

“Traffic signals do not adapt to real-time congestion”

Lab 1: Problem Discovery and Need Identification

Problem Statement

Traffic signals in urban areas do not adapt to real-time congestion, leading to unnecessary delays, increased fuel consumption, and commuter frustration.

Step 1: Observation

Observation Method

The situation was observed at busy urban intersections during peak (morning and evening) and non-peak hours through:

- Real-life observation at road junctions
- Traffic surveillance videos
- Personal commuting experience

Key Observations

- Traffic signals follow fixed-time cycles regardless of vehicle density.
- Long queues form on one road while the signal remains green for an empty road.
- Emergency vehicles (ambulances, fire trucks) are forced to wait.
- Drivers show frustration through honking, rash driving, and signal jumping.
- Pedestrians face extended waiting times at crossings.
- Traffic police manually intervene during extreme congestion.

Environmental / System Constraints

- Lack of sensor-based traffic detection.
- Dependence on outdated traffic infrastructure.
- Manual traffic control during peak congestion.
- Limited integration between traffic signals and traffic monitoring systems.

Output

Observation Log

Step 2: User Identification (Stakeholder List)

User Group	Role	Expectations
Daily Commuters (Drivers & Riders)	Use roads regularly for work and travel	Faster travel, reduced waiting time
Traffic Police / Authorities	Manage and regulate traffic flow	Smooth traffic, reduced violations
Pedestrians & Cyclists	Cross roads safely	Shorter wait times, safer crossings
Emergency Services	Respond to emergencies	Signal priority and faster movement
City Administration	Urban planning & infrastructure	Reduced congestion and pollution

Step 3: Interviews / Surveys

Sample Interview Questions

1. How often do you experience delays at traffic signals?
2. Do you feel traffic signal timings match actual traffic conditions?
3. How does congestion at signals affect your daily routine?
4. Have you noticed empty roads getting green signals?
5. Do you think technology can improve traffic signal efficiency?
6. How do traffic delays affect fuel consumption and stress?
7. Have you seen emergency vehicles stuck at signals?

Interview Summary

- Participants: 30 users (drivers, pedestrians, traffic police)
- Common User Statements:
 - “We wait even when there are no vehicles on the other road.”
 - “Signals don’t change even during peak hours.”
 - “Ambulances get stuck like normal vehicles.”
 - “Traffic police have to manually control signals.”
 - “Fixed timers don’t make sense in today’s traffic.”

Key Insights

- Majority users believe traffic signals are outdated.
- Fixed-time signals increase frustration and violations.
- Manual control is unreliable and stressful for police.
- Users want smarter, automated traffic systems.

Output

Interview Summary

Step 4: Pain-Point Analysis

Pain-Point Table

Category	Identified Pain Points
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Functional	Long waiting times, inefficient signal timing
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Emotional	Frustration, stress, anger while driving
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Systemic	Outdated fixed-timer signals, lack of real-time data
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Critical Pain Point

Traffic signals operate on fixed timings and do not respond to real-time traffic congestion.

Step 5: Root Cause Identification

Method Used

5-Why Analysis

1. Why do traffic jams occur at signals?
→ Signals do not adjust based on traffic volume.
2. Why don't signals adjust?
→ They operate on fixed time intervals.
3. Why are fixed timers used?
→ Lack of real-time traffic monitoring systems.
4. Why is real-time monitoring missing?
→ High implementation cost and outdated infrastructure.
5. Why is infrastructure outdated?
→ Slow adoption of smart traffic technologies.

Root Causes Identified

- Absence of adaptive traffic signal systems
- Lack of vehicle detection sensors and AI-based control
- Limited investment in smart traffic management
- Dependence on manual traffic policing

Output

Root Cause Diagram (Textual Representation)

Step 6: Wicked Problem Understanding

This problem qualifies as a Wicked Problem due to the following reasons:

- Multiple stakeholders with conflicting needs (drivers want speed, pedestrians want safety, authorities want control).
- Traffic patterns change continuously due to accidents, weather, festivals, and peak hours.
- No single solution fits all intersections or cities.
- Implementing smart signals requires coordination between technology, government, budget, and public behavior.
- Fixing one junction may shift congestion to another.

Problem Classification

Wicked Problem

Output

Wicked Problem Explanation

Step 7: Reflection

Reflection Report

Initially, it was assumed that traffic congestion is mainly due to an increase in vehicles. However, user interviews revealed that inefficient traffic signal management plays a major role in congestion. Observations showed that fixed-timer signals are unsuitable for dynamic urban traffic conditions.

User perspectives highlighted emotional stress, wasted time, and fuel loss as major consequences, which were underestimated earlier. This lab demonstrated that jumping

directly to solutions like “adding more roads” is risky without understanding real user pain points.

Through this lab, the following skills were developed:

- Observation and analytical thinking
- Stakeholder identification
- Interviewing and empathy building
- Root cause analysis using 5-Why method
- Understanding complex and wicked problems

This exercise emphasized the importance of problem understanding before solution design, especially in real-world urban systems.

Final Lab Deliverables

- Observation Notes
 - Stakeholder Identification
 - Interview Questionnaire & Summary
 - Pain-Point Analysis Table
 - Root Cause Identification
 - Wicked Problem Explanation
 - Reflection Report
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