Product Strategy Agent

# Abstract

**BlueCola,** a global beverage leader, is seeking to accelerate product innovation cycles without relying on expensive proprietary research or delayed insights from traditional panels. To achieve this, the company aims to harness publicly available data---news articles, social chatter, and search trends---through intelligent LLM-driven agents.

The **Public-Data Product Strategy Agent** addresses this by orchestrating four autonomous LangGraph agents:

* **TrendSpotterAgent** scrapes and clusters headlines into emerging consumer themes.
* **SocialSentimentAgent** mines Reddit posts to extract sentiment, pain points, and enthusiasm markers.
* **ConceptGenAgent** translates these insights into fresh product concept pitches.
* **RoadmapPlannerAgent** outlines a high-level launch plan with key deliverables and estimated resources.

All components are modular and integrated into a FastAPI backend, with endpoints for each insight stream and a React/Next.js UI for interactive exploration. Orchestration is driven by LangGraph and Cloud Functions, and monitoring is handled via Cloud Monitoring and Cloud Logging.

This low-cost, real-time strategy agent empowers BlueCola's innovation teams to explore and validate ideas faster---resulting in faster go-to-market, better alignment with market needs, and a leaner R&D investment.

# Background

In the hyper-competitive Consumer Packaged Goods (CPG) industry, beverage companies like **BlueCola** must continuously introduce new variants and flavors to retain market relevance. Traditional innovation cycles are hindered by:

* **High cost of proprietary research**, focus groups, and trend agencies.
* **Long lead times** for insight generation and validation.
* **Reactive decision-making**, often missing emerging micro-trends.

To stay ahead, BlueCola seeks an **LLM-driven agentic platform** that can:

* Monitor public signals continuously.
* Generate concept ideas autonomously.
* Deliver go-to-market plans rapidly and with minimal manual effort.

# Objectives & Success Metrics

Design and implement a fully agentic, publicly-driven product strategy engine using Google Cloud tools, enabling CPG product managers to:

1. Discover emerging trends from public data.
2. Assess market sentiment from social media.
3. Autonomously ideate new beverage product concepts.
4. Translate concepts into actionable product roadmaps.

**Success Metrics**

|  |  |
| --- | --- |
| Goal | Target Outcome |
| Trend Extraction Latency | < 30 seconds per batch |
| Sentiment Clustering Accuracy | ≥ 90% relevance in manual cross-check |
| Concept Generation Diversity | ≥ 3 distinct variants per trend |
| Roadmap Generation Completion | ≤ 10 seconds per request |
| System Stability (Uptime) | ≥ 99% with alerting |
| API Response Latency (avg) | < 1 second per endpoint |

# Data Assets

The following public-data APIs and integrations are available to the capstone team:

**News & Search APIs**

* **NewsAPI.org** – Real-time and historical articles from global and niche publications.
* **Tavily Search API** – Curated search insights for trend summarization and clustering.

**Social Media Mining**

* **Reddit API (via PRAW)** – Posts and comments from target subreddits like r/beverages, r/CPG, r/healthydrinks.

**Sample Tests**

* Simulated inputs for trend clustering, sentiment score validation, prompt tests for concept generation, and roadmap templates.

# Problem Statement

In the highly competitive **Consumer Packaged Goods (CPG) industry**, beverage companies face constant pressure to launch new and innovative products that align with rapidly shifting consumer preferences. Traditional approaches to product innovation rely heavily on **proprietary market research, focus groups, and trend agencies**. These methods are:

* **Expensive** – requiring large budgets for surveys, panels, and agencies.
* **Slow** – taking months to collect, analyze, and validate insights.
* **Reactive** – often identifying trends only after they have already matured.

As a result, companies frequently:

* Miss **emerging micro-trends** that could define new market segments.
* Invest in **products misaligned with consumer sentiment**.
* Struggle with **long go-to-market cycles**, reducing competitiveness.

For a global beverage leader like **BlueCola**, this challenge means lost opportunities, higher R&D costs, and weaker market adaptability.

# Solution Design & Phases

The **Public-Data Product Strategy** Agent is composed of four specialized agents, each focused on a specific sub-task in the product strategy lifecycle. These agents operate independently but are orchestrated using a LangGraph-based flow, which enables intelligent sequencing and conditional routing. The overall solution is implemented in modular phases:

**Phase 1: TrendSpotterAgent (Trend Identification)**

**1. Data Ingestion:**

* Collect news headlines and search data using NewsAPI.org and Tavily Search API.
* Ensure a diverse source mix (global, regional, niche publications).

**2. Preprocessing:**

* Clean text (remove stopwords, normalize terms).
* Enrich metadata with source, timestamp, and sentiment context.

**3. Clustering with LLM (Vertex AI Gemini):**

* Prompt model to extract key themes (e.g., “zero-sugar beverages,” “plant-based drinks”).
* Cluster them into trend groups with confidence scores.

**Output:**

* A JSON file containing trend clusters, each with theme name, confidence level, and supporting articles.

**Use Case:**

* Helps product managers spot micro-trends before competitors.

**Phase 2: SocialSentimentAgent (Consumer Insight Extraction)**

**1. Scraping Reddit:**

* Use PRAW (Python Reddit API Wrapper) to fetch posts & comments from targeted subreddits.
* Focus on communities like r/beverages, r/nutrition, r/CPG.

**2. Sentiment Scoring:**

* Prompt Vertex AI Gemini to classify posts into positive, negative, neutral.
* Extract drivers (e.g., taste, packaging, nostalgia, price).

**3. Pain Point Detection:**

* Identify repeated complaints or desires (e.g., “too sweet,” “needs eco-friendly packaging”).

**Output:**

* Consumer insight summary cards with sentiment distribution, keywords, and themes.

**Use Case:**

* Direct input for product features and marketing positioning.

**Phase 3: ConceptGenAgent (Product Ideation)**

**1. Input:**

* Top 3 trends from Phase 1.
* Sentiment clusters from Phase 2.

**2. Concept Generation:**

* Vertex AI Gemini generates 3–5 product pitches.

**3. Each pitch includes:**

* Flavor/Variant (e.g., “Mango-Chia Hydration”)
* Packaging Idea (e.g., recyclable can with bold tropical design)
* Tagline / Positioning (e.g., “Hydration from Nature, Energy for You”).

**4.Diversity Check:**

* Ensure outputs are not repetitive (≥ 3 unique variants).

**Output:**

* JSON list of concept cards with product description, packaging, and target audience.

**Use Case:**

* Quick ideation for R&D teams to evaluate feasibility.

**Phase 4: RoadmapPlannerAgent (Launch Planning)**

**1.Input:**

* A selected product concept from Phase 3.
* Constraints (budget, timeline, resources).

**2. Planning with LLM:**

* Generate milestones:
  + R&D & Formulation
  + Regulatory Approval
  + Packaging & Branding
  + Marketing & Distribution
  + Add tentative timelines (e.g., R&D = 2 months).

**Output:**

* A JSON roadmap with milestones, timelines, resources.
* Gantt-chart like structure for visual UI.

**Use Case:**

* Provides leadership with a quick launch path without manual planning.

**Phase 5: Agent Orchestration & Scheduling**

**1.Orchestration with LangGraph:**

* Define a flowchart-like pipeline where outputs from one agent feed into another.
* Conditional routing for low confidence results (e.g., retry trend clustering).

**2. Execution Triggers:**

* On-demand: API call (/insights/trends).
* Scheduled: Cloud Scheduler triggers daily runs.

**3.Error Handling:**

* Automatic retries.
* Fallback prompts for ambiguous cases.

**Output:**

* Fully automated workflow with minimal human intervention.

**Phase 6: UI Integration & Observability**

**1.Backend (FastAPI):**

* Expose endpoints for each agent:
* /insights/trends
* /insights/sentiment
* /concepts/generate
* /roadmap/plan

**2. Frontend (Next.js / App Engine):**

* Show trend clusters, sentiment charts, concept mockups, roadmap timelines.
* Interactive filters (date, region, product type).

**3. Monitoring (Cloud Monitoring & Logging):**

* Track API latency, error counts, uptime, token usage.
* Alerts for failures or low-confidence outputs.

**Output:**

* A dashboard-style UI for product managers.

# Expected Deliverables

**Code Assets**

* LangGraph workflow for orchestrating all four agents.
* Python-based FastAPI server exposing four REST endpoints.
* Prompt templates for each LLM call, abstracted for reuse.
* Dockerfile and deployment scripts (multi-stage builds)

**Google Cloud Configuration**

* Cloud Functions deployment configurations for scheduled triggers.
* App Engine application for frontend UI.
* Cloud Scheduler jobs for automated agent execution.
* Artifact Registry container configurations.

**Frontend & Demo UI**

* App Engine application featuring:
  + Trend clustering UI with tag clouds or keyword tiles.
  + Sentiment summary view (charts + commentary).
  + Concept gallery with flavor, packaging, and tagline.
  + Interactive roadmap viewer with Gantt-style layout.

**Observability Stack**

* Cloud Monitoring dashboard:
  + Latency, success rate, error distribution, fallback usage.
* Cloud Monitoring alerts:
  + Triggered on high error rates, low-confidence responses, or endpoint failures.

**Documentation**

* Setup Guide:
  + Google Cloud configuration, API key management, deployment scripts.
* Agent Customization:
  + Instructions for modifying prompt logic and swapping data sources.
* Runbook:
  + Monitoring, scaling, and common failure modes.
* Google API Discovery Service for each endpoint (/insights/trends, etc.)