

# **Transport for London: Reducing Passenger Congestion by Providing Additional Bus Services After Events to Disperse Passengers into the Wider Network**

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## ***Introduction***

TfL is a public company, tasked with providing a safe, reliable and effective public transport service for London. However, delays often occur, and overcrowding in stations is a frequent part of everyday life for Londoners.

A particularly dramatic example of this happening in London is within tube stations close to large stadiums, particularly after large scale events end, and people make their journeys home. Wembley Stadium is Europe's largest stadium, and its corresponding tube stations are overcrowded following events.

To help mitigate this problem for TfL, our consulting project provides an effective and realistic solution. We propose that a regular shuttle bus service will take people to stations which are up to 10 minutes' drive away from Wembley stadium. This will disperse crowds and take pressure off Wembley's three main stations: Wembley Stadium, Wembley Park and Wembley Central.

We then show that this is a valid project, fits within TfL's strategic vision, and that the risks identified within the risk assessment are minimal. We conclude that the strategy will deliver a net benefit for TfL and their quality of service.

## ***Company Overview***

TfL is a subsidiary of the Greater London Authority (GLA) and the operation of London's public transport network. TfL was established under the Greater London Authority Act 1999. (UK Parliament, 1999) and runs the Underground, Overground, DLR, Elizabeth Line trains, as well as bus, tram, and river services, which constitute over five million daily travels (TfL, 2024a).

By using TfL sources, the following Company Overview, and their business model was reflected in Figure 1.

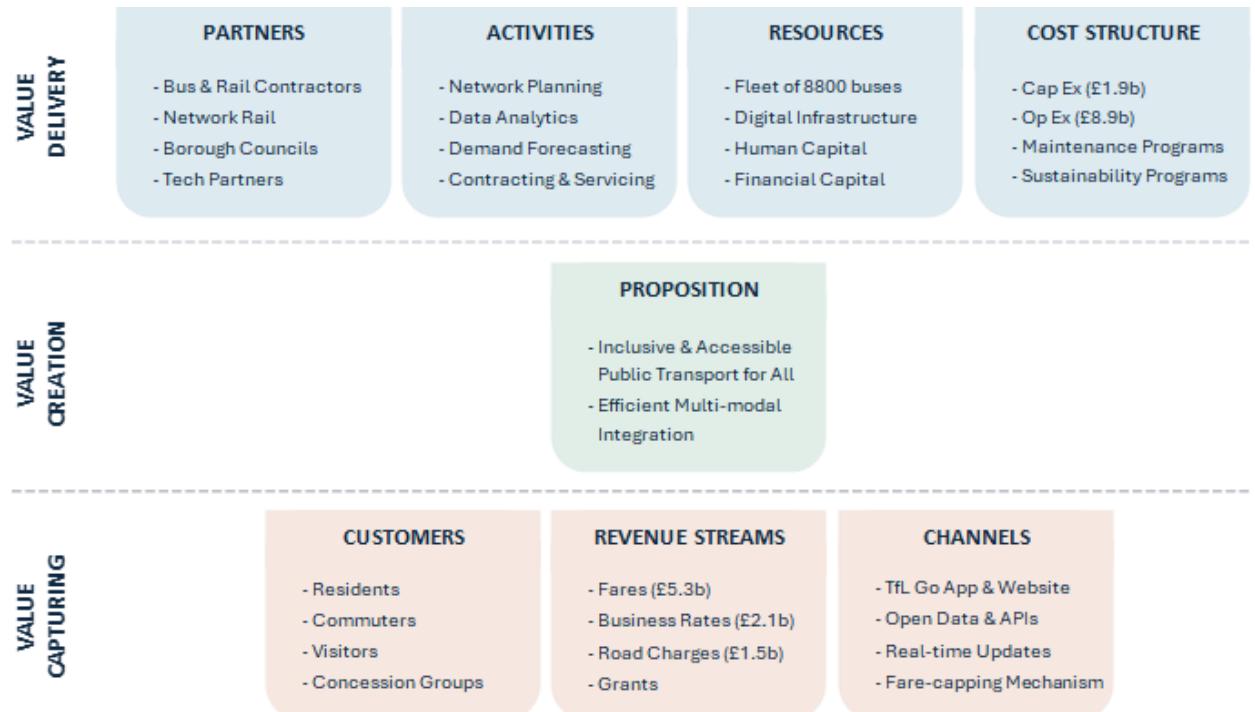
As demonstrated in Figure 1, TfL's key partners include contracted bus and rail operators, Network Rail, borough councils, and technology companies such as Siemens and Cubic, which run fare-collecting and other systems. (TfL, 2025a)

TfL also oversees a high number of physical assets, including, 8,800 buses and 402 kilometres of Underground track, as well as intangible assets such as human skills (TfL, 2025). Collectively, these enable TfL to operate an efficient and cost-effective service to London residents, regional commuters and visitors.

The organisation's cost structure reflects its operational complexity, with £8.9 billion in yearly operating expenses and £1.9 billion in capital investment in 2024/25 (TfL, 2024e). It is funded by several revenue streams, which include £5.3 billion in passenger income, £2.17 billion from retained business rates, and £1.5 billion from road fines and government funding (TfL,

2025a). Moody's (2025) retains TfL's credit rating at A1 (stable), noting enhanced liquidity, robust financial management, and continuous central government backing.

*Figure 1. TfL Company Overview and Business Model Visualisation*



*Source: TfL 2024d; TfL 2024e, TfL, 2025a*

In sum, TfL's business model, finances and operations make TfL an effective organisation. However, TfL has strategic problems, which can be addressed through creative solutions.

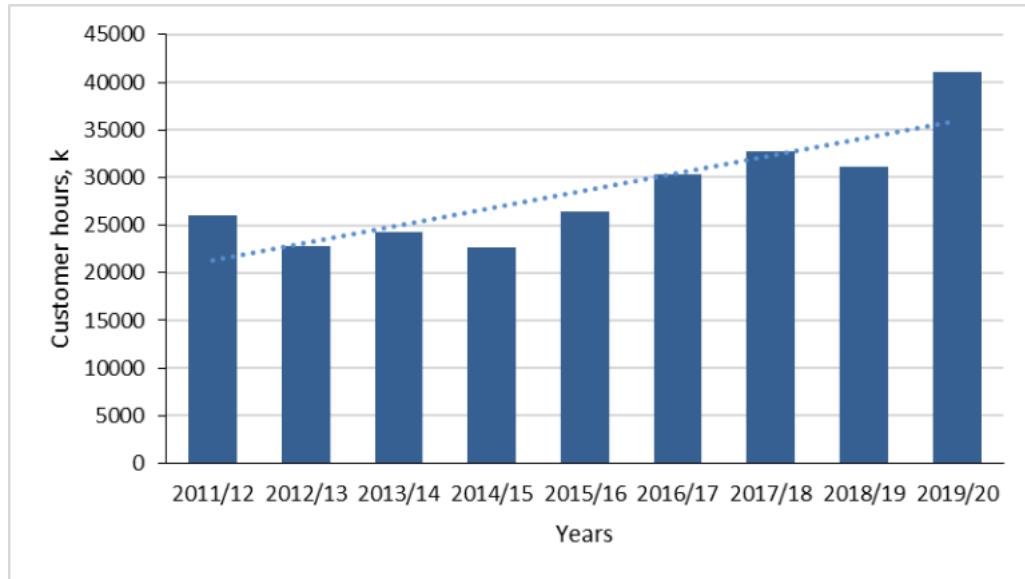
### ***Strategic Problem for TfL: Reducing congestion and waiting times after major events***

#### TfL has a Problem with Delays and Overcrowding

By law, TfL has to provide a safe and efficient service (Transport for London Act, 2008). However, TfL can at times fall short of these standards. Services can regularly encounter delays, meaning passengers lose time in their days.

Using the most recent data available, we can see that across the rail network, the total lost customer hours due to delays in a year, has trended upwards from the year 2011/12-2018/19. (Figure 2) The TfL stopped collecting this data from 2020, due Covid 19 decreasing the demand on the network.

*Figure 2. Number of Lost Customer Hours Over Time*

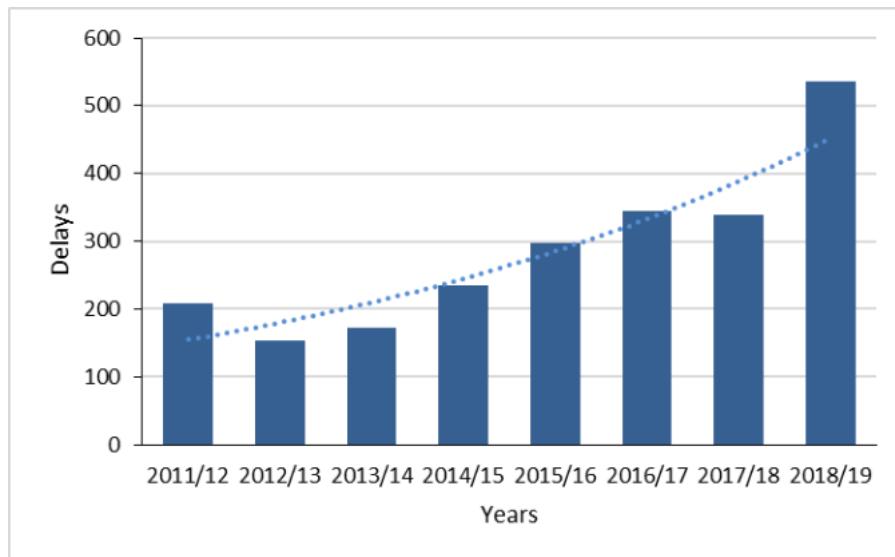


*Source: Mayor of London, 2019*

Many of these delays are caused by overcrowding. A response to a freedom of information request in 2020 details the number of crowding/congestion incidents that caused delays of 2 minutes or more between 2011/12 and 2019/20. (Mayor of London, 2020)

Again, data collection in this category stopped in 2020 due to Covid. This data covers underground lines, as overcrowding data on Overground, DLR or Elizabeth Line services were not available. The data for the shows us that overcrowding in stations causes delays, and that, at least until Covid, this problem was getting worse. (Figure 3)

*Figure 3. Delays on the London Underground Caused by Overcrowding*

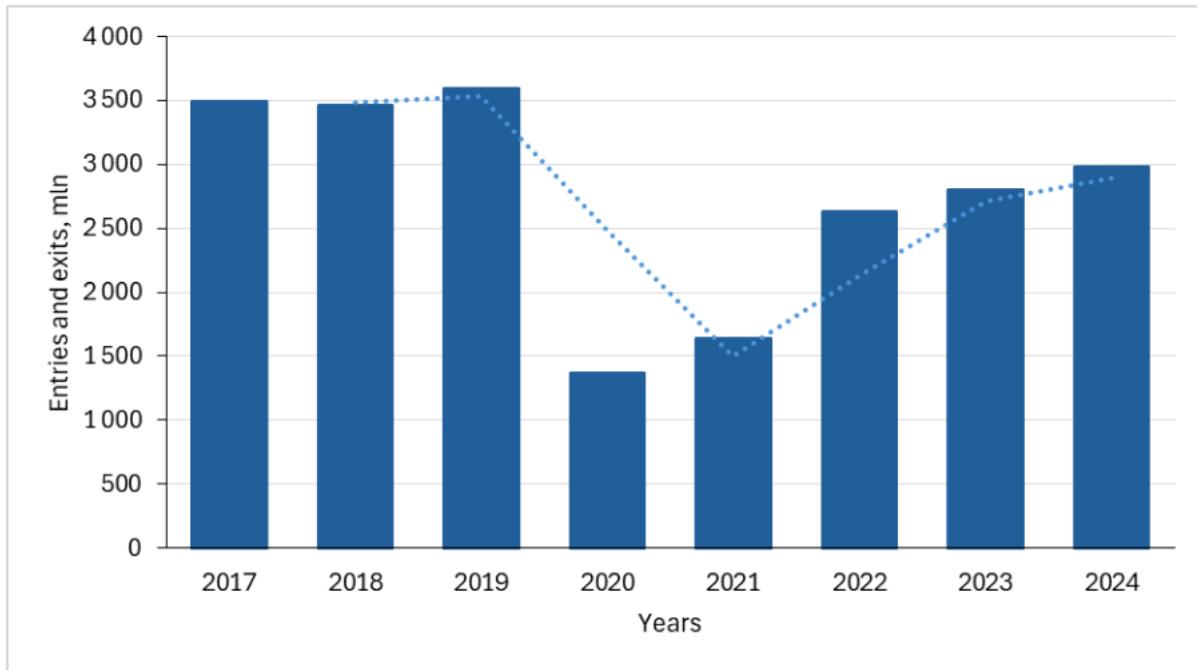


*Source: Mayor of London, 2020*

It is possible to hypothesise that overcrowding, delays and lost customer time is now less of an issue post Covid. It is true that passenger numbers severely decreased in 2020.

However, demand is returning. By analysing datasets which show the annual tap ins and outs per underground station, we can see that after a sharp dip in demand for rail services, passengers are returning to the network. The total entries and exits for 2024, is now only 19% down from 2019 levels.

*Figure 4. Annual Number of Entries and Exits Across Underground, Overground, DLR and Elizabeth Line Services*

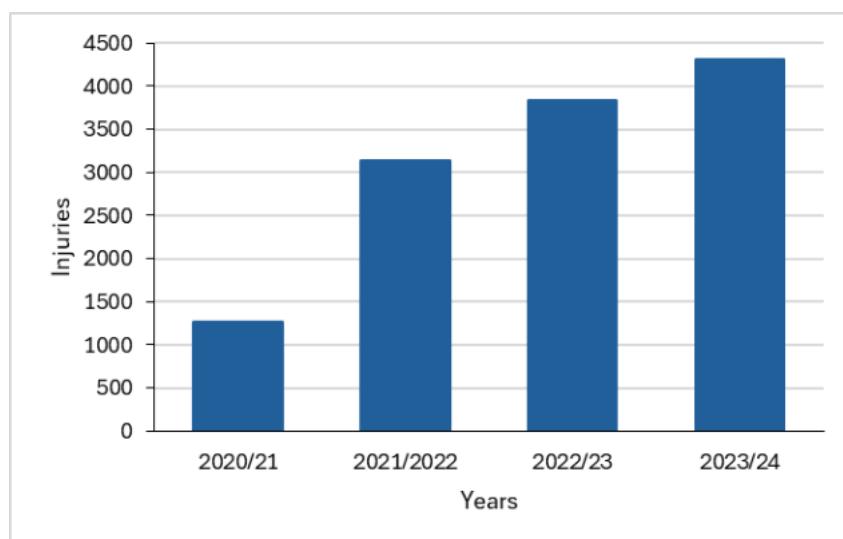


*Source: TFL, 2024h*

What this information shows us that lost customer hours due to delays is a historic and entrenched problem for TFL. As demand returns to a somewhat normal level TFL need to acknowledge the need to decrease delays across the rail network.

Moreover, as passenger numbers have recovered over recent years, we also see a sharp increase in passenger injuries

*Figure 5. Number of Minor and Major Injuries Across Underground stations*



*Source: TFL, 2025b*

Sufficient overcrowding data is not available to see if there's a correlation between overcrowding incidents and injuries between 2020-2024. However, it is notable that between 2020 and 2024, injuries across the underground network increased by 341%, while passenger numbers in the same period, only increased by 219%. (Figure 4; Figure 5) This increase in passenger injuries is disproportionately higher than the increase in passenger numbers.

Given that station crowding has historically been linked to injuries (Select Committee on Transport, 2003), it can be hypothesised that a similar situation is occurring in the present day as well

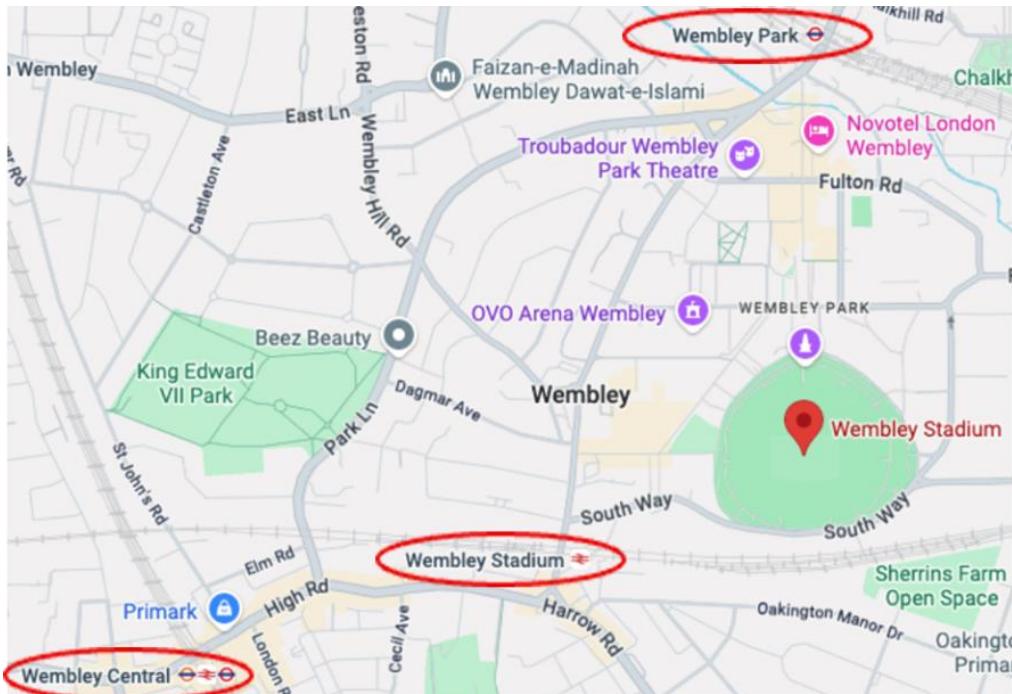
What the analysis in this section shows us is that, according to the most recently available data, delays are common and are often caused by overcrowding. Passenger numbers are recovering since Covid, and it is therefore likely that this problem is returning in severity. There is also a possibility that increased passenger crowding in stations are leading to more injuries.

### Wembley: A Focal Point for Congestion

An area where crowding and delays is pertinent is after major events in London, such as sports games and concerts. For example, for major sporting events alone, 250,000 fans use the capitals transport network, to travel to and from sports matches. Many of this number overcrowd TFL stations, in their effort to get home. (London Assembly, 2007)

The most dramatic example is Wembley. It is Britain's largest stadium, and Europe's second-largest stadium with a capacity of 90,000 people. (Wembley Stadium, 2025a) The events mainly held there are football matches, and concerts. After major events, tens of thousands of fans disperse and travel home from three rail stations: Wembley Stadium (national rail), Wembley Central (Overground and Underground) and Wembley Park. (Underground). (Figure 5)

Figure 5. Google Maps



Source: Google Maps, 2025

The team at Wembley Stadium claim that 75% people travel to and from Wembley events via public transport. (Wembley Stadium, 2024a) Given the capacity of the stadium, this means that on event days, a large number of passengers disperse onto these three stations from a very concentrated position, in a short period of time, two of which run TFL rail services.

This creates wait times which are excessive. Queue times to enter the rail stations can reach one hour or more. (Wembley Stadium, 2025b) Overcrowding at Wembley's stations after events, is a serious issue, and a strategy is needed to disperse passengers into the wider TFL network

### ***Proposed strategy***

The goal of this strategy is to reduce post-event congestion at the three key stations surrounding the stadium, through the introduction of targeted shuttle bus corridors.

These shuttles would transport a share of passengers to nearby Underground stations on different lines, helping disperse flows and restore normal service faster.

The approach follows three stages:

1. *Descriptive analytics* to identify congestion patterns in space and time.
2. *Econometric modelling* to quantify the parameters of station crowding.
3. *Scenario simulation* to assess the potential benefits of shuttle deployment.

### ***Descriptive analysis***

Daily and hourly crowding data from TFL were combined with official match and concert schedules for 2022–2025. The descriptive analysis highlights clear temporal and spatial patterns.

Average hourly entries and exits at Wembley Park reach three times their normal levels between 21:30–22:30 on match days. Wembley Central shows smaller but more sustained increases, while Wembley Stadium station records the sharpest spikes immediately after full-time. Across the 2019–2025 sample, 35 of the 103 extreme crowding spikes coincide with football matches, while concerts account for roughly one-third of the remaining anomalies (TfL, 2024g).

Two main trends stand out:

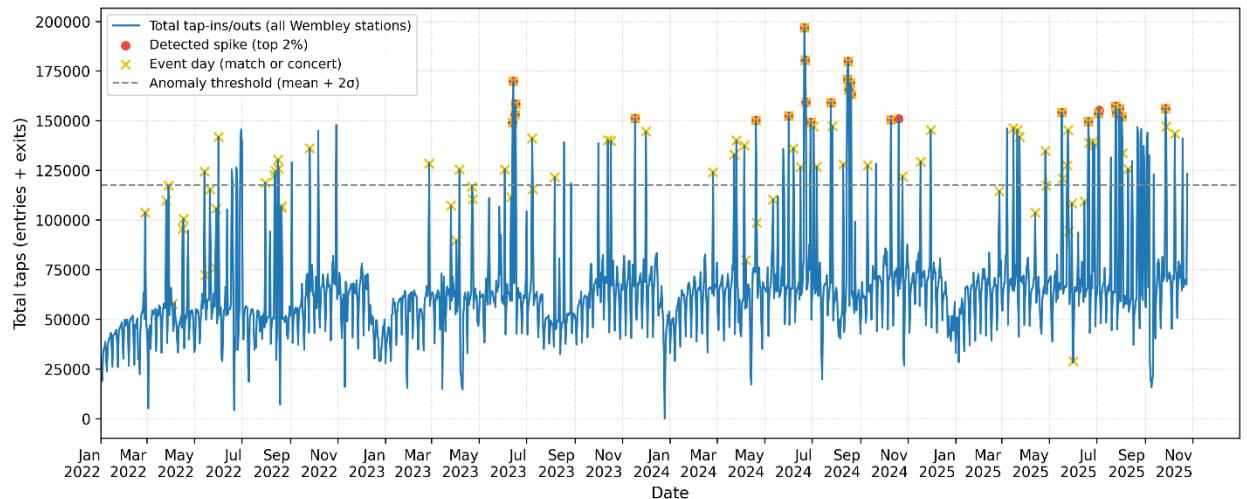
1. Football matches cause sharper but shorter peaks, concentrated within one hour after the event. (Wembley, 2024b)
2. Concerts cause smaller but more gradual increases, typically lasting up to two hours. (Engage Hospitality; 2025)

Combining Transport for London footfall records at the three Wembley stations (daily entries and exits), event schedules for matches and concerts (official Wembley Stadium listings), and city-wide mobility data (total Tube and bus journeys per day). From these sources, daily aggregates of station usage were computed as:

$$taps_t = \sum_{i=2022}^{2025} (entries_{i,t} + exits_{i,t}), \text{ where } i \text{ indexes the three stations (Wembley Park, Wembley Central, North Wembley) and } t \text{ denotes each calendar day.}$$

Graphs of hourly entries (*Figure 6*) show that crowd levels drop back to normal only after 23:30, confirming the need for targeted dispersal between 21:30–23:00.

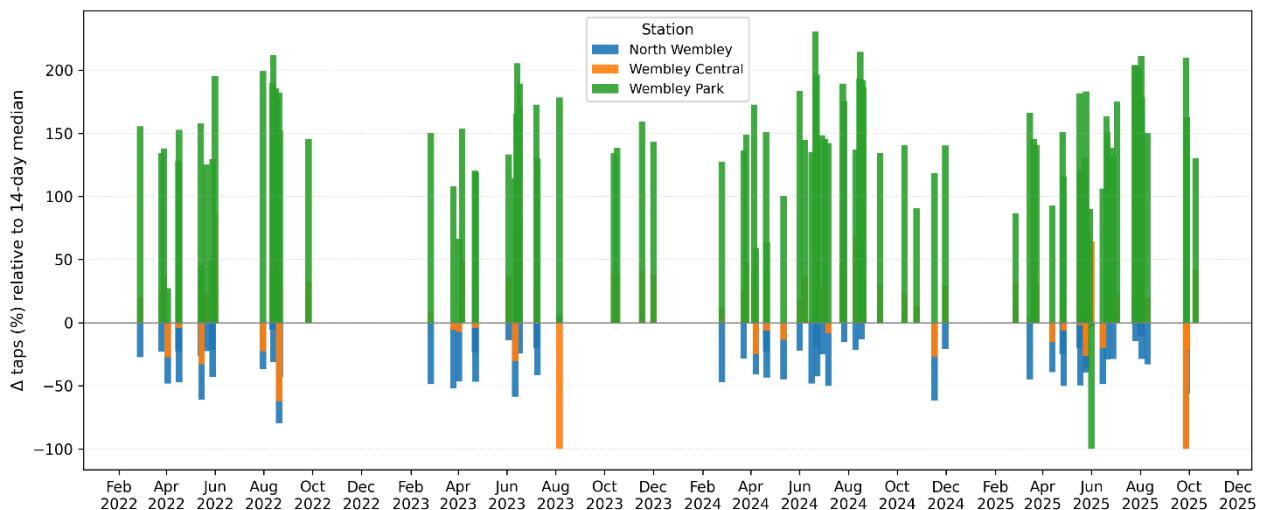
*Figure 6. Total passenger entries and exits across Wembley stations (Jan 2022 – Dec 2025).*



*Source: Author's visualization based on TfL passenger entry/exit data*

The 14-day baseline chart (*Figure 7*) shows that Wembley Park takes the largest spikes on event days, while nearby stations appear underused. Negative values are not lower demand but the result of TfL temporarily closing or limiting exits at Central/North Wembley. This forces crowds toward Wembley Park, creating artificial drops at neighboring stations despite very high overall demand.

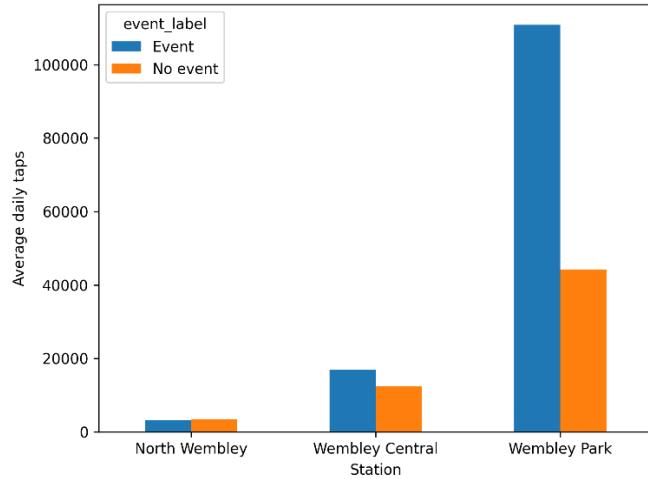
*Figure 7. Percentage deviation from 14-day local baseline on event days by station (2022-2025).*



*Source: Author's visualization based on TfL footfall data.*

The event vs. non-event station chart confirms the same pattern (*Figure 8*): Wembley Park carries the overwhelming share of match and concert traffic, with only limited spillover to Wembley Central and almost none to North Wembley.

*Figure 8. Average passenger flows by station (event vs non-event days)*



*Source: Author's visualization based on TfL data*

### Shuttle corridor design

Several shuttle routes are designed based on proximity to other Underground lines and available road infrastructure. Each route aims to relieve pressure on a specific part of the network:

*Table 1. "Proposed shuttle corridors and operational parameters"*

Destination station	Line	Distance	Travel time	Purpose
Sudbury Town	Piccadilly	3.9 km	10 min	Divert from Jubilee line (Wembley Stadium)
Alperton	Piccadilly	4.0 km	10 min	Redirect Westbound crowd (Wembley Park)
North Wembley	Bakerloo / Overground	2.9 km	7 min	Relieve central pressure (Wembley Central)

Operational coordination is essential to ensure that the shuttle system functions safely and efficiently:

- Stadium exits should be organized by fan sectors to prevent conflicts between supporter groups
- Shuttle lanes are to operate along Engineers Way and Empire Way
- Continuous communication between TfL staff, event stewards, and bus operators is required to maintain flow control
- Real-time crowd data can be used to redirect passengers toward less busy routes
- Digital screens should display estimated waiting times and route options to encourage balanced distribution across the available shuttles.

## Regression modeling

An OLS regression was estimated with the logarithm of total daily station entries/exits as the dependent variable to understand the magnitude of congestion:

$$\log(taps_t) = \beta_0 + \beta_1 Match_t + \beta_2 Concert_t + \beta_3 \log(taps_{t-1}) + \beta_4 Weekend_t + \beta_5 TubeJourney + \beta_6 BusJourney + \varepsilon_t$$

*Table 2. Variable Descriptions*

Variable	Description
$\log(taps_t)$	The natural logarithm of total daily passenger entries and exits across the three Wembley stations
$Match_t$	=1 on days when a football match took place at Wembley Stadium, =0 otherwise. Captures the effect of football events on metro station usage.
$Concert_t$	=1 on days with concerts or large entertainment events, =0 otherwise. Measures the crowding effect from non-sport events.
$\log(taps_{t-1})$	The logarithm of total station entries and exits on the previous day ( $t - 1$ ), included to control for short term persistence in passenger flows.
$Weekend_t$	=1 for Saturdays and Sundays, =0 otherwise. Accounts for higher leisure-related mobility during weekends.
$TubeJourney_t$	Continuous variable representing the total number of Underground journeys across London on day $t$ . Serves as a proxy for overall city-wide travel demand.
$BusJourney_t$	Continuous variable showing total daily bus journeys across London. Added as an additional mobility control variable.

*Table 3. OLS regression results for baseline model (log of total daily entries and exits across Wembley stations, 2022–2025).*

Variable	Coefficient	Std. Error	p-value	Significance
<i>Intercept</i>	8.5498	0.279	0.000	***
$Match_t$	0.702	0.038	0.000	***
$Concert_t$	0.839	0.041	0.000	***
$\log(taps_{t-1})$	0.136	0.025	0.000	***
$Weekend_t$	0.072	0.027	0.009	**
$TubeJourney_t$	$2.89e-07$	$2.3e-08$	0.000	***
$BusJourney_t$	$9.48e-09$	$2.18e-08$	0.663	—

$$R^2 = 0.659$$

$$Adjusted R^2 = 0.656$$

$$F - statistic = 211.1 (p < 0.001)$$

$$n = 663$$

The model fits well ( $R^2 = 0.66$ ), and all key variables are statistically significant (*Table 3*).

The coefficient for  $Match_t$  ( $\beta = 0.70, p < 0.001$ ) indicates that station usage increases by about 101% on football days relative to normal days.

$Concert_t$  ( $\beta = 0.84, p < 0.001$ ) shows an even stronger effect, roughly 132% higher flows, confirming that concerts generate longer and more dispersed exits.

The lagged  $\log_{-}taps_t$  ( $\beta = 0.14, p < 0.001$ ) term is positive, showing persistence in traffic: busy days tend to remain above average the next day.

The Weekend dummy ( $\beta = 0.07, p = 0.009$ ) captures an additional 7 % increase in activity.

City-wide controls show that  $TubeJourney_t$  ( $p < 0.001$ ) positively correlates with Wembley traffic, while  $BusJourney_t$  is insignificant ( $p = 0.66$ ).

Adding the interaction term (Weekend  $\times$  Match) did not improve the model.

Its coefficient is statistically insignificant ( $p = 0.286$ ), meaning there is no evidence that matches held on weekends behave differently from matches on weekdays (Table 7).

Overall, the model confirms that Wembley events more than double local passenger volumes, with concerts having the largest impact.

### Shuttle simulation: regression transformation

To test the effect of shuttle operations, a counterfactual scenario was modelled by reducing event-day passenger counts by 20%, reflecting the expected diversion of spectators and the results of prior sensitivity tests, which showed that a 20% shift produces the most efficient and realistic redistribution. The extended model adds a dummy variable  $Shuttle_t$  - equal to 1 under the simulated shuttle intervention and 0 otherwise.

$$\log(taps\_shuttle_t) = \beta_0 + \beta_1 Match_t + \beta_2 Concert_t + \beta_3 \log(taps_{t-1}) + \beta_4 Weekend_t + \beta_5 TubeJourney + \beta_6 BusJourney + \beta_7 Shuttle_t + \varepsilon_t,$$

The evening dispersal flow (approximately 90 000 spectators leaving the stadium) would decline to  $\approx 72 000$ , or 18 000 fewer people at peak hour.

This reduction translates into **20–25** minutes shorter waiting times and substantially less platform crowding.

*Table 4. OLS regression results for shuttle-scenario model (2022–2025).*

Variable	Coefficient	Std. Error	p-value	Significance
Intercept	8.5498	0.279	0.000	***
Match <sub>t</sub>	0.114	0.038	0.000	***
Concert <sub>t</sub>	0.251	0.041	0.000	***
log (taps <sub>t-1</sub> )	0.136	0.025	0.000	***
Weekend <sub>t</sub>	0.072	0.027	0.009	**
TubeJourney <sub>t</sub>	2.89e-07	2.3e-08	0.000	***
BusJourney <sub>t</sub>	9.49e-09	2.18e-08	0.663	—
Shuttle <sub>t</sub>	0.3648	0.019	0.000	***

$$R^2 = 0.577$$

$$Adjusted R^2 = 0.573$$

$$F - statistic = 148.9 (p < 0.001)$$

$$n = 663$$

The event variables remain significant but smaller in magnitude -  $Match_t$  ( $\beta_1 = 0.11, p < 0.001$ ) and  $Concert_t$  ( $\beta_2 = 0.25, p < 0.001$ ) - confirming that the shuttle plan effectively absorbs

part of the crowd pressure (*Table 4*). The Weekend and TubeJourney controls stay positive and significant.

The model maintains a solid fit ( $R^2 = 0.58$ ), supporting the effectiveness of shuttle operations as a congestion-mitigation measure.

The proposed shuttle service operates as a non-stop express link between Wembley Stadium and selected nearby Underground stations. Each route functions in a single direction - from the stadium to the destination station - with buses returning empty for the next departure. No intermediate stops are planned, ensuring faster turnover and predictable travel times driving in a bus lane.

Each double-decker bus can depart fully loaded from the stadium three times per hour, and since shuttles operate for two hours post-event, a single vehicle can move up to:

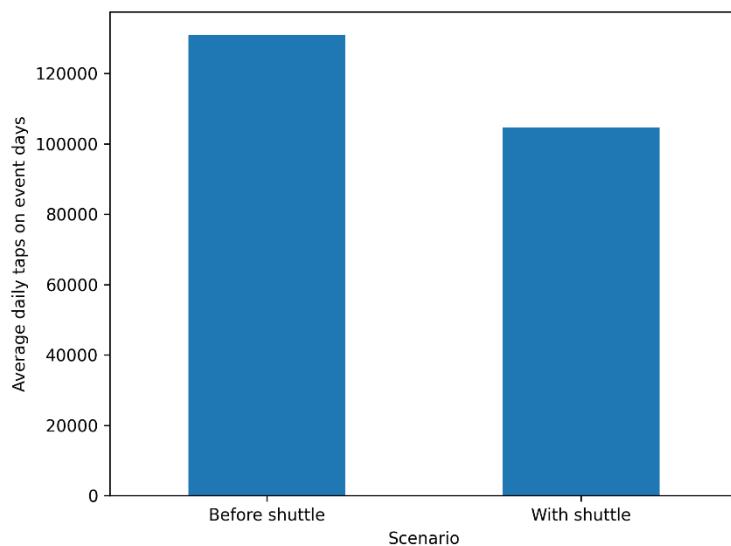
$$87 * 3 * 2 = 522 \text{ passengers (one-way, 3 times total over 2 hours)}$$

To transport 18 000 passengers (*Figure 9*), the required fleet size is:  $\frac{18000}{522} \approx 35$  buses, at a cost of £90 per hour, total operating expenses equal:  $35 * £90 * 2 = £6300$

Including coordination, police escort, and contingency, total cost is expected at £8,000–£10,000 per event ( $\approx £0.55$  per diverted passenger).

These express shuttles would operate directly from designated pick-up areas outside the stadium perimeter (e.g. Engineers Way), use reserved traffic lanes, and drop passengers directly at Sudbury Town, Alperton, and North Wembley without intermediate stops.

*Figure 9. Simulated impact of shuttle buses on Wembley station crowding*



*Source: Author's visualization based on Predicted reduction  $\approx 18,000$  passengers (-20%).*

## Summary

The analysis demonstrates that large-scale events at Wembley Stadium significantly increase passenger congestion, especially around Wembley Park station. Regression results and simulations confirm that targeted shuttle services could reduce overall station loads by about 20%, easing platform pressure and cutting waiting times by nearly a quarter.

Given the relatively low operational cost and strong predicted effect, shuttle deployment offers a realistic and scalable solution to manage post-event dispersal. This strategy improves passenger safety and comfort.

## Strategic Alignment

The proposed strategy strongly aligns with TfL's organizational vision of "providing safe, reliable, and inclusive transport that keeps London moving sustainably" (TfL, 2023a) and with their transport strategy which aims at reducing congestion, improving accessibility and fostering modal shift to public transport (Mayor of London, 2018). The proposed strategy directly feeds into that by easing overcrowding and bottlenecks at dense stations like Wembley's during events, while enhancing passenger safety and satisfaction, and upholding TfL's operational reliability.

From a sourcing angle, TfL has an existing fleet of 8800 buses approximately, from which around 8000 are continuously active (Mayor of London, 2025), leading to a surplus of 800 buses which can be used strategically.

Their bus network has flexible and redeployable capacity (TfL, 2024a). They also have the institutional expertise and capabilities needed to implement the strategy. Their existing contracts with private operators and the Bus Service Operators Grant (Department of Transport, 2024) lays the framework to fund additional event-based operations without large capital expenditure.

Additionally, TfL deploys a robust digital infrastructure, like bus tracking and journey planners that enable dynamic route and passenger management in real time (TfL, 2023b) making the proposed strategy ideal for their existing capabilities.

Finally, the proposed strategy requires in-depth stakeholder engagement, as TfL would need to secure buy-ins of event organisers, venue managers, municipalities and police, all of whom TfL has existing strong ties with, facilitating coordination needed for the strategy, to optimise route design, crowd management, monitoring, contracting, permitting, and PR & comms.

To conclude, by aligning the strategy with TfL's objectives, and by leveraging TfL's existing resources, capabilities and partnerships, the proposal presents an effective solution to tackle the issue.

## Validation

Several transportation trends are taken into consideration in validating the proposal. The TfL network post-pandemic use has greatly increased, with underground utilisation reaching 81% of pre-pandemic levels in 2024 (TfL, 2024f). Additionally, events hosted in Wembley stadium peak at 90,000, with 75% utilizing public transport, leading to a problematic pattern that can be effectively predicted and resolved using idle TfL fleet to compensate for overcrowding of the underground system.

Furthermore, customer surveys highlight that passenger satisfaction is highly dependent on crowding, safety and operational reliability (TfL, 2023c). Tackling long queueing times and injury rates associated with mega-events would directly enhance customer needs and satisfaction.

Additionally, TfL has been asked by the London Assembly (2022) to deploy mobility solutions to meet event-related travel demands and needs, showing that political, municipal and regulatory support can be leveraged in the proposal.

To validate the proposed solution, benchmarking is needed against similar strategies in other major cities that host events of the same size and nature. Transport for Greater Manchester (TfGM) is implementing a similar solution to football games transportation demands, by operating shuttle buses between major stadiums and nearby strategic hubs which has successfully reduced post-event crowding by up to 35% (TfGM, 2023) while also enhancing customer safety.

Likewise, Russia's Ministry of Transport and the Sochi Organising Committee have designed and implemented a wider winter Olympics transportation plan by combining high-frequency shuttle buses, dedicated lanes and temporary parking hubs to manage and transport crowds of 120,000 passengers per day across different zones (OECD, 2015), reducing congestions by up to 40% and enhancing customer safety. The two benchmarks show the extent of how effective an innovative mobility solution for large scale football events is.

To conclude, the findings validate the proposed strategy and its potential in resolving public transport overcrowding issues associated with mega-events at Wembley.

### Risk Assessment

Post-event congestion around Wembley may pose significant problem to the strategy. After events average traffic speed on the A406 near Wembley falls to 7 - 9 mph, and vehicle volumes increase by 42%. (TfL, 2023d) This congestion could delay redeployed buses and reduce their effectiveness in dispersing passengers. However, given that our strategy only requires 35 buses, it can be assumed that their effect on traffic will be negligible, especially given that the buses can use existing bus lanes.

It may also be possible that passengers may not be willing to participate in this scheme or aware of its existence. Surveys indicate that only 18% of event attendees are willing to alter their travel routes after large gatherings without visible guidance or prior communication (London Assembly, 2007). In order to make sure that passengers participate in this scheme, the strategy assumes that Wembley Stadium staff and TfL will take measures such as pre-event emails and deploying steward leg directions / adequate signage on the day.

The impact on the environment also needs to be acknowledged. Implementing an additional bus service would increase emissions, and lower local air quality around Wembley. Although many vehicles in the fleet are cleaner than older models, a noticeable share still runs on diesel and contributes to emissions in congested conditions. This creates tension with the Mayor's Net Zero 2030 pathway and with TfL's Bus Action Plan (Mayor of London, 2021; TfL, 2024c). To mitigate this concern, we assume that TfL will prioritise the use of their electric bus fleet, honoring their commitment to sustainability.

Budgetary constraints represent another limitation. TfL allocates roughly £6 million per year to flexible event-related transport operations, and additional staffing, signage, and maintenance could put pressure on this budget. (TfL, 2024d). However, our estimate that the strategy would cost £8,000–£10,000 per event suggests that it should be affordable within existing budgets, especially if a proportion of operating costs can be recouped via standard passenger fares of £1.75 per journey (TfL, 2024d). However, these figures remain indicative and could fluctuate.

## ***Generative AI Component and Consideration of Alternative Scenarios***

We used generative AI to conduct a targeted critique of our draft strategy for TfL and Wembley. We used the most up to date draft (different to this final draft) and asked the AI model to identify weaknesses in our project. (OpenAI, 2025).

The AI complemented our project, citing its clear argument, strong alignment to TfL's priorities, and a realistic solution. Its identified weaknesses were that there were not enough granular details in the proposed strategy section, including platform management. It also questioned that 20% of passengers would adopt the new scheme, citing that passengers are unwilling to break entrenched habits. It also critiques the risk assessment and validation sections, saying that we need to consider the environment further, address traffic risks, and give more detail on the Manchester and Russia examples.

This analysis was helpful, and we decided to add additional details on acknowledging passenger uptake willingness, and environmental and traffic risks. However, for the other critiques, the AI underestimates the challenge of delivering a strictly 4,000-word project. For example, providing additional details on platform management and taking deep dives into the Manchester and Russia examples would contravene the word count. Many of these additions would also not be possible due to the shortage of data at the very granular level.

The AI also included an analysis of two different scenarios. The first flagged up the possibility of a major traffic collision on the bus route, putting a literal roadblock in the way of our strategy. This is a valid concern. However, the same possibility of disruption could be levelled at the rail network. TfL buses are also highly adaptable in the wake of traffic disruption, with the bus networks inbuilt digital and dynamic route systems. (TfL, 2023b)

The second scenario told us to consider the possibility that either Wembley stadium creates plans for wider walkways and/or TfL introduce further Jubilee services after big events. This would render our project and its associated costs somewhat meaningless. However, there are no plans by Wembley stadium, or TfL, to make these changes any time soon. Therefore, the justification for this project is still strong.

## **Conclusion**

As aforementioned, TfL is a public company, which has ambitious targets for delivering a reliable and swift service for city's residents. However, TfL has a historic issue of service delays, overcrowding in its stations. These issues are shown to be prevalent in TfL stations which are near stadiums during corresponding large-scale events. Examining Wembley specifically, these issues are pronounced.

Our strategy provides an effective solution. By implementing 35 additional bus services near Wembley stadium after large events, passengers can be effectively dispersed into the larger network. Our findings show that this strategy would lead to a 20-25% reduction in passenger waiting times.

TfL has even at the busiest of times, 800 free buses could be used for the project. In addition, TfL already has sufficient IT systems, has political support and sound stakeholder relations with the staff at Wembley. Similar strategies have also been implemented for example in Manchester and Russia. Therefore, our strategy is implementable and realistic.

There are drawbacks. For example, environmental and traffic concerns have been considered. However, in sum, this strategy is effective and implementable and has the potential to be further expanded beyond the example of Wembley.

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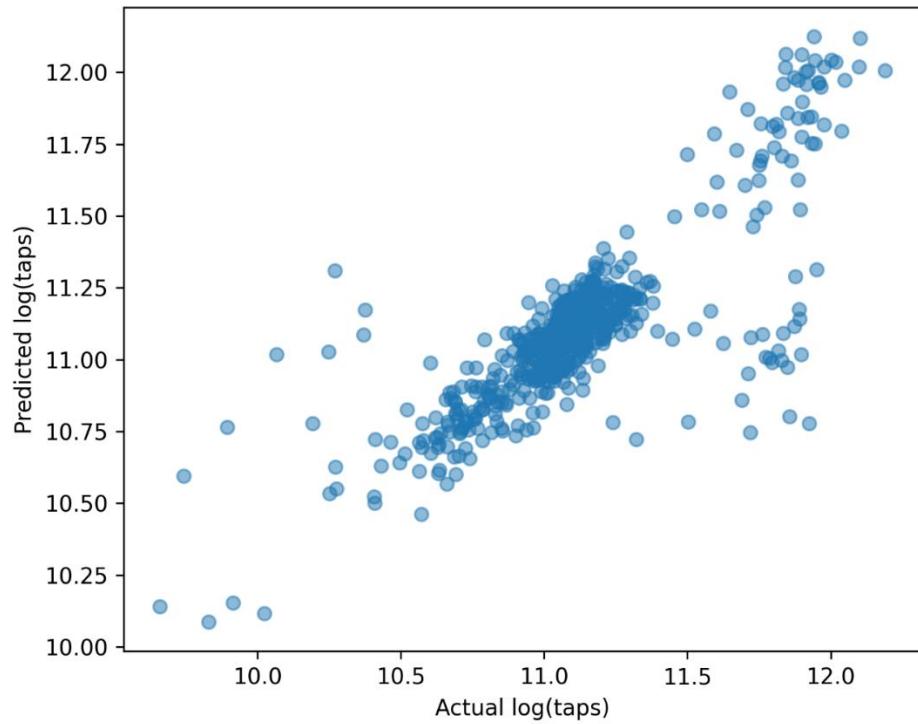
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## Appendix

*Figure 10. Actual vs Predicted passengers flows from the baseline regression model ( $R^2 = 0.66$ ) (Wembley stations)*



*Source: Author's visualization*

The model successfully captures event-related peaks in station usage.

*Table 5. OLS regression results for shuttle-scenario model (2022–2025)*

OLS Regression Results						
Dep. Variable:	log_taps	R-squared:	0.659			
Model:	OLS	Adj. R-squared:	0.656			
Method:	Least Squares	F-statistic:	211.1			
Date:	Mon, 17 Nov 2025	Prob (F-statistic):	1.53e-149			
Time:	23:11:30	Log-Likelihood:	114.74			
No. Observations:	663	AIC:	-215.5			
Df Residuals:	656	BIC:	-184.0			
Df Model:	6					
Covariance Type:	nonrobust					
coef	std err	t	P> t	[0.025	0.975]	
Intercept	8.5498	0.279	30.609	0.000	8.001	9.098
Match_t	0.7019	0.038	18.589	0.000	0.628	0.776
Concert_t	0.8388	0.041	20.390	0.000	0.758	0.920
log_taps_lag1	0.1359	0.025	5.428	0.000	0.087	0.185
Weekend_t	0.0722	0.027	2.636	0.009	0.018	0.126
TubeJourney	2.888e-07	2.3e-08	12.579	0.000	2.44e-07	3.34e-07
BusJourney	9.485e-09	2.18e-08	0.436	0.663	-3.32e-08	5.22e-08
Omnibus:	240.293	Durbin-Watson:	1.596			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	2995.206			
Skew:	1.250	Prob(JB):	0.00			
Kurtosis:	13.108	Cond. No.	2.01e+08			

Notes:

- [1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
- [2] The condition number is large, 2.01e+08. This might indicate that there are strong multicollinearity or other numerical problems.

*Table 6. OLS regression results for shuttle-scenario model (2022–2025)*

OLS Regression Results						
Dep. Variable:	log_taps_shuttle_t	R-squared:	0.577			
Model:	OLS	Adj. R-squared:	0.573			
Method:	Least Squares	F-statistic:	148.9			
Date:	Tue, 18 Nov 2025	Prob (F-statistic):	6.89e-119			
Time:	00:35:00	Log-Likelihood:	114.74			
No. Observations:	663	AIC:	-215.5			
Df Residuals:	656	BIC:	-184.0			
Df Model:	6					
Covariance Type:	nonrobust					
coef	std err	t	P> t	[0.025	0.975]	
Intercept	8.5498	0.279	30.609	0.000	8.001	9.098
Match_t	0.1139	0.028	4.104	0.000	0.059	0.168
Concert_t	0.2509	0.029	8.557	0.000	0.193	0.308
log_taps_lag1	0.1359	0.025	5.428	0.000	0.087	0.185
Weekend_t	0.0722	0.027	2.636	0.009	0.018	0.126
TubeJourney	2.888e-07	2.3e-08	12.579	0.000	2.44e-07	3.34e-07
BusJourney	9.485e-09	2.18e-08	0.436	0.663	-3.32e-08	5.22e-08
Shuttle_t	0.3648	0.019	18.917	0.000	0.327	0.403
Omnibus:	240.293	Durbin-Watson:	1.596			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	2995.206			
Skew:	1.250	Prob(JB):	0.00			
Kurtosis:	13.108	Cond. No.		1.90e+22		

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The smallest eigenvalue is 5.96e-29. This might indicate that there are strong multicollinearity problems or that the design matrix is singular.

Average predicted flow on event days without shuttles: 136,774

Average predicted flow on event days with shuttles: 109,540

*Table 7. OLS regression results for shuttle-scenario model (2022–2025)*

OLS Regression Results						
Dep. Variable:	log_taps	R-squared:	0.659			
Model:	OLS	Adj. R-squared:	0.656			
Method:	Least Squares	F-statistic:	181.2			
Date:	Mon, 17 Nov 2025	Prob (F-statistic):	1.31e-148			
Time:	23:17:09	Log-Likelihood:	115.32			
No. Observations:	663	AIC:	-214.6			
Df Residuals:	655	BIC:	-178.7			
Df Model:	7					
Covariance Type:	nonrobust					
coef	std err	t	P> t	[0.025	0.975]	
Intercept	8.5401	0.279	30.561	0.000	7.991	9.089
Match_t	0.6522	0.060	10.893	0.000	0.535	0.770
Concert_t	0.8401	0.041	20.415	0.000	0.759	0.921
log_taps_lag1	0.1368	0.025	5.461	0.000	0.088	0.186
Weekend_t	0.0676	0.028	2.437	0.015	0.013	0.122
TubeJourney	2.88e-07	2.3e-08	12.544	0.000	2.43e-07	3.33e-07
BusJourney	1.022e-08	2.18e-08	0.470	0.639	-3.25e-08	5.3e-08
WeekendMatch_t	0.0823	0.077	1.068	0.286	-0.069	0.234
Omnibus:	242.942	Durbin-Watson:	1.596			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	3105.756			
Skew:	1.260	Prob(JB):	0.00			
Kurtosis:	13.299	Cond. No.		2.01e+08		

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The condition number is large, 2.01e+08. This might indicate that there are strong multicollinearity or other numerical problems.

## *AI screenshots:*

Please provide a critique of our 4,000 word project for our strategy module.

Separately, please also stress test our project by considering two alternative scenarios, and then use these scenarios to provide further critiques on the project.

Don't make your answer long. 600 words max

### Strategy proposal

You work in an existing (real) organization, and you are tasked with proposing a new strategic direction to the senior management team. You must analyze the company's current positioning and propose a new business strategy to address a critical problem or opportunity. Ensure that your strategy aligns with the company's overall vision and capabilities. Use the concepts learned in this module to inform your strategic recommendations and decisions. Your final submission is required to have the following sections:

- ! Company overview. Summary of the organization, its business model, and current strategic position.
- ! Strategic problem or opportunity. Clear articulation of the key challenge or opportunity facing the firm. Consider how you are framing the problem/opportunity (Consider the difference between "Sales are down" and "Customers are migrating to easy-to-use digital platform alternatives, harming our sales.").
- ! Proposed strategy. Your recommended strategy, including key elements of what the company should do differently and why.
- ! Strategic alignment with existing business and feasibility. How your proposed strategy aligns with the company's vision, resources, and capabilities. Identify implementation requirements.
- ! Validation. Analysis of market trends, customer needs, competitors, or other data to support the strategy's potential.
- ! Risks assessment. Identify potential risks and how they might be mitigated.
- ! Scenario analysis. Consider at least two alternative future scenarios and how your strategy would perform under each ↓
- ! Conclusion. Include practical next steps.

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Below is a concise critique (Part 1) and a scenario-based stress test (Part 2), capped at ~600 words.

## Part 1 — Overall Critique of the Project

### Strengths

- **Clear problem framing:** You move beyond “overcrowding” as a generic issue and focus on Wembley as a critical node with predictable surges. The articulation of a *temporally concentrated, spatially localised* problem is strong.
- **Robust analytical backbone:** Using descriptive analytics, regression modelling, and counterfactual simulation is impressive and uncommon in strategy coursework. It gives the project analytical credibility.
- **Strong alignment argument:** You show convincingly that TfL has the fleet, digital systems, political backing, and stakeholder relationships needed. This section is well-reasoned and avoids hand-waving.
- **Practical, implementable solution:** A shuttle system is relatively inexpensive, uses existing assets, and requires little new infrastructure. The estimated cost per event is compelling.

### Weaknesses / Areas for Improvement

#### 1. Overlong and overly technical in places

Some of the econometric detail (formulae, variable definitions, adjacency of tables) could be pruned without losing value. Strategy audiences, especially senior decision-makers, want synthesis, not econometrics.

#### 2. Underdeveloped strategic alternatives

The strategy is presented as *the answer* rather than *an answer*. You do not seriously consider alternatives such as temporary metering, timed egress, enhanced platform management, temporary pedestrianisation to other stations, or surge pricing.

#### 3. Questionable behavioural assumptions

You rely heavily on the assumption that 20% of passengers will willingly walk to shuttle pick-up points and accept being diverted from familiar stations. Behavioural research suggests compliance falls sharply without mandatory routing. The mitigation (emails, signage) may be insufficient.

#### 4. Operational risks lightly treated

The largest operational risk—road congestion—gets only a few sentences. If buses get stuck in the same traffic as everyone else, the entire strategy collapses. You assume bus lanes can be used, but do not confirm that these lanes a) exist on the full corridor or b) can be repurposed exclusively post-event.

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## 5. Feasibility of redeploying 35 buses

You assume "800 surplus buses", but you must show where they are in the network at 10pm and whether pulling 35 vehicles from their home depots is actually operationally feasible on short notice.

## 6. Environmental analysis is underpowered

You mention emissions concerns but do not quantify them or compare diesel vs EV fleet options.

## 7. Validation section relies on external city analogues

Manchester and Sochi are useful benchmarks, but you need to show comparability: similar road layouts, crowd dynamics, policing regimes, and modal split. Without this, the benchmark appears "convenient" rather than "persuasive".

---

## Part 2 — Scenario Stress Test

### Scenario A — Strongly Adverse: Road Network Disruption

Assume the North Circular suffers a major incident (collision, emergency roadworks, or police cordon) during a high-profile event. Average speeds fall below 4 mph, bus lanes are partially blocked, and stewards must reroute pedestrians.

#### Stress-Tested Critique

- Shuttle performance becomes highly unreliable; modelled 20–25 minute reductions in waiting time disappear.
- The project is overly dependent on road fluidity but does not have contingencies (e.g., dynamic diversion plans, temporary road closures favouring buses, use of high-frequency shuttles to *rail hubs* rather than stations).
- This reveals an *over-reliance on a single transport mode*. The strategy needs multimodal resilience (pedestrianised "walking corridors", additional direct rail services, temporary crowd metering).

### Scenario B — Strongly Positive: Rapid-Egress Infrastructure Upgrade

Assume Wembley implements a major egress redesign: widened walkways, new crowd channels, improved metering, and DCMS/TfL fund a temporary event-day loop service on the Jubilee line every 3 minutes.

#### Stress-Tested Critique



- Your shuttle system becomes marginal rather than central. If rail absorbs +15–20% more passengers, the

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### Scenario B — Strongly Positive: Rapid-Egress Infrastructure Upgrade

Assume Wembley implements a major egress redesign: widened walkways, new crowd channels, improved metering, and DCMS/TfL fund a temporary event-day loop service on the Jubilee line every 3 minutes.

#### Stress-Tested Critique

- Your shuttle system becomes marginal rather than central. If rail absorbs +15–20% more passengers, the marginal benefit of buses declines sharply.
- This reveals you have not analysed the *relative cost-effectiveness* of alternative congestion-reduction tools.
- The strategy should clarify whether buses remain core, or whether they become part of a portfolio response, scaled up or down depending on event size.

---

## Summary

Your project is analytically impressive and strategically plausible, but you should (1) sharpen behavioural and operational assumptions, (2) consider alternative interventions, and (3) show how the strategy adapts under adverse and favourable scenarios. This will strengthen its credibility and realism.

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## **Project Management Summary**

### Team Charter

Our team approached this assignment with a structured and collaborative project management process that closely mirrored real-world consulting project delivery. From the start, we set clear expectations through our Team Charter, defining our goals, strengths, behavioral norms, communication norms, decision making processes and key roles and responsibilities. This method ensured timely scope progress and made coordination smoother and guaranteed that everyone owned a clear part of the work.

*Table. Team Charter*

	<i>Name</i>	<i>Strength</i>
<b>Team Members/ Key Strength</b>	1.Leya Sherman	Former financial analyst (data expertise)
	2.Abdel Hadi Noureddine	Former consultant (strategy expertise)
	3.Pablo Williams	Coding expert
	4.Marcus Hudson	Planning, logistics, strategy
	5.Emir Yuksel	Visualisation, look & feel
<b>What Brings us Together</b>	We're working together to deliver a strong project for the Business Strategy & Analytics course, developing a strategic solution for the overcrowding issue that TfL (Transport for London) faces during mega-events.	
<b>Team Goal</b>	Aim for a distinction and deliver work that stands out from other teams in clarity, insight, and execution. But most importantly, collectively learn about Strategy with a growth mindset.	
<b>Norms of Behaviour</b>	<ul style="list-style-type: none"><li>- Meet weekly (Tuesdays after class)</li><li>- Come prepared, respect each other's time, and keep momentum between meetings</li><li>- Maintain a collaborative, open, and positive working environment</li><li>- Ask for teammate support when needed in a timely and respectful manner</li></ul>	
<b>Communication Norms</b>	<ul style="list-style-type: none"><li>- Everyone speaks freely and contributes equally</li><li>- Share updates transparently and early</li><li>- Use the group chat and emails to actively keep everyone aligned</li></ul>	
<b>Increasing Accountability</b>	Each member takes ownership of a defined section and keeps the team updated on progress. Peer support is available, but responsibility stays clear on the initial assigned team member.	
<b>Decision Processes</b>	We discuss openly as a group, aim for consensus, revisit data and objectives when unclear, and seek guidance from teammates and TAs when needed.	
<b>Key Roles</b>	<ul style="list-style-type: none"><li>- Project Management and Strategy Lead: Abdel Hadi</li><li>- Project Coordination and Communications Lead: Marcus</li><li>- Research, Technical &amp; Financials Lead: Leya</li><li>- Modelling Lead: Pablo</li><li>- Design &amp; Visuals Lead: Emir</li></ul>	

## Project Planning and Phasing

Our team organized the workflow on MS Planner on Teams dividing the project into five classic PM phases:

- Initiating: forming the team, aligning goals, selecting our company, and scoping the project.
- Planning: drafting the scope management plan, agreeing on deliverables, planning timelines, and assigning responsibilities.
- Executing: implementing the scope plan, conducting research, building the analysis, and refining the structure and visual identity of the final report.
- Monitoring: holding bi-weekly progress discussions (five cycles in total), tracking task completion, ensuring quality, and supporting each other on blockers.
- Closing: submitting the final project, reflecting on lessons learned, and reviewing team performance.

The MS Planner board helped the team stay accountable and transparent. Every task was agreed upon, assigned, completed, and time stamped, making it easy to see progress and redistribute workload when needed.

*Screenshot. MS Planner workflow on Teams*

Initiating	Planning	Executing	Monitoring	Closing
+ Add task	+ Add task	+ Add task	+ Add task	+ Add task
Completed tasks 4	Completed tasks 5	Completed tasks 4	Completed tasks 5	Completed tasks 3
Team Formation HM Completed by Hudson, Marcus ...	Create Scope Management Plan HM Completed by Hudson, Marcus ...	Implement Scope Plan Completed by Noureddine, Abd...	Bi-Weekly Progress Discussion (#1) Completed by Sherman, Leya on...	Submit Project on System Completed by Noureddine, Abd...
Identify Goals and Objectives Completed by Noureddine, Abd...	Review Scope Management Plan HM Completed by Hudson, Marcus ...	Review Progress Completed by Noureddine, Abd...	Bi-Weekly Progress Discussion (#2) Completed by Sherman, Leya on...	Discuss Lessons Learned Completed by Noureddine, Abd...
Create High-Level Project Plan Completed by Sherman, Leya on...	Specify Deliverables and Acceptance Criteria Completed by Noureddine, Abd...	Finalize Scope Implementation Completed by Noureddine, Abd...	Bi-Weekly Progress Discussion (#3) Completed by Sherman, Leya on...	Discuss Team Performance Completed by Noureddine, Abd...
Identify Potential Companies and Scopes of Work Completed by Noureddine, Abd...	Create Project Schedule Completed by Noureddine, Abd...	Finalize Document Look & Feel Completed by Noureddine, Abd...	Bi-Weekly Progress Discussion (#4) Completed by Noureddine, Abd...	Bi-Weekly Progress Discussion (#5) Completed by Noureddine, Abd...
Assign Responsibilities Completed by Noureddine, Abd...				

*Shared Workspace and Documentation*

Additionally, we used a dedicated Teams shared folder to keep all our data and files organized, while also working in the open on shared documents, allowing team members to see each other's progress and give comments and support in a live and timely manner, which turned out to be very effective and smooth.

### *Screenshot. Shared Workspace on Teams*

Team Cappuccino > Assignment 1			
Name	Modified	Modified By	Add column
Orsted	November 4	Noureddine, Abdel H.	
Team Charter	October 22	Noureddine, Abdel H.	
Wimbley	November 4	Noureddine, Abdel H.	
Team Assignment 25-26.pdf	October 22	Noureddine, Abdel H.	
team_charter_guidelines.pdf	October 22	Noureddine, Abdel H.	

### Team Dynamics and Coordination

The team upheld the norms defined in the Team Charter, and met weekly after class on Tuesdays, following the communication and behavior norms set in the charter:

- Everyone spoke openly and constructively
- Everyone owned “their bit” of the project
- Everyone used group chat actively for quick decisions and updates
- Everyone maintained a supportive and respectful working environment

When uncertain, the team made decisions collectively and consulted the TA to stay aligned with expectations. This helped reduce ambiguity and maintain a high standard of work.

### Scope Roles & Responsibilities

Finally, the scope was distributed among team members taking into consideration the key strengths of different members, while continuously ensuring that everyone pitched in and supported each other where needed. The scope sections were distributed as follows:

- Introduction: Marcus
- Company Overview: Emir
- Strategic Problem: Marcus
- Proposed Strategy: Leya
- Data Analysis: Leya
- Strategic Alignment: Abdel Hadi
- Validation: Abdel Hadi
- Risk Assessment: Pablo
- Conclusion: Marcus
- Project Management: Abdel Hadi