Reducing Dwell Time: London Underground Central Line

JAKE KELLEY ❖ DANNY KO
LAURIE MAZZA ❖ SAMANTHA ROBINSON
Presentation Introduction

AN INTRO TO THE PRESENTERS AND PRESENTATION
Meet the Team

Jake Kelley
Home: Massachusetts
Major: Mechanical Engineering (Mechanical Design)

Laurie Mazza
Home: Rhode Island
Majors: Computer Science and Interactive Media & Game Development (Visual Arts)

Danny Ko
Home: South Korea, Colorado
Major: Aerospace Engineering (Astronautics)

Sam Robinson
Home: Pennsylvania
Major: Mechanical Engineering (Mechanical Design)
Presentation Outline

Introduction
- Project Goal & Objectives
- Station Observation
- Initial Employee Interviews
- Train Observation

Background
- CCTV Observation
- Passenger Survey
- Frontline Employee Interviews

Identify Factors
- Propose Solutions
- Station Platforms
- Display of Information
- Employees
- Rolling Stock

Determine Key Factors
- Recommendations
Nature of the Problem
Central Line Problems

Third highest average excess journey time

Highest average total lost customer hours

Delays due to overcrowding
Delays & Dwell Time

- Train starts (Departure)
- Operating speed
- Acceleration
- Deceleration
- Train stops (Arrival)
- Alighting
- Open doors
- Close doors
- Boarding
- Dwell Time
- Train starts (Departure)
Project Objectives

Form solutions to minimize high dwell times in the Central Line

Objective 1: Identify Possible Factors

Objective 2: Determine Key Factors

Objective 3: Propose Possible Solutions
<table>
<thead>
<tr>
<th>Objective</th>
<th>Task</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
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<td><strong>Propose Solutions</strong></td>
<td>Analyze Data</td>
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Identifying Possible Factors

OBJECTIVE 1 OVERVIEW

- Employee Interviews
- Station Observation
- Train Observation
Interviews: Behind the Scenes
Interviews: Behind the Scenes
Train Crowdedness Level (TCL)

0 = empty train

1 = some seats taken

2 = all seats taken

3 = all seats and some standing room taken

4 = all seats and most standing room taken

5 = all seats and standing room taken
Train Observation

Note: Dwell Time  TCL  Passenger Flow
Train Observation

Dwell Time and Train Crowdedness Level Per Eastbound Platforms

- TCL 5
- TCL 4
- TCL 3
- TCL 2
- TCL 1

Station names: West Ruislip, Ruislip Gardens, South Ruislip, Northolt, Greenford, Pervale, Hanger Lane, North Acton, East Acton, White City, Shepherd's Bush, Notting Hill Gate, Queensway, Lancaster Gate, Marble Arch, Bond Street, Oxford Circus, Tottenham Court Road, Holborn.
Train Observation

*note: Loughton and Leytonstone are caused by delays in the line, not passenger behavior
OBJECTIVE 1
Identify Possible Factors

System Constraints

Passenger Behavior
Passenger Behavior Factors

- Station Passenger Flow
- Platform Passenger Flow
- Alighting & Boarding
- Door Reopening
- Luggage
- Train Car Passenger Flow
- Commuters
- Shoppers
- Tourists
System Constraint Factors

- Station Layout
- Platform Layout
- Signalling System
- Tunnels
- Rolling Stock
- Employees
- Announcements
- Signage
- Maps
Determining Key Factors

OBJECTIVE 2  OVERVIEW

CCTV Observation  Passenger Survey  Employee Interviews
CCTV Observation
## CCTV Observation

### Average Dwell Time

<table>
<thead>
<tr>
<th>Average Dwell Times</th>
<th>PCL (front)</th>
<th>PCL (middle -front)</th>
<th>PCL (middle -back)</th>
<th>PCL (back)</th>
<th>Walking Support Items</th>
<th>Large Luggage</th>
<th>Accidental door reopening</th>
<th>Intentional door reopening</th>
<th>Type: rushing/ in a hurry</th>
<th>Type: oblivious/ obstructing</th>
<th>Type: groups/ chatting</th>
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**Platform Crowdedness Level (PCL)**
CCTV Observation
Problem Passengers per 10 Trains

0.8 Groups: Families & Friends

1.3 Obstructing: Oblivious & Confused

5.1 W/Luggage: Larger than Backpack

11.2 Rushing: Last second boarders
Passenger Survey

What is your primary reason for using the Central Line?

- Commuting
- Tourism
- Shopping
- Casual

If possible, do you typically run onto trains last minute?

- Yes
- No
- I am not sure

If you knew that a later train is more empty than the next train, would you be willing to wait?

- Yes
- No
Respondent Types

- Commuting: 59.05%
- Tourism: 20.00%
- Shopping: 10.48%
- Casual: 10.48%
Willingness to Wait

Percentage

- Yes
- No
- I am not sure
- Other:

0.00% 10.00% 20.00% 30.00% 40.00% 50.00% 60.00% 70.00%
Passenger Satisfaction

Provision of Information

Platform Layout

- Satisfied
- Neutral
- Dissatisfied
Satisfaction with Carrying Capacity

Passenger Satisfaction with Train Size and Passenger Capacity

- Satisfied
- Neutral
- Dissatisfied
Passengers’ Favorite Lines
Commuters’ Favorite Lines

- Victoria: 26.32%
- Waterloo & City: 17.54%
- Piccadilly: 12.28%
- Central: 12.28%
- Hammersmith & City: 7.02%
- District: 7.02%
- Bakerloo: 3.51%
- All Others: 8.77%
Tourists’ Favorite Lines

- Piccadilly: 50.00%
- Victoria: 10.00%
- Bakerloo: 10.00%
- Westminster & City: 10.00%
- I am not sure: 10.00%
- Central: 10.00%
- Circle: 10.00%
- District: 10.00%
- Hammersmith & City: 10.00%
- Jubilee: 10.00%
- Metropolitan: 10.00%
- All Others: 10.00%
Shoppers’ Favorite Lines
Casual Riders’ Favorite Lines
Interviews: Frontline

Problem Areas
● Rushers
● Groups
● Platform crowding

Solutions
● Upgrade trains
● More platform attendants
OBJECTIVE 2
Determine Key Factors

- Uneven Platform Crowding
- Obstructed Boarding & Alighting
PCL vs Platform Entrance/Exit

Front: 4.1  
F-Mid: 3.2  
B-Mid: 1.9  
Back: 1.1
Key Factor: Uneven Platform Crowding

Platform Crowding at Entrances/Exits

Problem Passengers

Provision of Information

Station Platforms
Key Factor: Boarding & Alighting Issues

Obstructed Boarding & Alighting

- Problem Passengers
- Provision of Information
- Rolling Stock
Door Reopening

Observed Door Reopening Cause

- Intentional: 62%
- Accidental: 38%

The pie chart illustrates the observed causes of door reopening, with intentional causes accounting for 62% and accidental causes for 38%.
Solving the Problem
OBJECTIVE 3
Propose Solutions

- Station Platforms
  - Benches
  - Visibility
- Information Display
  - Updated and New Signage
  - Platform Floor Lines
- Employees
  - Platform Attendants
- Rolling Stock
  - Handles
  - Directional Train Doors
  - New Trains
Platform Benches
Platform Benches
Reduce Train Visibility
Signage Placement
Passenger Information Display

- 1 Hainault via Newbury Park
- 2 Special
- Central Line
- 10:07

3 Mins
5 Mins
### Passenger Information Display

#### Central Line Eastbound

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<tr>
<td>1</td>
<td>Epping</td>
<td>1 min</td>
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<tr>
<td>2</td>
<td>Woodford via Hainault</td>
<td>4 min</td>
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<tr>
<td>3</td>
<td>Epping</td>
<td>6 min</td>
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10:07
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<tr>
<th>Destination</th>
<th>Time</th>
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<tr>
<td>1 Epping</td>
<td>1 min</td>
<td>••••</td>
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<tr>
<td>2 Woodford via Hainault</td>
<td>4 min</td>
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<tr>
<td>3 Epping</td>
<td>6 min</td>
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Central Line Eastbound 10:07
ALL TRAINS GO TO STRATFORD
Platform Floor Lines
Way Out Indicators
No Standing Zone Lines
Platform Attendants
Handle Placement
Single Direction Doors
New Rolling Stock
Recommendations

Central Line Improvements

Testing Solutions

Technical Aspects

Tourist Information
Recommendations

Station Layouts

Leytonstone

Mile End & Stratford

Bank & Monument
Recommendations

Future IQP Projects

Transport for London

National Rail

Network Rail

Crossrail
Reducing Dwell Time: London Underground Central Line

Questions?

JAKE KELLEY  ❖  DANNY KO
LAURIE MAZZA  ❖  SAMANTHA ROBINSON
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Conclusion
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*Heartbeat database*