Scottish International Conference on

Multidisciplinary research and Innovation (SICMRI 2026)

ISSUES IN IMPROVING DATA-DRIVEN STRATEGIC MANAGEMENT OF URBAN PUBLIC TRANSPORT

Ruslan Rozmetov
Independent Researcher at the Academy of Public Policy and Administration under the President of the Republic of Uzbekistan

Abstract. This article examines a data-driven strategic management mechanism for urban public transport, drawing on London's open transport data and Singapore's DataMall. An analytical framework connects passenger demand, service headway, reliability and intermodal transfers. All numerical scenarios are illustrative and require empirical validation.

Keywords: urban mobility, digital data, strategic management, passenger demand, headway, service reliability, GTFS.

INTRODUCTION

The effectiveness of urban public transport cannot be assessed merely by purchasing new buses or increasing the number of routes. The same vehicle fleet may produce substantially different service outcomes under different management conditions. For passengers, the key outcome is reaching their destination on time, safely and comfortably. This depends not only on bus availability but also on arrival times, occupancy levels, waiting at stops, and the transfer process.

Under conventional planning, timetables are often based on average demand. Yet demand varies between weekdays and weekends, morning and evening hours, neighborhoods, and transport hubs. GPS signals, electronic fare payments and observations at stops make these differences visible. Nevertheless, the availability of data does not in itself ensure sound management decisions: data quality, analytical methods and the allocation of responsibilities must also be clearly defined.

The objective of this study is to substantiate a strategic management mechanism linking digital data to route planning, service standards and investment decisions. Data collection, verification, decision-making and subsequent reassessment of outcomes are considered as stages of a single cycle.

LITERATURE REVIEW

From a strategic management perspective, a transport network is not simply a collection of separate operators but an interconnected system of services. Mintzberg and Waters distinguish between the deliberate and emergent components of strategy [1]. This approach helps explain why timetables in urban transport need to be revised in response to changes in demand.

The ITDP BRT Planning Guide provides guidance on calculating the minimum service frequency from passenger flows, vehicle capacity and permitted occupancy [2]. The open GTFS standard enables the exchange of stop, route, timetable and real-time vehicle movement data between information systems using a consistent format [3]. Digital data therefore provide a technical infrastructure for strategic planning but do not replace planning itself.

RESEARCH METHODOLOGY

The research applies comparative institutional analysis, a review of publicly available regulatory and technical documents, scenario calculations and service-outcome assessment. First, the official

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

mechanisms for providing transport data in London and Singapore were compared. Second, the functions of data throughout the planning cycle were identified. Third, the theoretical relationships between demand, service headways and waiting times were calculated.

The primary unit of analysis is the number of passengers traveling in one direction during one hour along the busiest segment of a particular route. The calculations are not based on actual operator data; they are constructed to illustrate how the proposed mechanism would work.

$$f = \lceil q / (C \times \alpha) \rceil ; \quad h = 60 / f; \quad N = \lceil \tau / h \rceil$$

Here, q is hourly passenger demand; C is the nominal capacity of one bus; α is the target occupancy ratio; f is departures per hour; h is the headway in minutes; τ is the round-trip cycle time; and N is the number of buses in operation. Rounding upward to the next integer is used to avoid violating capacity and safety requirements. Spare vehicles are calculated separately.

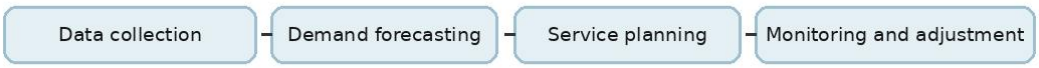


Figure 1. Data-driven management cycle. Developed by the author.

ANALYSIS AND RESULTS

The London experience. Transport for London (TfL) provides public transport open data through its Unified API. Official documentation describes interfaces for real-time bus arrival predictions, stops, routes and transport services [4; 5]. Updated bus arrival information, for example, helps passengers plan journeys and enables planners to analyze differences between predicted and actual operations.

The principal lesson from London is that information should not be retained solely in internal reports; it should also be made available to external digital services under clearly defined standards. However, the existence of an open interface does not itself prove that transport quality has improved. Assessing outcomes requires indicators such as waiting time, service regularity and passenger satisfaction.

The Singapore experience. The Land Transport Authority's DataMall platform defines categories of data covering bus arrival predictions, routes, stops, passenger volumes by stop, and origin–destination pairs [6; 7]. Having both real-time data and periodic statistics within one system creates a link between short-term dispatching decisions and long-term transport plans.

It should be noted that DataMall datasets are not all available under the same access conditions. Some require registration or a separate request and agreement [7]. The economic benefits of data governance must therefore be evaluated alongside requirements for privacy, security and lawful use.

Both systems feature defined data fields, update procedures and conditions of use. The distinction is that TfL highlights the importance of a public journey-information platform, whereas DataMall demonstrates the potential to integrate operational and analytical data.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

CALCULATING SERVICE HEADWAYS AND PASSENGER WAITING TIMES

From a planning perspective, service frequency is one of the key variables influencing service quality. If buses operate at regular intervals and passengers arrive at stops randomly, theoretical average waiting time equals half the headway. This simplification does not fully apply where headways are uneven, buses arrive full, or trips are tied to a specific timetable.

$$W \approx h / 2$$

For illustrative purposes, a 10-minute bus headway gives an average waiting time of 5 minutes; an 8-minute headway gives 4 minutes; and a 6-minute headway gives 3 minutes. Changing the timetable alone does not guarantee these outcomes: available fleet capacity, road conditions and delays at stops must also be considered.

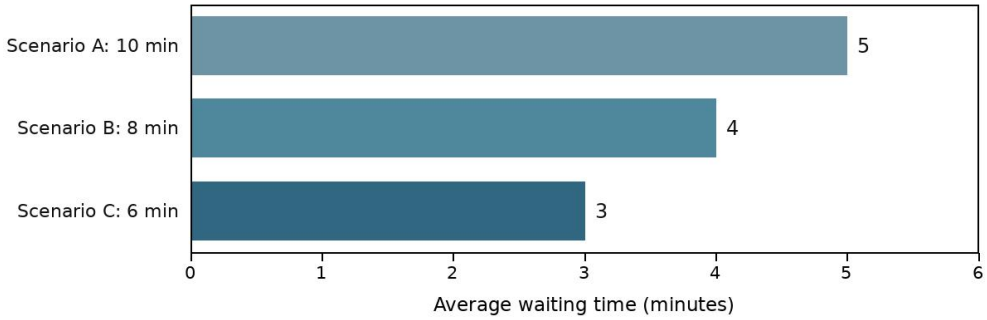


Figure 2. Illustrative average waiting time by service headway. Author's calculations.

For example, if q = 960 passengers/hour, C = 100 passengers and α = 0.80, meeting estimated demand requires f = 12 departures/hour, or h = 5 minutes. With a cycle time of τ = 75 minutes, the operating fleet would be N = 15 buses. If reducing traffic-signal delays and improving terminal operations lowers the cycle time to 65 minutes, N = 13 buses may be sufficient to maintain the same headway. This is only an illustrative optimization scenario.

TRANSPORT HUBS AND TRANSFER QUALITY

A single bus arriving on time does not guarantee that the entire journey will be successful. Passengers may transfer between metro services, city buses and intercity transport. If a five-minute delay on the first service causes a 20-minute wait for the next one, a minor local disruption turns into a substantial system-wide loss of time.

$$T_total = T_access + T_wait + T_in_vehicle + T_transfer + T_egress$$

Each component should be measured separately using digital data. GPS reflects vehicle movement; electronic payments and voluntary passenger counts indicate the distribution of demand; and observations at transfer points capture connection opportunities. Access to personal identifiers should be restricted, and analyses should use aggregated data.

As a scenario, it is assumed that, among 100 passengers, 25 make the planned connection with a 15-minute delay, 30 with a 10-minute delay, and 35 with a 5-minute delay. These numbers are not observed results; they merely illustrate how even relatively small delays may affect connection rates.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

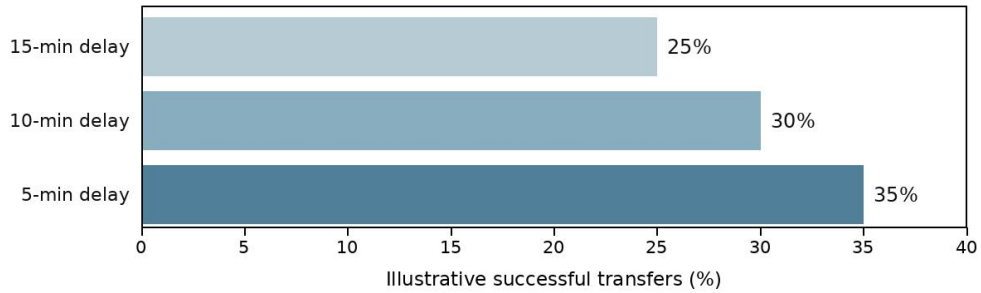


Figure 3. Delay scenarios and illustrative connection rates. Author's model.

Journey-chain planning improves when a transport hub accounts for coordinated timetables, pedestrian access time, distances between platforms and a buffer for safe transfers. This approach also shows that existing services can be better coordinated before new infrastructure is constructed.

DISCUSSION

The findings indicate that digitalization should be viewed not as an end in itself but as a means of improving strategic decisions. Introducing an open interface, GPS monitoring or electronic payments does not automatically improve service. What matters is converting data into concrete actions by planning authorities and carriers, then evaluating those actions against established indicators.

The management model proposed for Uzbekistan has three stages. First, data standardization: assigning consistent identifiers to routes, stops, timetables and vehicle movements. Second, demand-based planning: calculating bus type, headway and operating fleet from hourly and spatial passenger flows. Third, performance monitoring: measuring scheduled and actual headways, waiting times, occupancy and successful transfer rates.

Institutionally, the strategic planning authority should establish minimum service indicators; the carrier should regularly provide vehicle movement data; and the operator or dispatch center should record daily deviations. The responsible organization, update frequency and error-correction procedure should be established in advance for each dataset.

However, the adoption of digital decisions also faces limitations. GPS signal loss, passengers who do not use electronic payments, groups without smartphones and route-level sampling bias can result in inaccurate demand estimates. Electronic records should therefore be checked against periodic passenger counts at stops and field observations.

An important limitation is that the model has not been calibrated using actual city data. Before implementation, baseline observations should be conducted on several routes, followed by pilot management and comparison with a similar control route. Social benefits should be measured not only by the number of buses saved but also by passengers' overall time savings and access to services.

CONCLUSIONS AND RECOMMENDATIONS

The study proposes a continuous cycle for data-driven strategic management of urban public transport, comprising data collection, analysis, modification of service plans and evaluation of outcomes. The London experience demonstrates the importance of distributing information through standardized open interfaces, while Singapore shows the opportunities provided by combining real-time and periodic demand data.

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.

Practical recommendations are as follows: (1) gradually introduce GTFS-compatible data exchange requirements for routes, stops and timetables; (2) calculate service headways and vehicle capacity based on the busiest route segment; (3) jointly evaluate walking and waiting times at transport hubs; (4) cross-check GPS and electronic payment data against manual counts; and (5) use pilot and comparison routes to assess effectiveness. These are organizational proposals and should be verified against applicable regulatory requirements and local data.

REFERENCES

1. Mintzberg H., Waters J. A. Of Strategies, Deliberate and Emergent. Strategic Management Journal. 1985. Vol. 6(3). P. 257–272.
2. Institute for Transportation and Development Policy. The BRT Planning Guide. Service Planning. https://brtguide.itdp.org/
3. General Transit Feed Specification. Overview and GTFS Schedule/Realtime documentation. https://gtfs.org/documentation/overview/
4. Transport for London. Our open data. https://tfl.gov.uk/info-for/open-data-users/our-open-data
5. Transport for London. Unified API documentation. https://api.tfl.gov.uk/ (API portal).
6. Land Transport Authority (Singapore). LTA DataMall API User Guide, version 6.2, 21.11.2024. https://datamall.lta.gov.sg/
7. Land Transport Authority (Singapore). DataMall Search Datasets and On-Request Datasets. https://datamall.lta.gov.sg/
8. General Transit Feed Specification. GTFS Schedule Reference. https://gtfs.org/documentation/schedule/reference/
9. Institute for Transportation and Development Policy. BRT Planning Guide, section 6.3: Basic Service Planning Concepts. https://brtguide.itdp.org/branch/master/guide/service-planning/basic-service-planning-concepts
10. General Transit Feed Specification. What is GTFS? https://gtfs.org/getting-started/what-is-gtfs/

© 2026Scottish International Conference on Multidisciplinary Research and Innovation. All Rights Reserved.