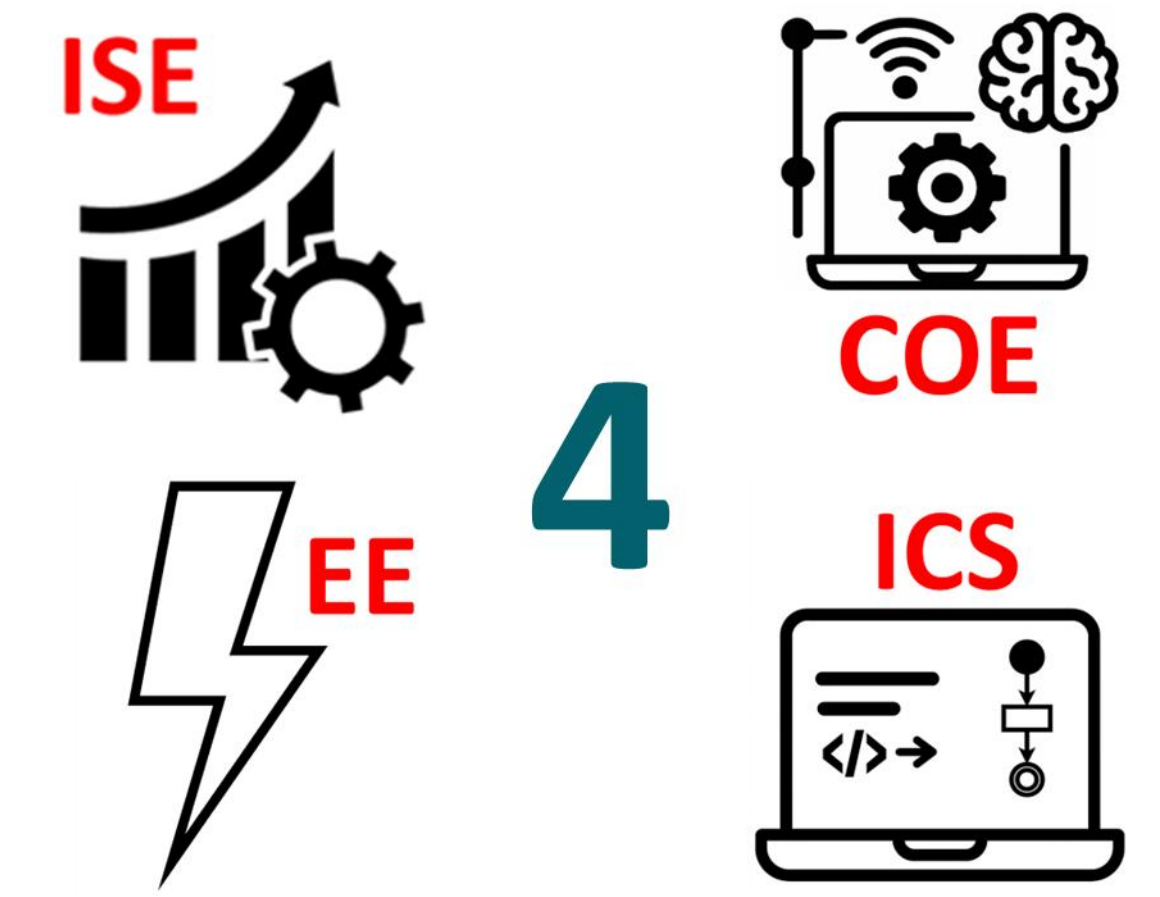


# Smart Warehouse Platform: AI Forecasting with IoT Tracking and Real-Time Optimization

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## Introduction

**Problem:** Saudi SME warehouses lack an affordable, automated solution to manage inventory, leading to:

- Inaccurate and outdated records.
- Stockouts and overstocking.
- Unreliable demand forecasting.

**Objective:** Design a low-cost platform for Saudi SMEs that provides:

- Real-time stock tracking (IoT sensing).
- Demand forecasting through AI.
- Warehouse layout optimization.

## Specifications

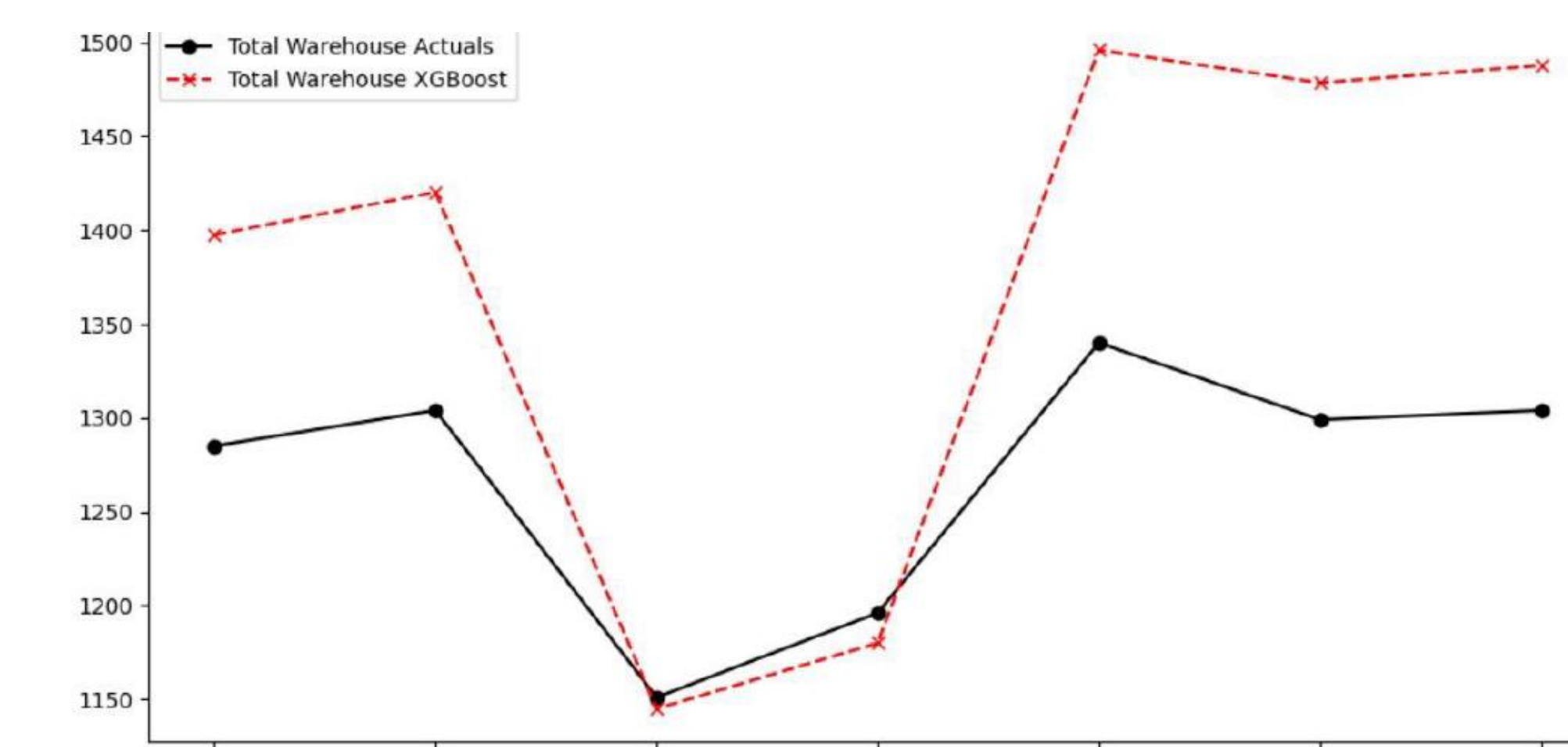
Dashboard uptime >= 98%
Tracking accuracy >= 80%
Communication delay <= 1 second
Forecasting MAPE <= 15%
Holding cost reduction >= 10%
Dashboard response time <= 5 seconds
150% overcurrent protection >= 2 seconds
Encryption overhead <= 200 ms
Average user task completion 5-7 clicks
Near-zone pick share >= 50% of total picks
<b>Complete end-to-end cycle &lt;= 20 seconds</b>
<b>AI, IoT, and cloud accuracy/integrity &gt;= 80%</b>
<b>Overall system uptime &gt;= 98%</b>

## Constraints

Deployment cost <= 1,000 + 100d SR
Ongoing monthly cost <= 700 SR
Compliance with SASO
Data duration >= 6 months
Total unit power <= 90 W

## Validation & Verification

- **100% of constraints, specs, and integrated specs were attained** in FPR.
- Cost 912 SR + 184 SR/mo. 2 years of historical data. Total power ≈ 85W.
- SW Uptime = (total – down / total) = 99.997%. HW Uptime = 99.7%.
- Tracking accuracy, by measuring known weights, is 94%. Comm. delay 74ms.
- Demand forecast accuracy ≈ 93.6%.



- Holding cost reduction 10.34%.
- Dashboard response time = page load + host RTT = 0.5s <= 5s.
- Encryption overhead = 30ms <= 200ms.

- Layout optimization formula (near-zone pick share).

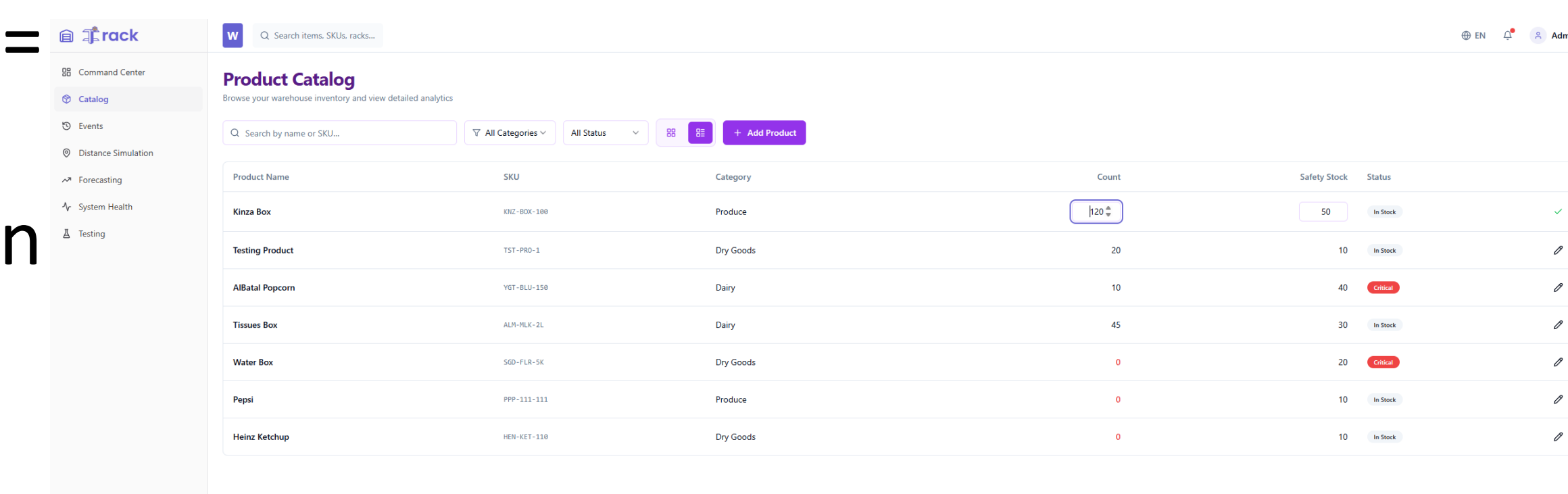
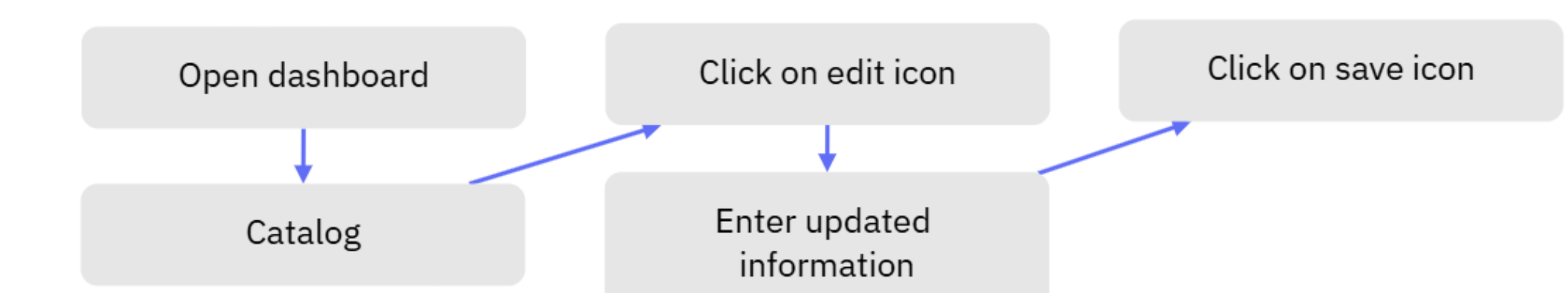
$$\min Z = \sum_{i \in I} \sum_{j \in J} f_i d_j x_{ij}$$

$f_i$ : how often item  $i$  is picked

$d_j$ : distance of location  $j$  from dispatch

$x_{ij}$ : whether item  $i$  is placed in location  $j$

- Average steps to complete an action on the system 5-7 clicks.



- Please scan this code to watch the demo:



## Conclusions

Demonstrated a low-cost smart warehouse platform for Saudi SMEs that provides near-real-time visibility, forecasting, and decision support.

## Prototype

**Hardware Labels:** Moving Camera Rail, Camera, Inventory Sensor

**Software Interface:**

To exclude the status column from the results, we can filter out the items with a critical or in-stock status. Here are the results:

- \* The item with Berain Water Box has a status of critical and its current count is 0.
- \* The item with Tissue Box has a status of in-stock and its current count is 45.
- \* The item with Kinza Box has a status of in-stock and its current count is 120.
- \* The item with Al Batal Popcorn has a status of critical and its current count is 10.
- \* The item with Testing Product has a status of in-stock and its current count is 20.

Is there anything else you would like to know about these items?

**Scan Event Details:** Apr 20, 2026, 6:22 AM @ RACK-01

**Detected Inventory:**

Product	Count
Kinza Box (KZ-BOX-100)	2
AlBatal Popcorn (YGT-BLU-150)	1
<b>Total Items</b>	<b>3</b>