# Smart Truck Yard & Dock Queue Management & Optimization System

TEAM M019

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COE 4 ICS EE ISE

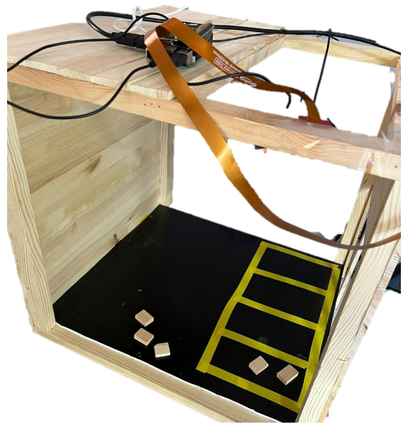
## Problem Statement

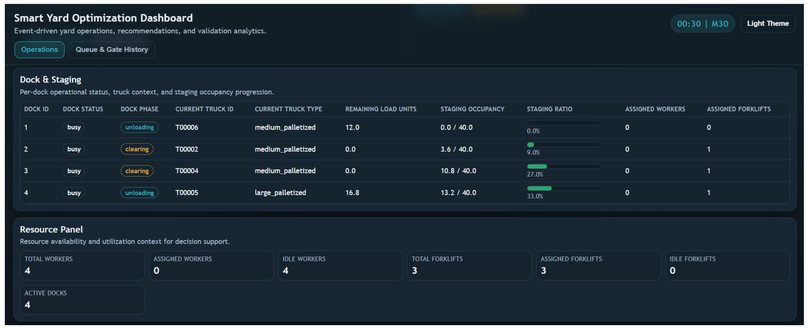
Distribution centers often experience congestion at yard gates and dock doors due to variable truck arrivals, unloading times, and limited resources. This results in long waiting times, poor dock utilization, staging-area overload, and delays in receiving operations. Since these decisions often rely on manual observation and personal judgment, there is a need for an integrated system that provides real-time visibility, predicts near-term congestion, and supports better operational decisions.

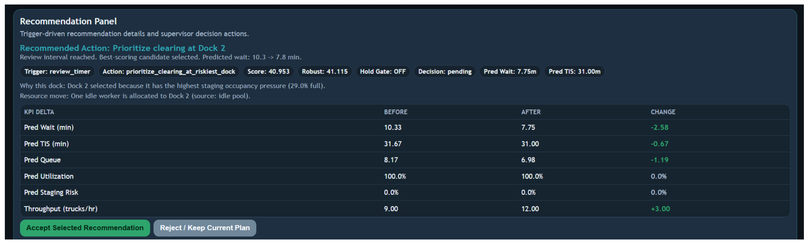
## Objectives

To develop an integrated smart yard and dock management system that provides real-time visibility, predicts near-term congestion, and supports better operational decisions to reduce truck waiting time and improve resource utilization.

## Prototype Design







## Constraints

- Fixed worker and dock limits
- Frame-loss tolerance
- IEEE 802.11 / 802.3 compliance
- CRF / PDPA compliance
- Low-power indoor operation

## Specifications

- Packet loss ≤ 1%
- Latency ≤ 1 s
- Little’s Law error within ±10%
- CI half-width within ±20%
- Refresh time ≤ 5 s

## Specifications

- Occupancy accuracy ≥ 90%
- Reliability ≥ 85%
- Wireless range ≥ 3 m
- Detection accuracy ≥ 80% at 1 m
- Prediction accuracy ≥ 85%
- Dashboard visibility ≤ 10 s
- Closed-loop cycle ≤ 60 s

## Validation

- Little’s Law: 2.73% error
- CI Ratio: 9.7%
- Refresh Time: 1.02–1.04 s
- Occupancy Accuracy: 94.7%
- Packet Loss: ≤ 1%
- Latency: ≤ 1 s
- Wireless Range: 2–3 m

## Conclusion

The project demonstrates that integrating sensing, communication, analytics, and simulation-based decision support can improve truck yard and dock operations. It enables real-time visibility, better resource utilization, and more informed decisions to reduce congestion and improve operational efficiency.