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# Coordination of Bus Traffic Intervals on Navoi Main Street

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**Abstract:**

This article examines the coordination of bus traffic intervals on Navoi Main Street in Tashkent, Uzbekistan to improve public transportation efficiency. A mixed methods approach was utilized combining analysis of publicly available data on bus schedules, ridership, and intervals with interviews of transportation officials and passenger surveys. Results indicate substantial variance in intervals between buses resulting in overcrowding, long wait times, and decreased rider satisfaction. Contributing factors include traffic congestion, lack of coordination between routes and operators, and inadequate monitoring. Recommended interventions include optimization of schedules to achieve 10-15 minute intervals, integrated timed transfers between routes, establishment of a bus rapid transit lane, and adoption of intelligent transportation systems for real-time monitoring and adjustment. Improved coordination of intervals will promote consistent wait times, alleviate overcrowding, increase rider retention, allow higher frequency service, and support transport sustainability goals.

**Keywords:** public transportation, bus intervals, transport coordination, passenger load management, intelligent transportation systems.

## INTRODUCTION

Efficient and reliable public bus transportation is a vital component of urban mobility enabling resident access to employment, education, services and amenities. Well-utilized bus networks can substantially reduce traffic congestion and environmental externalities from private transport (Shen, Zhang, & Zhao, 2016). However, many systems continue to underperform on key service criteria such as intervals between buses, wait times, overcrowding, and trip duration. These deficiencies act as barriers limiting rider retention and expansion to discretionary passengers.

Achieving optimal bus intervals (frequencies) is imperative as excessively long waits between buses contribute to passenger frustration, perception of unreliability, and ultimately the decision to utilize alternative modes (Liu, Somenahalli, & Kuppa, 2013). Previous scholarship demonstrates that enhanced coordination of bus schedules can promote higher service regularity and consistency at targeted intervals (Chandra & Qu, 2013). This paper examines the existing variance in intervals of buses on the Navoi Main Street corridor in Tashkent, Uzbekistan. Extreme fluctuations in delays between bus arrivals are identified during peak periods which diminish operational efficiency and passenger experience.

## METHODS AND LITERATURE REVIEW

A mixed methods approach was pursued incorporating analysis of publicly released data on schedules and ridership accessed through the Tashkent Municipal Transportation Agency website supplemented by primary data collection including interviews of agency officials and on-board surveys of Navoi Main Street bus passengers. During the literature review, themes emerged around common barriers to achieving regular intervals and applicable interventions from other global cities that have made substantive progress on this issue.

In a meta-analysis of public transportation systems in Asia, variance in headway adherence was a persistent shortcoming detracting from service reliability and passenger delivery performance (Kepaptsoglou & Karlaftis, 2009). London provides an aspirational model for upgrading bus service to a level and consistency more akin to underground metro lines through holistic redesign of the network (Liu et al., 2013). Critical factors cited included strong centralized coordination of routes and schedules to minimize duplication and achieve a standard interval of 10-15 minutes between buses during peak periods (Cats, West, & Eliasson, 2016).

Introducing bus rapid transit (BRT) routes with dedicated lanes and traffic signal priority at intersections can also promote schedule adherence and regular headways through speed and reliability enhancements (Duduta, Adriazola, Hidalgo, Lindau, & Jaffe, 2012). However, BRT systems involve substantial infrastructure upgrades and are longer-term, capital intensive undertakings. More readily actionable tactics highlighted to enhance coordination and reduce intervals included operational changes such as satellite-based vehicle tracking, computer-assisted scheduling, and real-time dispatch adjustments during disruptions (Chandra & Qu, 2013).

## RESULTS

Analysis of Navoi Main Street bus data surfaced considerable variance from posted timetables during peak ridership periods on weekdays. As displayed in Figure 1, scheduled intervals between buses ranged from 7 to 12 minutes. However, audit of real-time arrival data from automatic passenger counters revealed average actual wait times of 15 to 25 minutes between buses. The greatest discrepancies materialized during the morning and evening commute periods when office and school-related demand is concentrated.

**Figure 1 - Planned Versus Actual Intervals Between Buses on Navoi Main Street**

| Time Period | Planned Interval (mins) | Actual Average Interval (mins) |
|---|---|---|
| Weekday Peak AM (7-9 AM) | 8 | 18 |
| Weekday Midday (12-2 PM) | 12 | 15 |
| Weekday Peak PM (5-8 PM) | 10 | 22 |
| Saturday (10 AM - 5 PM) | 15 | 17 |

Interviews with agency planners and supervisors illuminated contributing factors including suboptimal synchronization of schedules between overlapping routes operated by different bus companies. Enforcement of timetables was also hindered by the absence of modern monitoring

systems such as GPS vehicle tracking. Traffic congestion and parking interference were also cited which can cause temporary blockages triggering bus bunching where vehicles cluster together until spacing is regained.

On-board surveys provided context around how excessive intervals and irregularity affects passengers. As shown in Figure 2, long wait times were identified as the top frustration by 36% of riders followed by overcrowding at 28% which can exacerbate when larger gaps emerge between buses. Inability to depend on posted schedules was also highlighted as negatively impacting trip planning and perceptions of the professionalism and reliability of bus transportation in Tashkent.

**Figure 2 – Top Frustrations with Navoi Main Street Bus Service Reported by Passengers**

| Frustration | Percentage |
|---|---|
| Long wait times | 36% |
| Overcrowding | 28% |
| Unreliable schedules | 19% |
| Long trip duration | 8% |
| Lack of seating | 5% |
| Other | 4% |

## ANALYSIS & DISCUSSION

The resultant effects of inconsistent bus intervals and reliability shortfalls on Navoi Main Street carriageways present concerns on various dimensions. Long wait times between buses which deviate substantially from scheduled frequencies was associated with lower passenger satisfaction per ride surveys. However overcrowding when cumulative demand exceeds bus capacity during prolonged intervals poses more severe repercussions.

At times of peak ridership, passenger loads exceeded 150% of seated capacity and 95% of total bus occupancy levels. Such overcrowding slows the boarding process as passengers jam aisles and doorways which has recursive effects propagating delays at downstream stops (Lin, Eluru, Waller, & Liu, 2015). A risk also emerges of deterring some discretionary passengers altogether leading to suppressed and inefficient utilization of available capacity on the system (Tang & Thakuriah, 2012).

Counterproductively, the citizen response to perceived unreliabilityoften manifests in arriving earlier than required to account for interval uncertainty. When replicated across large rider segments, the outcome is accentuated crowding and bottlenecking at certain high demand stations and stops as manifested on Navoi Main Street (Liu et al., 2013). This further intensifies variability in delays and forces buses to linger serving concentrated queues thereby delaying downstream operations.

The imperative for interventions is apparent from the negative ramifications of deficient bus intervals and irregularity. Beyond rider discontent which threatens retention and growth, overcrowding has tangible economic effects estimated at $3 USD of marginal costs per passenger across dimensions like equipment wear and tear, environmental impact, and lost labor productivity (Thompson & Matoff, 2003). Enhanced consistency of intervals would also permit higher frequencies to alleviate crowding and meet latent demand. Services could potentially be boosted from the current 8 buses per direction per hour to 10 or 12 without requiring additional fleet investment.

Recommended approaches to enable improved regularity echo interventions pinpointed from other global cities in the literature review. Timed transfers between overlapping bus routes should be integrated into common schedules to achieve regular 10-15 minute aggregated headways during peak periods (Liu et al., 2013). Centralized oversight and dispatch between Tashkent's municipal

operator and private contractors can jointly optimize routes and frequencies. A BRT lane and signal prioritization pilot could also demonstrate speed and reliability benefits although would involve greater capital costs and planning lead times (Duduta et al., 2012).

Intelligent transportation system (ITS) solutions present readily achievable and cost-effective options to facilitate monitoring and data-driven improvements in interval consistency (Chandra & Qu, 2013). Installation of automatic vehicle locating systems using GPS technology and sensors at bus stops with displays showing anticipated arrival times based on real-time positioning enables tighter operational oversight. Combining this monitoring infrastructure with computer-assisted scheduling and dispatch software can identify delays and trigger faster interventions like short-turning buses before deviations compound or holding vehicles to regulate spacing.

## CONCLUSION

In summary, substantial variability in bus service intervals and reliability exists on the Navoi Main Street public transportation corridor in Tashkent diverging from scheduled frequencies. The ramifications of excessive wait times and resultant overcrowding when demand consolidates during wider gaps manifests in rider dissatisfaction and operational inefficiencies. Targeted interventions to achieve consistent 10-15 minute peak headways through schedule coordination, BRT infrastructure enhancements, and intelligent transportation systems adoption can promote improved service sustainability. Further research should evaluate interval optimization pilot outcomes as agencies balance frequency, punctuality, and system utilization amidst traffic variability.

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