Here's a **comprehensive and detailed project blueprint** for your Amazon ML Hackathon 2025 entry. This project is designed to be **non-trivial**, **deep-tech**, and **broadly applicable** to e-commerce, logistics, and food delivery platforms like Amazon, Flipkart, Zomato, Swiggy, and Zepto.

**🧠 Project Title:**

**IntelliSupply: AI-Driven Demand Forecasting and Autonomous Supply Chain Optimization**

**📌 Abstract**

The project introduces *IntelliSupply*, a next-gen AI-powered platform designed to forecast inventory demand with high precision and optimize supply chain operations autonomously. With rapid growth in e-commerce and food delivery sectors, supply chains face challenges like demand volatility, last-mile delivery inefficiencies, and over/understocking. IntelliSupply combines **time series forecasting**, **reinforcement learning**, **AI-driven logistics automation**, and **MLOps** to create a system that reduces operational costs, enhances availability, and improves customer satisfaction. It leverages **multi-source data fusion** (e.g., sales, reviews, weather, events) to provide context-aware insights and actions.

**📖 Project Description**

**🏷 Problem Statement:**

Companies face:

* Overstocking leading to storage costs and wastage.
* Understocking resulting in missed revenue and poor customer experience.
* Manual, siloed supply chain decisions without AI automation.
* No real-time decision-making or contextual awareness.

**💡 Solution:**

IntelliSupply will:

* Predict product-level demand using **multi-variate time-series models**.
* Automate restocking and shipping using **RL-based optimizers**.
* Use **sentiment analysis** and **external signals** (weather, holidays, trends) to dynamically adjust forecasts.
* Integrate a **real-time dashboard** for human-in-the-loop decision-making.
* Ensure **end-to-end automation** and traceability using **MLOps pipelines**.

**🌍 Target Companies:**

* **E-commerce**: Amazon, Flipkart
* **Q-commerce**: Zepto, BigBasket, Blinkit
* **Food delivery**: Swiggy, Zomato
* **Retail chains**: D-Mart, Reliance Retail

**⚙️ Tech Stack**

**🔢 Languages & Libraries**

* **Python**, **SQL**
* ML: Scikit-learn, XGBoost, Prophet, PyTorch, TensorFlow, Statsmodels
* NLP: HuggingFace, spaCy, TextBlob, NLTK
* RL: Stable Baselines3, OpenAI Gym, Ray RLlib
* Explainability: SHAP, LIME

**📦 Data Engineering**

* Pandas, NumPy, AWS Glue, Apache Airflow
* Storage: AWS S3, Redshift, PostgreSQL

**🚀 MLOps and Deployment**

* Amazon SageMaker, Docker, MLflow, Kubeflow, DVC
* CI/CD: GitHub Actions, AWS CodePipeline
* Deployment: AWS Lambda, API Gateway, SageMaker Endpoints

**📊 Monitoring & Visualization**

* Monitoring: Amazon CloudWatch, Prometheus, Grafana
* Visualization: Plotly Dash, AWS QuickSight, React.js + Tailwind CSS

**📡 Notifications**

* Alerts: Amazon SNS, Slack API

**🛣️ Roadmap (45 Days)**

**✅ Week 1–2: Ideation + Data Preparation**

* Finalize problem definition
* Collect datasets from:
  + [Kaggle](https://kaggle.com/)
  + [UCI ML Repo](https://archive.ics.uci.edu/)
  + [OpenFoodFacts](https://world.openfoodfacts.org/)
  + Simulated APIs (Amazon, Flipkart inventory style)
* Clean and preprocess data
* Engineer time-based and external features (e.g., holiday, promotions)

**✅ Week 3–4: Model Development**

* Build time-series forecasters:
  + Prophet, LSTM, and ensemble XGBoost regressors
* NLP pipeline for:
  + Sentiment extraction from product reviews
* RL model for dynamic inventory control
  + Train RL agent to learn restocking, shipping, pricing strategies

**✅ Week 5–6: MLOps & Integration**

* Set up SageMaker Pipelines or Kubeflow Pipelines
* Track experiments with MLflow
* Automate retraining & testing pipelines
* Deploy models as APIs
* Real-time inference optimization with AWS Elastic Inference

**✅ Week 6–7: UI, Analytics & Monitoring**

* React dashboard with:
  + Inventory forecasts
  + Stockout alerts
  + Optimization actions
* Integrate with Amazon QuickSight or Plotly
* Add monitoring using CloudWatch & drift detection
* Setup Slack alerts via Amazon SNS

**🔬 Research-Backed Insights**

**🔗 Papers and Resources**

1. **DeepAR: Probabilistic Forecasting with Autoregressive Recurrent Networks**  
   <https://arxiv.org/abs/1704.04110>
   * Used by Amazon for retail forecasting.
2. **Demand Forecasting Using Machine Learning Algorithms**  
   <https://ieeexplore.ieee.org/document/9416394>
   * Describes regression-based ML for retail demand.
3. **Reinforcement Learning for Supply Chain Optimization**  
   <https://arxiv.org/abs/2011.09881>
   * Discusses reward modeling in supply chains.
4. **Prophet by Facebook for Time Series Forecasting**  
   <https://facebook.github.io/prophet/>
5. **RL in Logistics: Use Case for Warehouse Robotics**  
   <https://arxiv.org/abs/1912.11443>

**📈 Expected Results & KPIs**

| **Metric** | **Description** |
| --- | --- |
| **Demand Forecast Accuracy** | >90% MAPE on test data |
| **Inventory Holding Cost Reduction** | Target 20–30% |
| **Stockout Reduction** | >25% reduction |
| **On-time Deliveries Improvement** | >15% |
| **Model Drift Detection Latency** | <5 minutes |
| **CI/CD Deployment Time** | <10 minutes |

**🏁 Final Deliverables**

* 🚀 Deployed APIs for Forecasting & Optimization
* 📊 Interactive Dashboard (React + Plotly/QuickSight)
* 🔁 Automated MLOps Pipelines (retrain, redeploy)
* 📁 GitHub Repo with:
  + Code
  + Docs
  + Test cases
* 🧪 Slide deck and demo video for jury presentation

Let me know if you'd like:

* Full folder structure
* Prebuilt dataset links
* A demo app hosted with sample outputs
* Help writing the research paper or hackathon pitch deck