Using Multi-Agents to Solve IBP Problems

Team 505

1 Introduction

Inventory and Business Planning (IBP) is a critical challenge for companies aiming to optimize stock levels, predict future demand, and align resources efficiently. Traditional IBP methods rely on manual analysis and historical data, which often lack real-time adaptability.

To address these challenges, we developed an AI-driven Forecasting and Planning System using CrewAI agents that integrate real-time weather conditions, economic news, and trending product analysis to make better business decisions.

2 System Overview

Our system consists of three AI agents:

- **Forecasting Agent** – Predicts demand based on external factors.
- **Planning Agent** – Optimizes stock levels and budgeting.
- **Execution Monitoring Agent** – Evaluates execution progress and detects anomalies.

These agents work in a cooperative CrewAI environment to automate IBP tasks.

3 Agent 1: Forecasting Agent

3.1 Functions

- **Data Collection** – Retrieves economic, weather, and customer trend data.
- **Demand Forecasting** – Uses AI models to predict product demand.
- **Market Analysis** – Evaluates trends influencing IBP decisions.
- **Reporting** – Generates insights for further planning.

4 Agent 2: Planning Agent

4.1 Functions

- **Stock Level Optimization** – Balances inventory to minimize costs.
- **Budget Allocation** – Distributes financial resources efficiently.
- **Supply Chain Coordination** – Enhances logistics and supplier management.
- **Strategy Adjustment** – Adapts plans based on new forecasts.

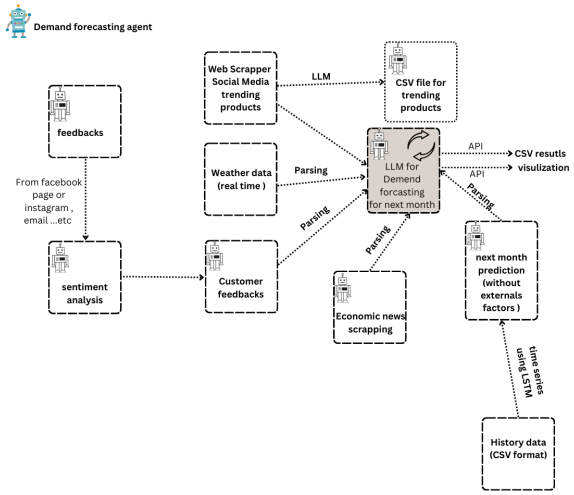

Figure 1: Forecasting agent workflow.

5 Agent 3: Execution Monitoring and Anomaly Detection

5.1 Functions

- **Monitoring Real Execution** – Tracks progress of implemented plans.
- **Statistical Performance Analysis** – Evaluates KPIs.
- **Anomaly Detection** – Identifies operational inefficiencies and risks.
- **Data Integration** – Collects information from economic reports and competitors.
- **Problem Identification** – Detects bottlenecks and misalignments.
- **Feedback Mechanism** – Sends issues to managers and the planning agent.

6 Full System Workflow

7 Economic Implications

Using AI for IBP has several economic benefits:

- **Reduction in Holding Costs**: Avoid overstocking and free up capital.
- **Minimizing Stockouts**: Prevent revenue loss due to unavailable products.
- **Efficient Resource Allocation**: Optimize procurement and labor costs.
- **Adaptive Pricing**: Dynamic pricing strategies based on real-time demand.

8 Why Use LLMs?

- **Generalization** – LLMs can handle a wide variety of tasks without requiring task-specific training.

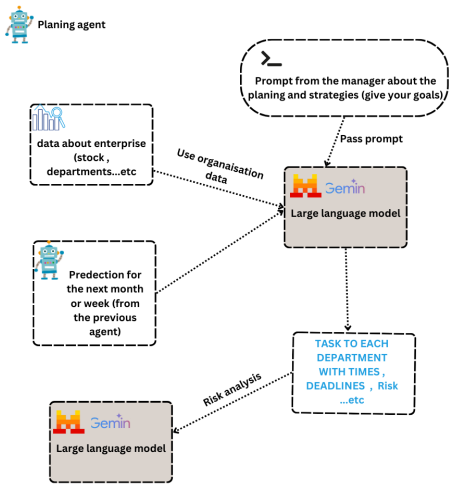

Figure 2: Planning agent workflow.

- **Contextual Understanding** – They process unstructured data (e.g., text, trends, reports) more effectively than traditional ML models.
- **Zero-Shot and Few-Shot Learning** – No need for large labeled datasets, unlike traditional ML models.
- **Multi-Task Capability** – Can perform forecasting, planning, and risk assessment simultaneously.
- **Dynamic Decision-Making** – Adapt to new inputs without retraining.
- **Better Natural Language Interaction** – More suitable for business-oriented IBP tasks.

9 Conclusion and Future Work

By leveraging AI-driven agents, we create a dynamic IBP system that adapts to market conditions. Future work includes:

- Integrating deep learning for advanced forecasting.
- Expanding datasets to include global market trends.
- Enhancing explainability of AI decisions.

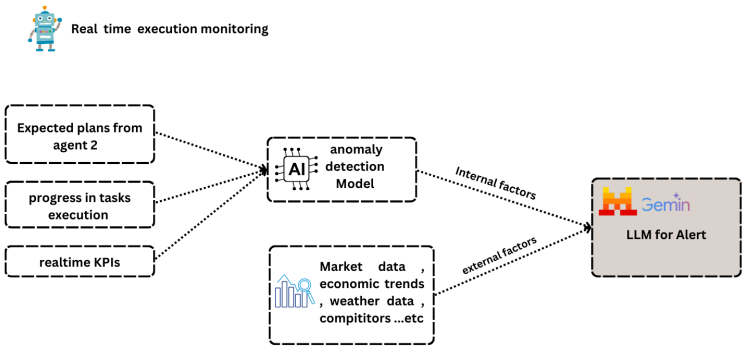

Figure 3: Execution Monitoring and Anomaly Detection agent workflow.

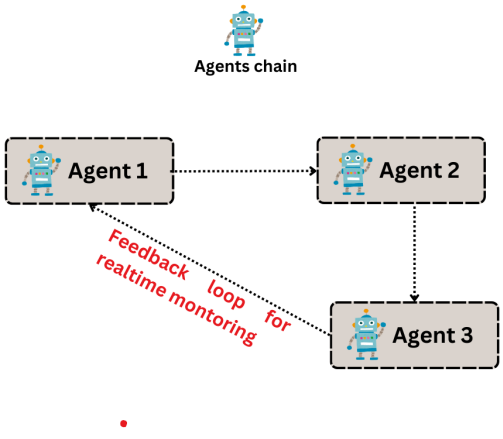

Figure 4: Overall system workflow with all three agents.