offer within margin guardrails

— VALUE —

Win rate: 35% (vs 15% human).  
Basket-aware negotiation upsells.  
Rep freed for relationship work.

12:00

DISTRESS

TARGETED FLASH DEALS  
AI identifies 20 chefs with relevant menu items → sends structured interactive "Flash Deal" via WhatsApp  
→ one-tap acceptance

— VALUE —

Conversion: 25–40% (vs 5% blast).  
Write-off reduced from 30% to 5%.  
Brand protected – looks premium.

16:00

COLLECT

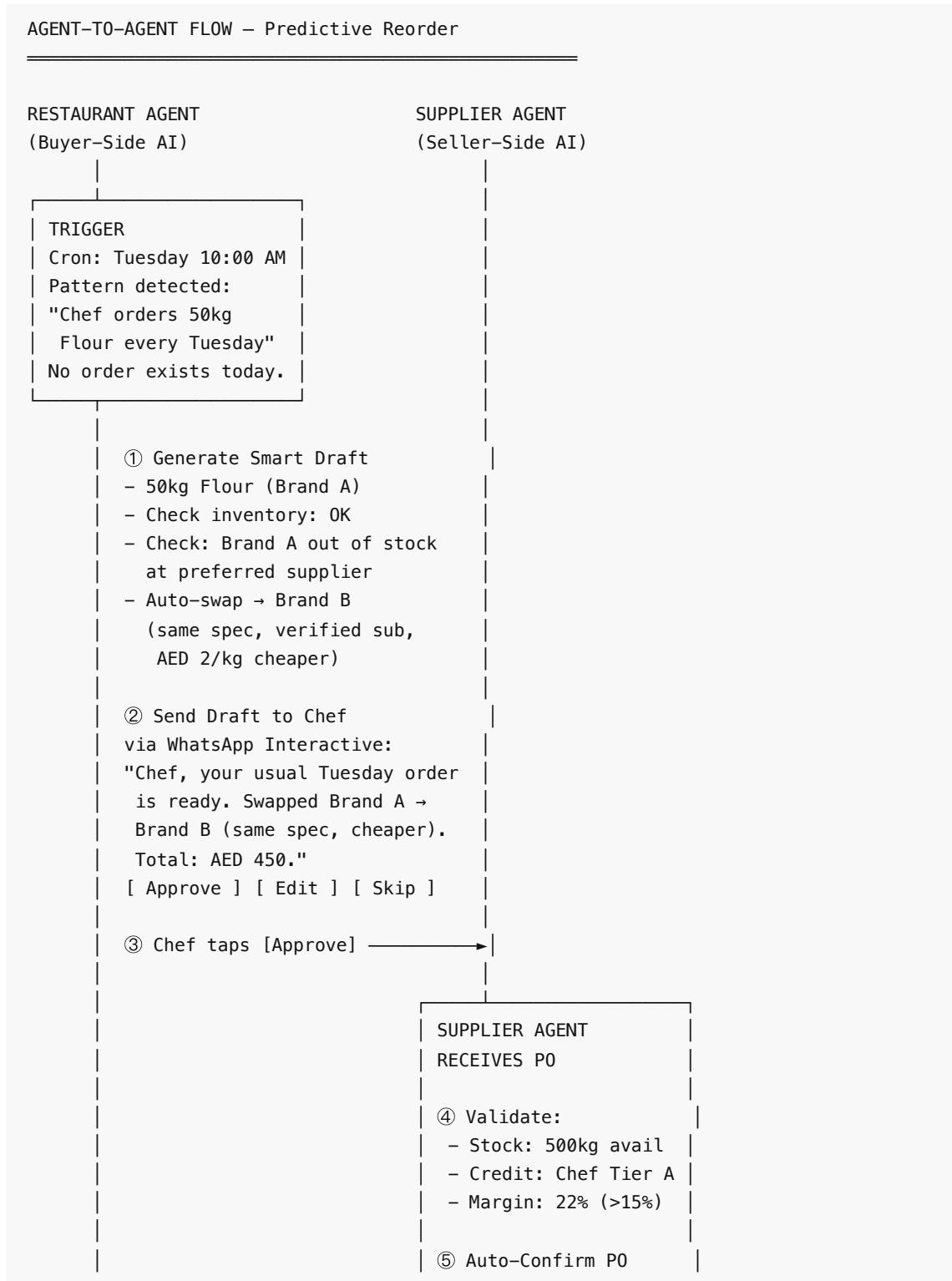
AUTO-INVOICING & SMART COLLECTIONS  
E-invoice generated at deal close → FTA-compliant XML+PDF → automated payment reminders with escalation

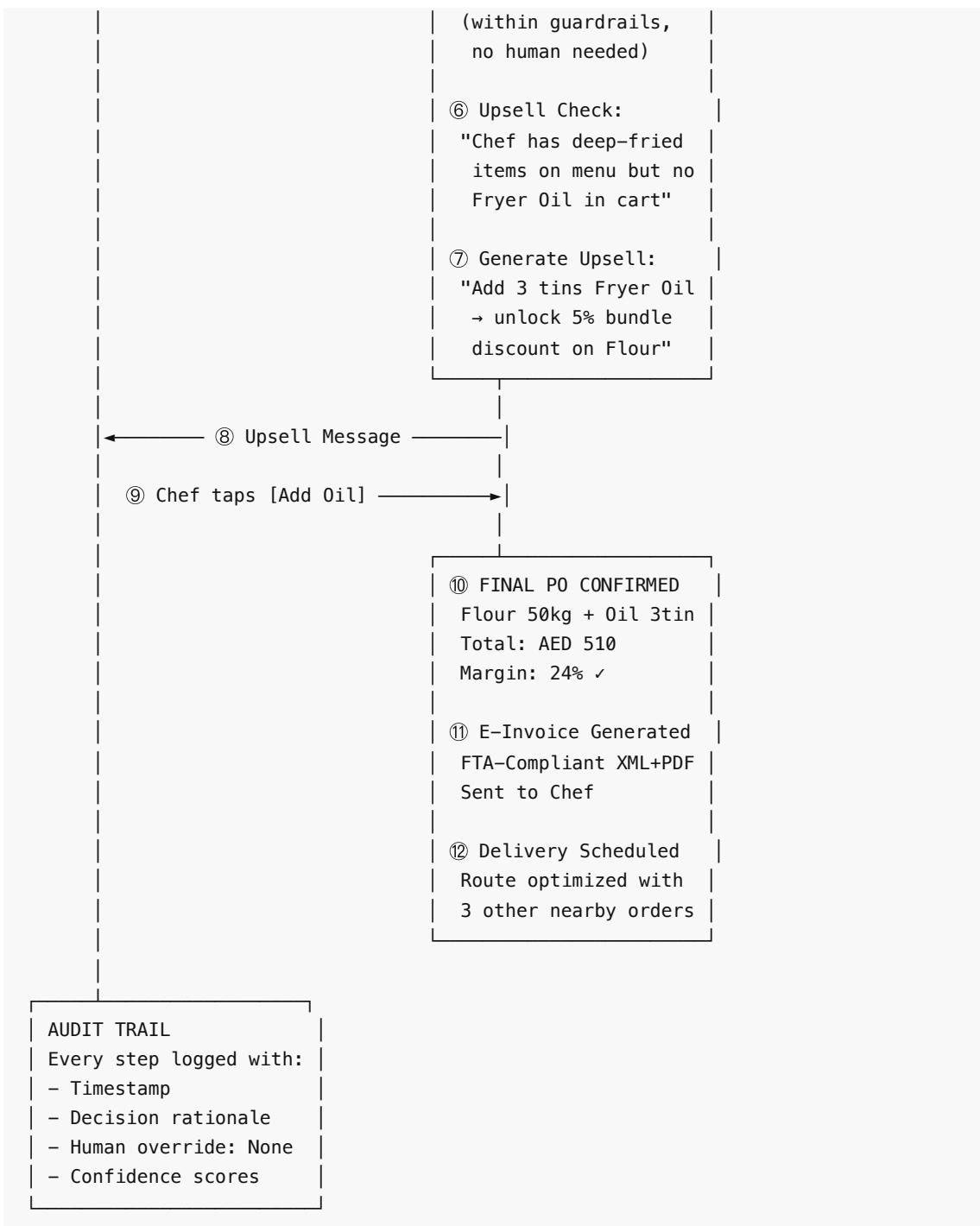
— VALUE —

DSO: 45 days → 20 days.  
100% e-invoicing compliance.  
Collections on autopilot.

## 1.3 Agent-to-Agent Simulation: The "Tuesday Flour" Scenario

A complete walkthrough of how the Restaurant AI and Supplier AI interact autonomously.





### Simulation Outcome Metrics

Metric	Value
Total elapsed time (trigger → confirmed PO)	~45 seconds
Human interventions required	2 taps (approve + add oil)
Upsell achieved	<input checked="" type="checkbox"/> +AED 60 (Fryer Oil)
Supplier margin	24% (above 15% floor)

E-Invoice generated

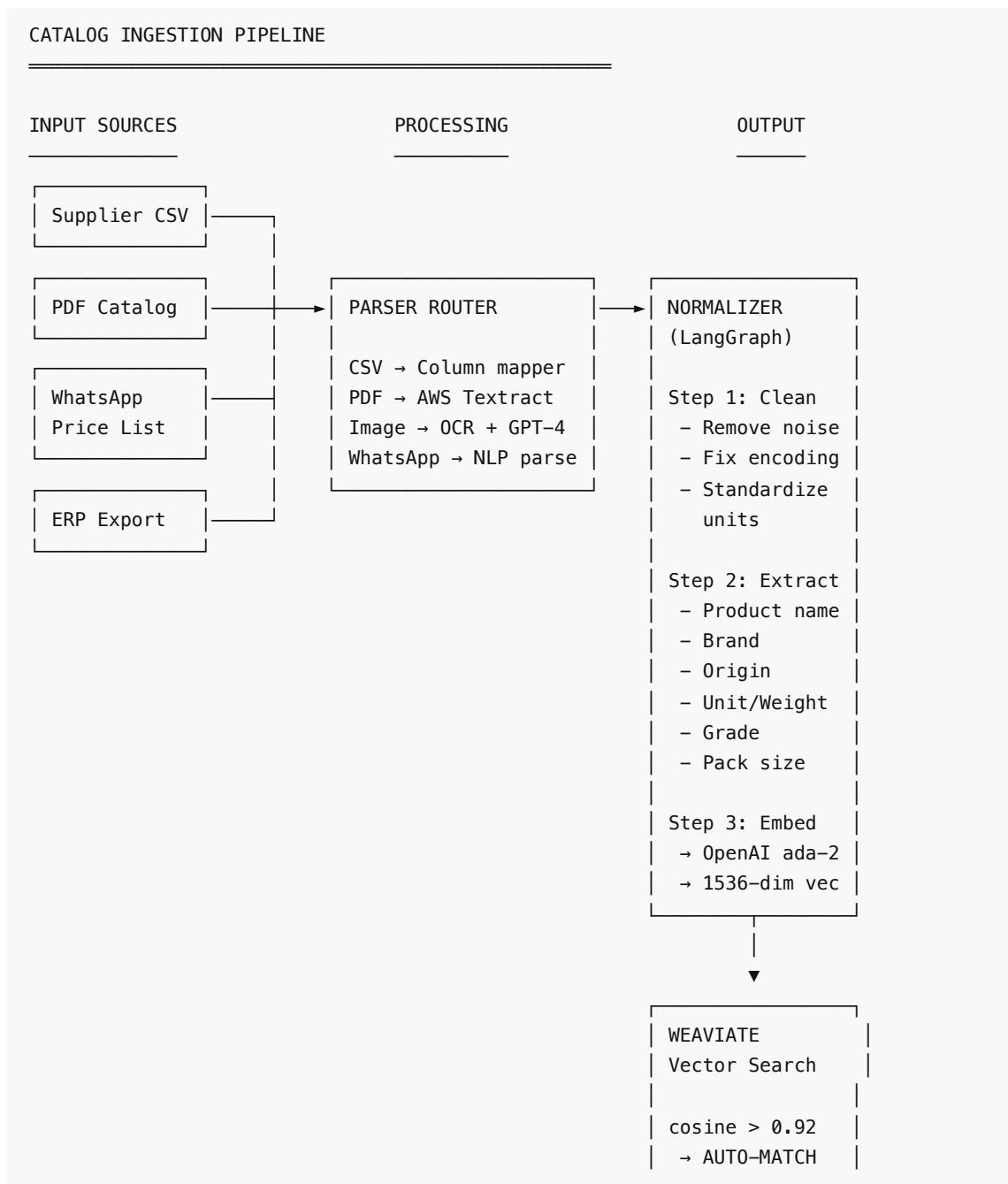
Instant, FTA-compliant

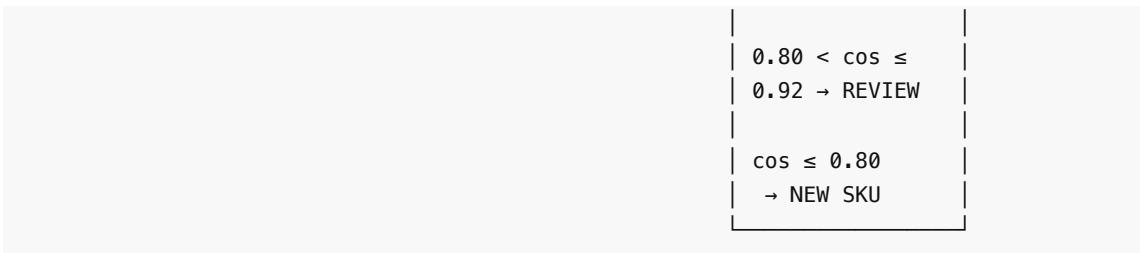
## 2. Technical Logic & Matching

### 2.1 AI Ingredient Extraction Pipeline

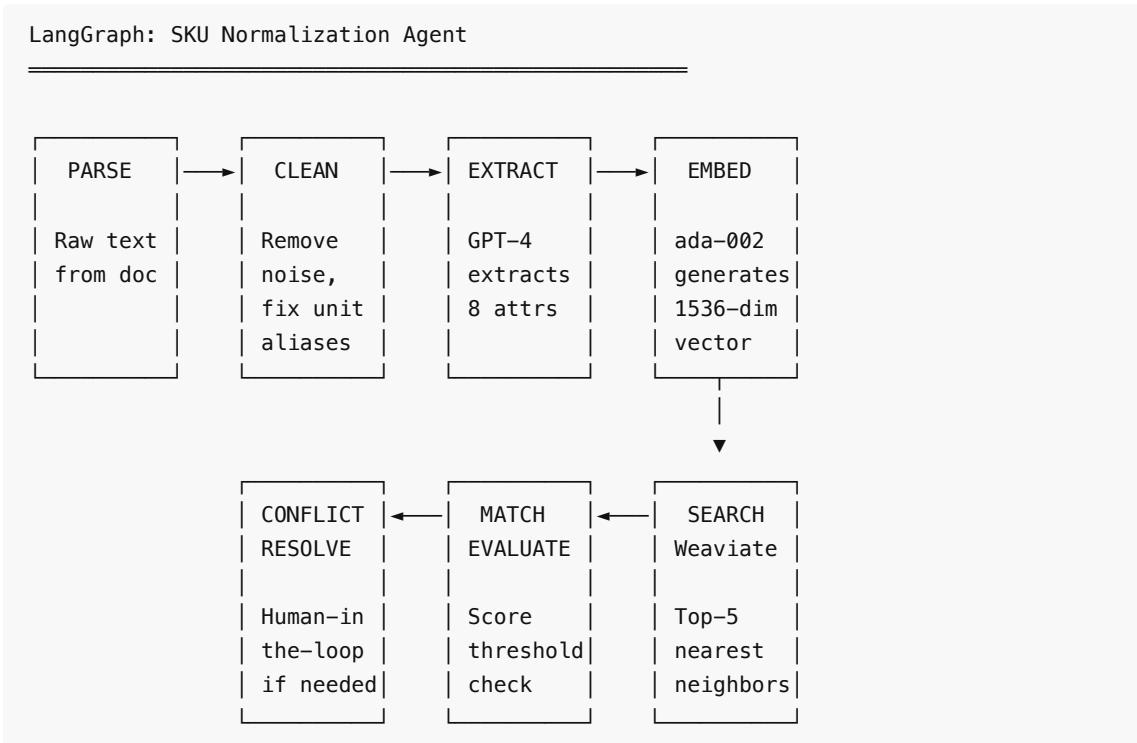
The platform must convert unstructured supplier catalogs (PDFs, CSVs, WhatsApp photos) into a universal product language using vector embeddings.

#### Extraction Architecture





### Attribute Extraction Logic (LangGraph State Machine)



### Extracted Attributes Schema

Attribute	Example	Normalization Rule
canonical_name	"Australian Beef Tenderloin"	Standardized via embedding cluster center
brand	"Angus Pure"	Exact match or "Generic"
origin_country	"AU"	ISO 3166-1 alpha-2
unit_of_measure	"kg"	Converted to SI (lb→kg, oz→g)
pack_size	5.0	Numeric, base unit
grade	"Premium"	Enum: Premium/Standard/Economy
category_l1	"Meat & Poultry"	3-level taxonomy
category_l2	"Beef"	""
category_l3	"Tenderloin"	""

is_halal	true	Boolean (critical for UAE)
shelf_life_days	7	Integer

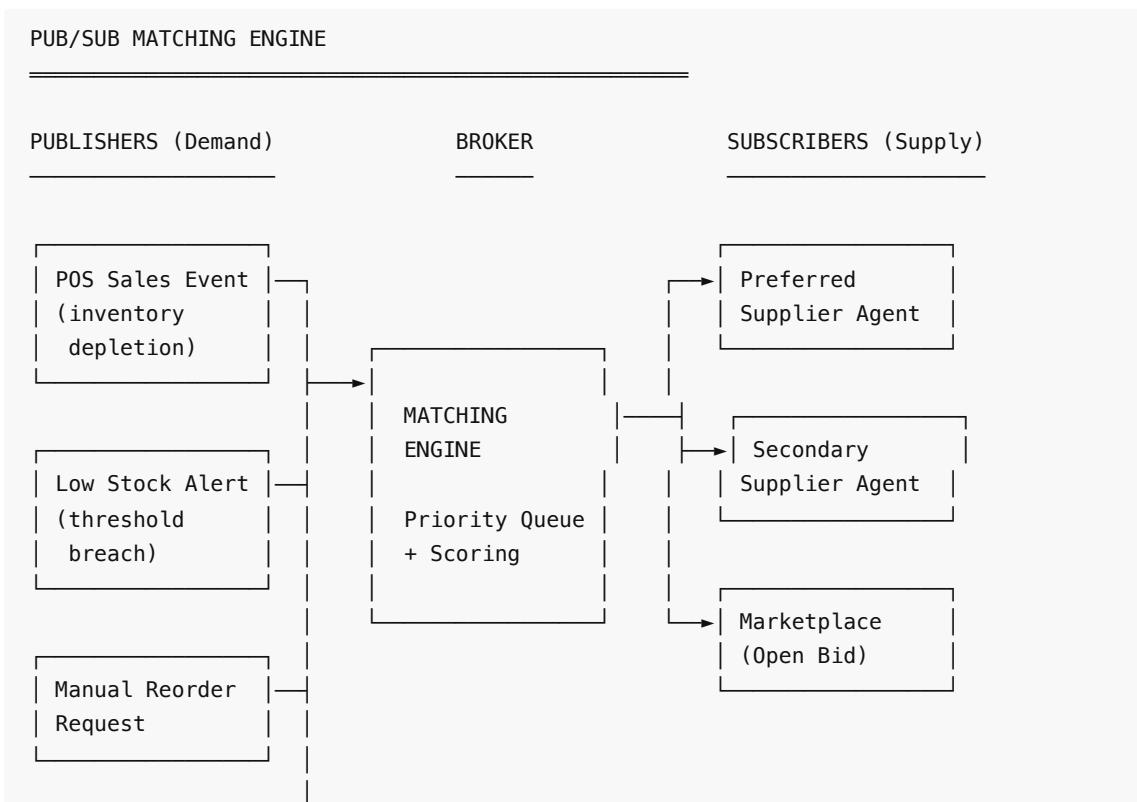
### Edge Cases & Guardrails

Scenario	Handling
Supplier uses Arabic product names	GPT-4 multilingual extraction → normalize to English canonical + store Arabic alias
Same product, different pack sizes	Normalize to per-unit price (AED/kg) for comparison; preserve pack_size metadata
"Chicken" vs "Dajaj" vs "دجاج"	All map to same embedding cluster; alias table maintained
Supplier updates price but not catalog	Price change event triggers re-index of affected SKUs only
Ambiguous grade ("good quality")	Flag for human review; default to "Standard"

## 2.2 Pub/Sub Matching Engine

The matching engine connects restaurant demand signals to supplier inventory using an event-driven, priority-tiered architecture.

### Event-Driven Architecture



Predictive  
Reorder (AI)

## Tiered Priority Logic

The matching engine uses a **4-tier priority system** to route demand to the optimal supplier:

### PRIORITY TIER RESOLUTION

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#### TIER 1: CONTRACTED / PREFERRED

Condition: Active contract exists for this SKU category  
Action: Route directly to contracted supplier's agent  
SLA: Response within 30 seconds  
Timeout: If no response in 5 min → escalate to Tier 2

#### TIER 2: HISTORICAL / SCORED

Condition: No contract, but purchase history exists  
Action: Rank suppliers by Composite Score  
Score =  $0.35 \times \text{Price} + 0.25 \times \text{Quality} + 0.20 \times \text{SLA}$   
 $+ 0.10 \times \text{Fill Rate} + 0.10 \times \text{Payment Terms}$   
Route: Top-3 suppliers get simultaneous request  
Timeout: First valid response wins (within 15 min)

#### TIER 3: MARKETPLACE / DISCOVERY

Condition: No history for this SKU at this restaurant  
Action: Broadcast to marketplace suppliers with  
matching SKU in catalog  
Filter: Only suppliers with delivery radius overlap  
Ranking: Platform reputation score + price  
Timeout: 30 min open window, then best-offer selected

#### TIER 4: FLASH DEAL / DISTRESSED

Condition: Supplier-initiated (near-expiry stock)  
Action: Match supplier's SKU against restaurant menus  
using Weaviate vector similarity  
Target: Only restaurants with matching menu items  
Channel: WhatsApp Interactive Message (one-tap accept)

Pricing: Deep discount (supplier sets floor)

## Composite Supplier Score — Calculation Detail

### SUPPLIER SCORING MODEL

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```
Score(s, r, sku) =  
  w1 × PriceScore(s, sku)      # 0.35 weight  
+ w2 × QualityScore(s, r)      # 0.25 weight  
+ w3 × SLAScore(s, r)         # 0.20 weight  
+ w4 × FillRateScore(s, r, sku) # 0.10 weight  
+ w5 × PaymentScore(s, r)      # 0.10 weight
```

WHERE:

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```
PriceScore(s, sku) =  
  1 - (supplier_price - market_min) / (market_max - market_min)  
  // Normalized 0-1. Lower price = higher score.
```

```
QualityScore(s, r) =  
  (1 - rejection_rate) × 0.7 + avg_grn_quality_rating × 0.3  
  // Based on GRN history. Rejections penalized heavily.
```

```
SLAScore(s, r) =  
  on_time_deliveries / total_deliveries  
  // Simple ratio from last 90 days.
```

```
FillRateScore(s, r, sku) =  
  items_fulfilled_correctly / items_ordered  
  // Per-SKU, last 90 days. Short deliveries penalized.
```

```
PaymentScore(s, r) =  
  normalize(credit_terms_days, 0, 60)  
  // Longer credit terms = higher score for buyer.
```

DECAY FACTOR:

```
All scores weighted by recency:  
weight(order) = e^(-λ × days_since_order)  
// λ = 0.03 → 30-day half-life
```

## Matching Engine — Redis Implementation

### REDIS ARCHITECTURE

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Redis Streams (Event Bus)

```
stream:demand:{restaurant_id}
  → Low stock events, reorder triggers

stream:supply:{supplier_id}
  → Price updates, stock changes, deals

stream:matches:{request_id}
  → Match results, confirmations
```

```
Redis Sorted Sets (Priority Queues)

queue:tier1:{sku_normalized_id}
  Score: contract_priority
  Members: supplier_ids

queue:tier2:{sku_normalized_id}
  Score: composite_supplier_score
  Members: supplier_ids

queue:flash:{sku_normalized_id}
  Score: urgency (hours_to_expiry)
  Members: flash_deal_ids
```

```
Redis Hash (State Cache)

supplier:{id}:inventory
  → Real-time stock levels per SKU

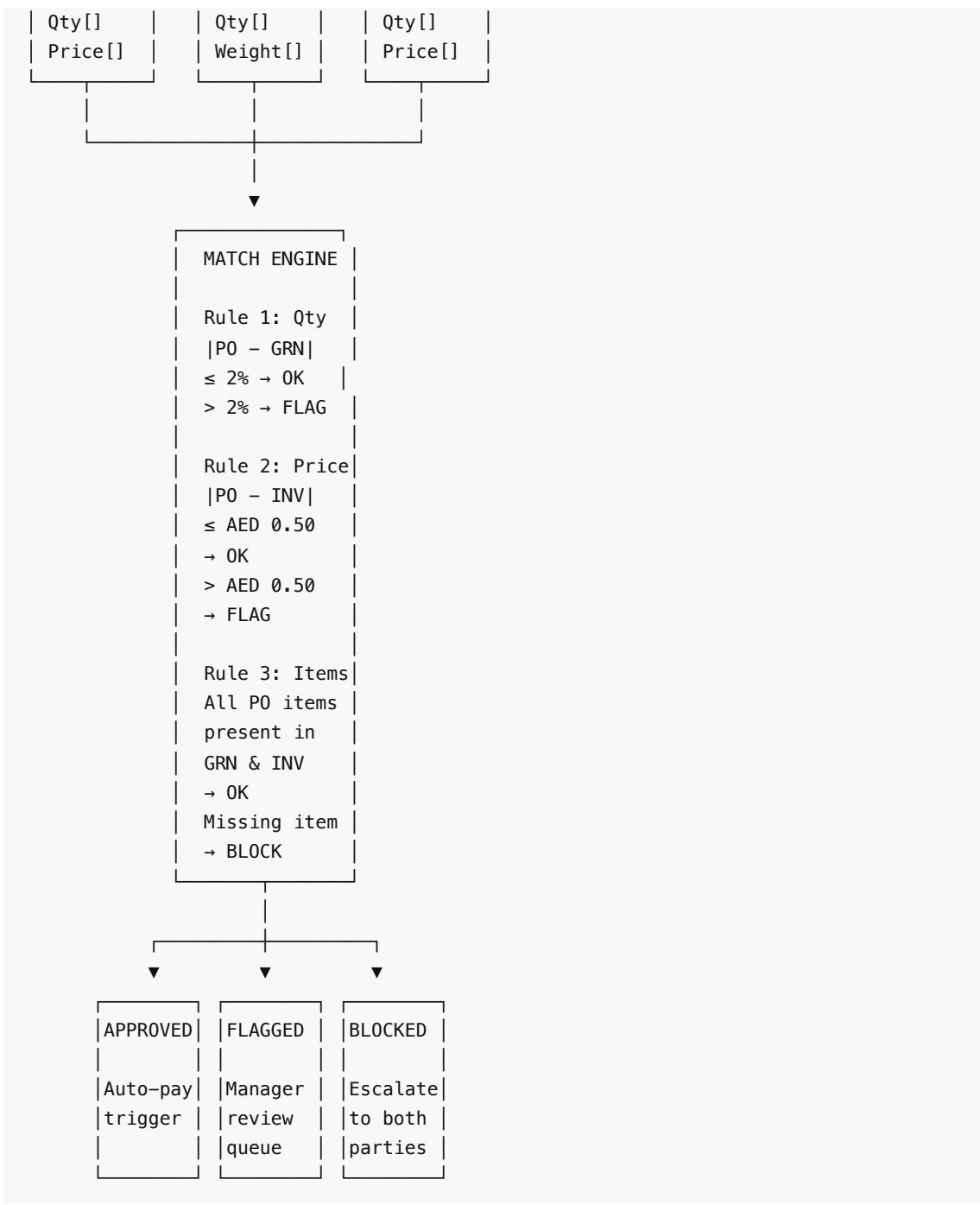
restaurant:{id}:thresholds
  → Reorder points per SKU

match:{request_id}:state
  → Current tier, responses, timeout
```

## 2.3 Three-Way Match Logic (GRN ↔ PO ↔ Invoice)

THREE-WAY MATCH ENGINE

PO (Order)	GRN (Goods)	INVOICE (Bill)
Items[]	Items[]	Items[]



### 3. Channel Strategy & Engagement

#### 3.1 Omnichannel Assessment

Channel Matrix

Channel	Restaurant Use	Supplier Use	Platform Strategy
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<b>WhatsApp</b>	Primary (95% of UAE F&B)	Primary for orders & quotes	<b>Core channel</b> — Interactive Buttons, List Messages, Reply Buttons. All critical actions must be completable via WhatsApp.
<b>Mobile App</b>	Secondary — power users	Dashboard & config	<b>Full experience</b> — Cart management, GRN, analytics. Progressive Web App for low-friction install.
<b>Web Dashboard</b>	Finance/AP teams, multi-outlet owners	Owner/GM strategic view	<b>Analytics hub</b> — P&L, supplier performance, AI agent leaderboard.
<b>Email</b>	Invoices, statements, reports	Order confirmations, compliance docs	<b>Transactional only</b> — E-invoices, payment reminders, monthly reports.
<b>SMS</b>	Fallback for critical alerts	Delivery notifications	<b>Emergency channel</b> — Used only when WhatsApp unreachable.
<b>POS Integration</b>	Invisible (data pipe)	N/A	<b>Data backbone</b> — Sales data → inventory depletion → AI cart. Restaurant never "uses" it directly.

## WhatsApp-First Design Rationale

### WHY WHATSAPP-FIRST

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#### UAE F&B REALITY:

95% of procurement conversations happen on WhatsApp today.  
Chefs will NOT download another app for ordering. They barely use the POS.  
The platform that REPLACES WhatsApp fails.  
The platform that ENHANCES WhatsApp wins.

#### PLATFORM APPROACH:

- ① STRUCTURED MESSAGES replace free-text  
"What's the price?" → Interactive button with pre-populated options
- ② ONE-TAP ACTIONS replace typing  
[Approve Order] [Confirm GRN] [Pay Now]

③ RICH MEDIA replaces attachments AI Cart summary card with breakdown Flash Deal card with scarcity timer	
④ ESCALATION to App only when needed Complex edits, bulk operations, reports	

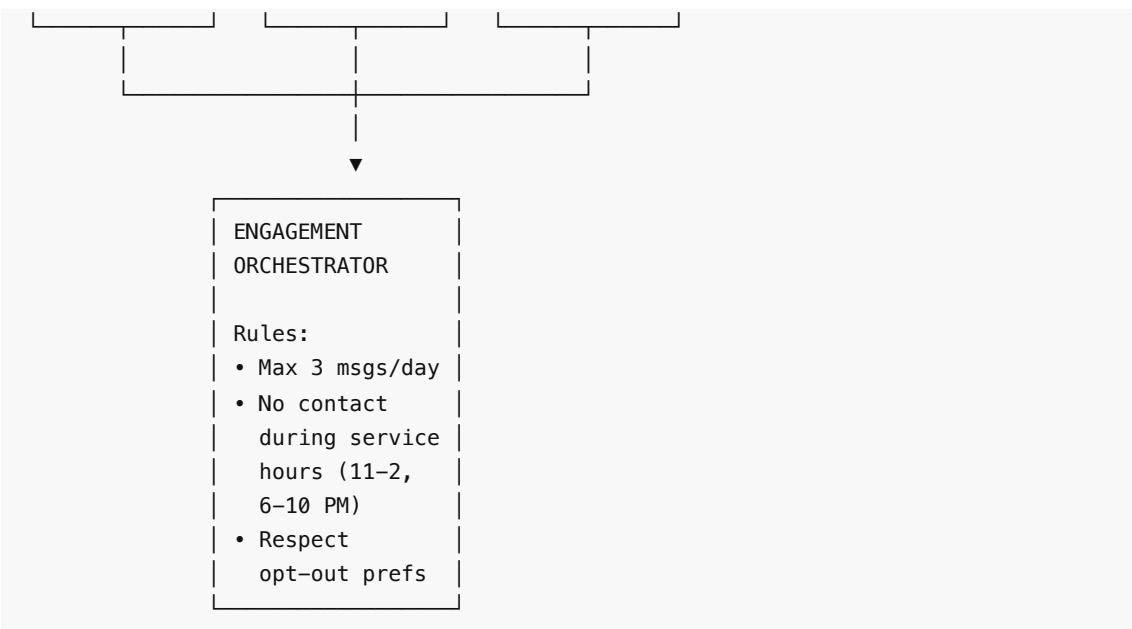
## Channel Escalation Rules

Trigger	Primary Channel	Escalation
AI Cart ready for approval	WhatsApp (interactive card)	If no response in 2h → push notification
GRN discrepancy detected	WhatsApp + in-app alert	If unresolved in 4h → email to Finance
Invoice requires review	WhatsApp (flagged match)	If unresolved in 24h → email + SMS
Payment overdue (D+5)	WhatsApp (collections)	D+10 → email escalation, D+15 → call alert
Flash Deal available	WhatsApp (interactive)	No escalation — time-limited by design
System critical alert	SMS + WhatsApp	Email backup within 5 min

## 3.2 Engagement Triggers & Retention Loops

### Proactive Engagement Framework

ENGAGEMENT TRIGGER MAP		
BEHAVIORAL TRIGGERS	TEMPORAL TRIGGERS	PREDICTIVE TRIGGERS
<ul style="list-style-type: none"> <li>• Cart abandoned</li> <li>• Price viewed 3x, not ordered</li> <li>• Competitor substitute searched</li> </ul>	<ul style="list-style-type: none"> <li>• Weekly order day missed</li> <li>• Invoice due date approach</li> <li>• Contract renewal window</li> <li>• Ramadan/holiday prep</li> </ul>	<ul style="list-style-type: none"> <li>• Stockout prediction (POS data)</li> <li>• Demand surge (weather, events)</li> <li>• Churn risk (declining orders)</li> </ul>



### Churn Risk Detection

Signal	Weight	Action
Order frequency declining (>30% drop over 4 weeks)	High	Alert supplier rep + AI sends "We miss you" offer
Competitor SKU appearing in GRN (new supplier detected)	Critical	Supplier notified + AI proposes price match
Response time to AI Cart increasing	Medium	Switch to simpler message format, reduce options
Payment delays increasing	Medium	Tighten credit terms proactively

## 4. Research & Discovery

### 4.1 Innovation Benchmarking: India F&B Tech → UAE Adaptation

#### India's F&B Supply Chain Revolution

India's F&B tech ecosystem has scaled solutions that are directly relevant to the UAE market. Key innovations:

Innovation	Indian Pioneer	What They Did	UAE Adaptation Opportunity
Farm-to-Restaurant Direct Supply	Hyperpure (Zomato)	Eliminated middlemen; 100K+ outlets served via 11 warehouses; quality + traceability from farm	UAE is smaller geographically — can achieve faster with fewer warehouses. Halal traceability is the additional layer.

<b>Kirana Digitization</b>	Jumbotail	250K+ stores digitized; AI-driven demand forecasting; embedded credit/financing for small retailers	UAE's "cafeterias" (small restaurants) are the equivalent of kiranas. Platform credit could unlock loyalty.
<b>Fresh Produce &lt;12h Delivery</b>	Ninjacart	Direct farmer procurement; supply chain algorithms; RFID crate tracking; quality benchmarks	UAE imports 90% of food — adapt to port-to-restaurant tracking with cold chain IoT.
<b>Open Commerce Network</b>	ONDC	Decentralized marketplace; 764K merchants in 616+ cities; 15-20% lower food delivery prices via reduced commissions	UAE has no equivalent open network. Platform could become the de facto "UAE ONDC for procurement."
<b>Embedded Finance</b>	Jumbotail + Ninjacart	Buy-now-pay-later for small retailers; credit scoring based on order history	Direct mirror — UAE SME restaurants have limited credit access. Order history = creditworthiness signal.
<b>Agricultural DPI</b>	India (Bharat Vistaar)	Unified agricultural data (soil, weather, advisories) feeding supply chain predictions	UAE's food import dependency makes <i>supplier country</i> agricultural data (India, Pakistan, Australia) critical for price forecasting.

## Key India → UAE Adaptation Insights

### ADAPTATION FRAMEWORK

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#### DIRECT TRANSPLANT (works as-is):

- AI demand forecasting from POS data
- WhatsApp-first interaction model
- Predictive reorder ("Smart Draft")
- Supplier scoring / reputation systems

#### NEEDS LOCALIZATION:

- Halal certification verification layer
- Multi-language (Arabic + English + Hindi)
- FTA e-invoicing (vs India's GST e-invoicing)
- Import-heavy supply chain (vs India local)
- Smaller market → faster network effects

#### NOT APPLICABLE:

- 616-city scale logistics (UAE is ~7 cities)
- Farm-level DPI (UAE = import-dependent)
- Kirana cash-economy model (UAE = card/bank)

## 4.2 Gap Analysis: Journey, Technical & Assumption Challenges

### 4.2.1 Journey-Based Assumption Gaps

**Restaurant Journey Challenges:**

Assumption	The "What If" Scenario (Gap)	Stakeholder Question
Chef Adoption	We assume the Chef trusts the AI Cart at 6:00 AM. <b>What if the Chef systematically edits &gt;50% of the cart?</b> Does the model learn, or does the user abandon the feature?	"What is the maximum 'edit rate' acceptable before the AI Cart feels like a burden? How do we handle 'I just want to order what I feel like today'?"
Receiving Logic	We assume a Storekeeper exists and uses the app at 9:00 AM. <b>What if the delivery arrives during service (1:00 PM)</b> when no one can scan items? Does the driver leave goods without a digital GRN?	"If goods arrive during peak service, do we allow 'Auto-Accept' based on trust? How does the 3-way match handle this?"
Emergency Orders	We assume urgent orders go through the platform. <b>What prevents the Chef from just calling their 'guy' for a cash deal?</b> How do we capture off-platform leakage data?	"How do we incentivize Chefs to log emergency cash purchases? Loyalty points? Or do we integrate 'Expense Claims'?"

**Supplier Journey Challenges:**

Assumption	The "What If" Scenario (Gap)	Stakeholder Question
Pricing Authority	We assume the Agent has margin authority. <b>What if the Supplier's ERP requires a Human Manager's approval for any discount &gt;5%?</b> Does the 'Instant Close' promise break?	"Can we negotiate a pre-approved 'Delegation of Authority' matrix for the AI? Or must every deal >5% go to a human approval queue?"
Stock Accuracy	We assume 'Flash Deals' sell real stock. <b>What if the Supplier's WMS is only updated nightly?</b> Will we sell stock that physically isn't there?	"Is real-time inventory API available? If not, do we allocate a 'Platform Buffer' stock solely for the AI agent to sell?"

### 4.2.2 Technical & Integration Gaps

**Data Latency & Reliability:**

System	The Failure Mode	Technical Question
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<b>POS Integration</b>	The 6:00 AM cart relies on overnight POS sync. <b>What if the API sync fails or delays by 4 hours?</b> Does the Chef see an empty cart?	"What is the fallback logic for failed POS sync? Use 7-day average sales? Or just repeat last week's order?"
<b>ERP Latency</b>	The 'Instant Chat' Agent needs millisecond inventory checks. <b>If the Supplier's SAP B1 instance has 3-second API latency</b> , the chat feels sluggish.	"Do we cache supplier inventory locally in Redis? If so, what is the TTL before we risk overselling?"
<b>SKU Normalization</b>	A Supplier uploads 500 new SKUs. <b>If AI confidence &lt;80% on 200 items</b> , they hit a manual review bottleneck. Who clears it?	"Do we block new SKUs until reviewed? Or show them as 'Unverified' with a warning flag?"
<b>Invoice OCR</b>	We assume text extraction works. <b>What if the Supplier hand-writes adjustments on a printed invoice?</b> Can the vision model read handwriting on thermal paper?	"What is the error rate for handwritten invoice amendments? Do we flagging them all for human review?"

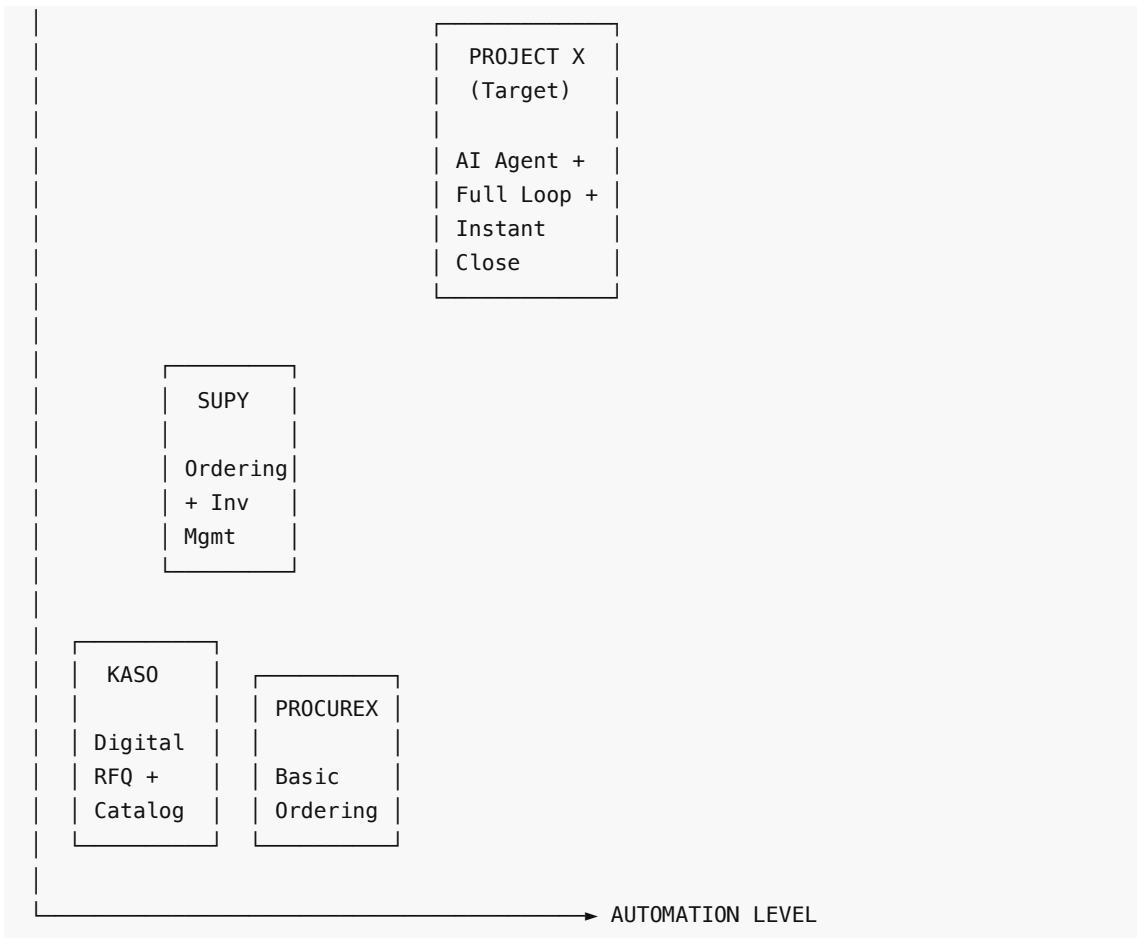
#### 4.2.3 Business & Operational Gaps

Challenge	Impact if Unresolved	Review Question
<b>The "Kickback" Problem</b>	Procurement managers sometimes receive personal incentives (cash/gifts) from suppliers. <b>How does the platform compete with personal graft?</b>	"Is there a compliant 'Loyalty Rewards' module for the Chef personally (e.g. Amazon cards) to align incentives?"
<b>Credit Logic Reality</b>	We assume 'Credit Score' determines payment terms. <b>In reality, do Suppliers offer credit based on relationship/tenure rather than data?</b>	"Can the system model 'unwritten' credit rules (e.g. 'Ahmed gets Net 60 because I know his father')?"
<b>Regulatory: Halal</b>	Does the platform need to verify and display Halal certification status per SKU? Who is the certifying authority (ESMA? Municipality?)?	"Is 'Halal Certified' a required filter? Do we need to store certificate PDFs per SKU?"
<b>Data Residency</b>	Must all data (especially POS/payment/customer data) reside within UAE borders?	"Does ADGM/DIFC law require localized hosting for F&B transactional data?"

## 4.3 Competitive Moat Analysis

### Current UAE Competitors vs. Project X

COMPETITIVE POSITIONING
FEATURE DEPTH → ▲ 



Capability	Supy	KASO	Project X
Digital Ordering	✓	✓	✓
Inventory Management	✓	✗	✓
SKU Normalization	✗	Partial	✓ (AI + embeddings)
Price Comparison	Manual	Partial	✓ (Automatic via normalized SKUs)
AI Suggested Cart	✗	✗	✓
Instant-Close Agent	✗	✗	✓
Flash Deals (Menu-Matched)	✗	✗	✓
GRN → Invoice Auto-Match	✗	✗	✓
E-Invoicing (FTA)	✗	✗	✓
Kitchen Copilot	✗	✗	✓
Waste Intelligence	✗	✗	✓

### The Moat: Why Competitors Can't Easily Replicate

## MOAT COMPONENTS

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- 1. NORMALIZED SKU GRAPH  
Every supplier product mapped to universal taxonomy. Network effect: each new supplier enriches the graph for all.  
TIME TO REPLICATE: 18–24 months
- 2. POS DATA LOOP  
Real-time sales → inventory → prediction → auto-order. Competitors lack POS pipe.  
TIME TO REPLICATE: 12 months + POS deals
- 3. SUPPLIER PRICING AUTHORITY  
Trust relationship: suppliers grant AI binding quote authority. Requires months of relationship building per supplier.  
TIME TO REPLICATE: 6–12 months/supplier
- 4. GRN TRUTH LAYER  
Digital receiving = ground truth for all downstream (invoicing, payments, waste).  
Competitors don't have receiving data.  
TIME TO REPLICATE: Requires restaurant behavior change (hardest part).

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## Appendix A: UAE Food Safety Regulatory Landscape

Authority	Jurisdiction	Relevance to Platform
<b>ADAFSA</b> (Abu Dhabi Agriculture & Food Safety Authority)	Abu Dhabi	Food traceability, supplier licensing, handler certifications
<b>Dubai Municipality – Food Safety Dept</b>	Dubai	Food import registration, restaurant inspections
<b>MOCCAE</b> (Ministry of Climate Change & Environment)	Federal	Federal food safety standards, Nutri-Mark labeling
<b>FTA</b> (Federal Tax Authority)	Federal	VAT, e-invoicing mandates, 5-Corner model
<b>ESMA</b> (Emirates Authority for Standardization)	Federal	Halal standards, product quality certifications

### Key 2025 Regulatory Changes

- Nutri-Mark nutritional labeling mandatory from June 2025
- Risk-based inspection framework (high-risk F&B = more frequent audits)

- **E-commerce food permits** now required for digital food operations
  - **Federal Procurement Law** (Decree-Law No. 11/2023) effective May 2025 — impacts any government catering contracts
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## Appendix B: Data Flow Cross-Reference

Document	Flow	This Document Section
<a href="#"><u>system-specification.md</u></a>	Core Architecture	§2.1 (Extraction), §2.2 (Matching)
<a href="#"><u>detailed-flows.md</u></a>	Flow 1: Catalog → SKU	§2.1 (Extraction Pipeline)
<a href="#"><u>detailed-flows.md</u></a>	Flow 2: POS → AI Cart	§1.1 (Restaurant Journey), §2.2 (Matching)
<a href="#"><u>detailed-flows.md</u></a>	Flow 3: GRN → Invoice Match	§2.3 (Three-Way Match)
<a href="#"><u>autonomous_sales_agent.md</u></a>	Instant-Close Agent	§1.3 (Agent Simulation), §2.2 (Tier 1-4)