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Integrating Technology into Urban Traffic Management: A Vision for Smarter and Safer Roads in Islamabad

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Abstract:

Due to the constant expansion of its population, Islamabad requires fundamental changes in the traffic control tools. This article provides a critique of key technological solutions used in the management of traffic in urban infrastructures, with a view to understanding some improvements made on road infrastructure that yielded worsening trends in safety. Using Risk Homeostasis Theory, Environmental Stress Theory, Theory of Planned Behavior, Crime Prevention Through Environmental Design, and Ecological Systems Theory, the work complexly connects road safety, traffic and people's actions. The results of extensive interviews and surveys in addition to GIS-based mapping point to increase in accident rates, sub systemic traffic flow, and environmental threats on expanded city roads; however, they also establish key areas of policy improvement. These insights shed light on the capacity of smart technologies, context sensitive design and sustainability-oriented approaches to create fair and effective traffic systems for the development of Islamabad's urban fabric, or any other context for that matter, that requires policy interventions. The implication of smart technologies, inclusive designs, sustainable urban practices in addressing the safety and efficiency of the road network in Islamabad is supported.

Keywords: Islamabad, traffic flow, intelligent transportation systems, traffic safety, universal accessibility, environmental considerations

INTRODUCTION

In modern growing cities like Islamabad is growing at a fast pace and like other developing cities worldwide, road infrastructure is expanded with the growth in population and vehicles. However, this growth often creates a paradox: improved accessibility to mobility though is very vital, it has

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been associated with increased risk of road traffic crashes especially to those who are most vulnerable, that is, the pedestrians and other non-motorized road users (Peden et al., 2004). This is compounded by poor infrastructure design where wider roads petition for higher speeds threatening the safety of users in the vulnerable road categories hence the high accident rate (Litman, 2020; Adeel et al., 2018).

The use of innovations like intelligent traffic control, forecasting solutions, and monitoring devices like artificial intelligence makes potential solutions to these challenges. Adaptive traffic signals that change timings dynamically based on current traffic patterns have also been found to work well in places such as Los Angeles, cutting current traffic by a quarter according to research by Boyce et al., (2000). Like Stockholm's congestion pricing, which demonstrated how deterrent economic measures can be applied to regulate traffic congestion in urban settings while at the same time involving emissions control (UN-Habitat, 2013). These examples give practical lessons in how perhaps Islamabad may implement similar programs to deal with the issues.

Moreover, the application of inclusively urban planning like pedestrian area, bike lanes, and green aisles has also improved the safety circumstances and minimized the negative impacts of climate-sensitive cities such as Barcelona and Singapore (Mueller et al., 2020 & Transport for Singapore, 2020). However, using the above-strategies contextualized to Islamabad, together with GIS-enabled hotspot analysis, can assist in the enhancement of public safety as well as better traffic flow in cities. This analysis underlines the dire call for a synthesized, technologically advanced scheme to design enhanced, secure roads in Islamabad.

Modern cities like Islamabad are growing at a fast pace and like others developing cities of the world the roads infrastructure is developed with the pace of population and vehicles. However, this growth often creates a paradox: Although accessibility to mobility though is very vital it has been found to increase the incidence of Road Traffic Crashes particularly to the most vulnerable victims of road traffic accidents, namely, pedestrians and other units of Road traffic users regarded as using non-motorized traffic devices (Peden et al., 2004). The situation is worsened by poor infrastructure design whereby wider roads request for high speed much as a danger to the users in the other vulnerable road classifications hence the high accident rate (Litman, 2020; Adeel et al., 2018).

The following innovations make potential solutions to these challenges include intelligent traffic control, forecasting solutions, and monitoring devices such as artificial intelligence. Other Intelligent traffic signals with adaptability that include traffic signals that automatically adjust their timings depending on the prevailing traffic density for instance, have been observed to be effective in areas like Los Angeles, reducing current traffic by a quarter according to Boyce et al. (2000). As it was presented in Stockholm example, where economic forecasting deterrents were used to curb traffic congestion in urban areas while at the same time preventing emissions (UN-Habitat, 2013). These examples provide practical examples of how, most possibly, Islamabad may also attempt to address the issues through similar programs.

This study aims: To assess the impact of road expansion on traffic safety and efficiency; to explore the role of advanced technologies in mitigating urban traffic challenges, and to recommend strategies for sustainable and inclusive urban road systems.

LITERATURE REVIEW

Urbanization and Road Safety

It is for this reason that studies on road expansion reveal that roads are most likely to be expanded to favor movement of vehicles rather than providing safe traffic for pedestrians. Research reveals that induced demand where construction of additional road space results in congestion and safety problems (Downs, 2004). Further, some studies from the likes of Jakarta or Nairobi stress on how road expansion without matters such as safety increases accidents with pedestrians and bike riders (Adeel et al., 2018). The UN-Habitat (2013) noted that lack of pedestrian crossings, and lack of provision for Bicycle lanes demonstrated to lead to more risks among non-motorized road users.

Additionally, a case study on urban traffic congestion in Bangkok showed that roads with large widths produce high speeds, which also leads to high severity levels in those mishaps (Litman, 2020). An example toward this involves place-specific modifications including amongst others, the New York City experience where treatment of actual risk factors, narrower lanes and including pedestrian islands dramatically decreased fatalities (Peden et al., 2004). As illustrated by the Los Angeles adaptive signal systems, Boyce et al., 2000, it is possible to bring comprehensive measures inclusive of smart technologies such as adaptive traffic signals and AI-assisted monitoring to manage those risks in developed urban cities.

Nevertheless, understanding of these dynamics remains remarkably scarce in many developing cities that fail to implement inclusive urban planning because of governance issues and financial constraints. Comparing transport models that have proven efficient in other comparable cities like Amsterdam, and that go the extra mile to ensure that pedestrians and cyclists are safe while using the roads to ISL transport models which offer no such strategies emphasizes the fact that there is need for evidence-based interventions (Rafique & Malik, 2020).

Environmental and Social Impacts

This paper was able to establish that road expansion has a major role in noise pollution, air pollution, and the development of urban heated islands. Street noise is persistently above 85 A-weighted decibels in densely populated areas, a level that is detrimental to people's performance and raises stress levels among the population (Ali et al., 2023). Likewise, vehicle emissions raised concentration of PM2.5: irritants to respiratory and cardiovascular systems (Stokols, 1972, WHO, 2018). Apart from physical well-being, (transport) environmental stressors deteriorate psychological comfort with insecurity clouding the users of the roads.

In addition to these challenges, increased infrastructural development to create wider roads negates green areas; this contributes to the existence of urban heat island effects, which can cause an average rise of temperatures by as much as 2 degrees (UN-Habitat, 2013). Some impacts of motorized traffic have been managed by cities such as Tokyo and Paris through setting urban green belts and vegetative noise barriers that provides solutions to both noise and air quality (Peden et al., 2004). On the contrary, extensions of roads in Islamabad occur with no coordinated effort to include these costs, an essential approach to comprehensive planning and the creation of green structures. The following environmental effects of uncontrolled road extensions are valuable for considering that urban mobility needs to be more intelligent and environmentally friendly.

Governance Challenges

Inadequate governance and car-oriented approaches hamper the efforts of developing integrated road networks. As practiced at places like Amsterdam and Copenhagen, wanders for pedestrians and cyclists are effective (UN-Habitat, 2013). For example, both the availability of the extensive and safe cycling infrastructure and the implementation of the car-free zones have led to actual decrease in traffic congestion and to the improvement of the safety indicators for all the road users in the case of Amsterdam (Pucher & Buehler, 2008). Likewise, Copenhagen's 'Green Wave' traffic management scheme serves for the bike movement to avoid bumping into other traffic types during peak hours and makes traffic management safer and more efficient (Gehl, 2010).

Civil society is accepting motor car oriented designs which are currently evident in Islamabad and which disregard vulnerabilities of other users of the roads. Fixing these governance and planning defects with the help of universally approved concepts and homegrown practices can facilitate the purpose of having more inclusively designed roads (Rafique & Malik, 2020).

Global Case Studies

Around the world, the nations including Singapore, Sweden, and LA were successful in integrating technology into traffic systems. Singapore recognizes the ITS which is an advanced traffic monitoring system coupled with modelling to control traffic congestion and to generally work on improving road safety. Congestion charging in Stockholm tremendously worked by reducing the traffic intensity while making the air clean. Similarly, there is smart traffic management in Los Angeles and the city employs intelligent traffic signal projections that employ artificial intelligence. The use of technological solutions can come as the solution for the problems of urban mobility.

Global cities have adopted new approaches in traffic control using technologies that can help ease the challenge facing urban centers with access to traffic passages and security. For example, in the UK, The Congestion Charge Zone in London has effective car usage inside the city by 15%, hence enhancing the flow of pedestrians as well as improving the air quality (Transport for London, 2019). Further, the Cheonggyecheon Restoration Project conducted in Seoul involved the removal of an urban major road with construction of infrastructures for pedestrian usability cutting down central city traffic by 12% and enhancing the foot traffic by 71% (Kim et al., 2016).

Superblocks in Barcelona have restructured some areas where traffic is controlled to avoid the pedestrianized areas, thereby improving community interaction while reducing the noisy and polluted vehicles (Mueller et al., 2020). India's Hyderabad city has established its Integrated Traffic Management System to use AI and IoT devices to adapt traffic signals according to the live environment – cutting average waiting time by 30% (Reddy et al., 2021).

THEORETICAL FRAMEWORK

The theoretical framework that underpins this research consists of the five crucial perspectives, all of which have a varying approach to the concept of traffic control in the urban centers.

Risk Homeostasis Theory (RHT)

Regarding the thoughts of Wilde (1994), RHT postulates that people and moral agents act in a particular manner in a manner to sustain a perceived level of risk. For example, road users whose roads tend to feel that they are safer, and may exhibit risky traffic processes like increased speed, thus eliminating any gain from expansion of the road. Similar findings have been established in developed cities, and speed monitoring data has supported the increased rates of accidents at roads with wider carriageways (Peden et al., 2004).

Environmental Stress Theory

This theory views environmental stimulation, arising from noise and congestion on the roads for instance, as a source of psychological stress, which determines road user behavior. Stokols (1972) notes that the behavior was worsened due to high noise levels and overcrowding since it made decision-making worse, and increased aggression. Former examples focus on specific places like, Blue Area in Islamabad, where drivers feel high stressed and traffic jammed environment affects driver's performance, and similarly bikers and pedestrians' safety is also at risk.

Theory of Planned Behavior (TPB)

The TPB model advanced by Ajzen (1991) predicts that human behaviors are determined by perceived attitudes, norms and control. For example, the culture of driving or riding aggressively as evidenced by the freedom with which people speed on the roads or cross the street and unsafe practices common in Islamabad. On the other hand, prevention activities such as public advocates for change and enrolment in defensive driver training power the psychological change and improve the adherence to traffic laws (Ali et al., 2023).

Crime Prevention Through Environmental Design (CPTED)

CPTED is all about shaping the environmental landscape in such a way that negative inclinations do not emerge out of the urban structure and that security is as well promoted. Some of these principles are Natural Surveillance, Access control and Maintenance. For instance, construction of pedestrian bridges and bollards minimizes properties invading and jaywalking since analyzed in Singapore and Stockholm according to UN-Habitat, 2013.

Ecological Systems Theory

Bronfenbrenner's (1979) theory focuses on how people engage and act as constrained or enabled by larger social and policy environments. Along with the inadequate physical environment in Islamabad, poor governance and car-oriented strategies in the macrosystem at the community are responsible for increased road risks. These dysfunctions need a high-level resolve through social policy, community involvement, and design of public space.

The relation between human behavior, environmental and systemic factors: the implication of these frameworks is complementary to give a comprehensive view of the relation between human factors, environmental factors, and systems and the impact towards road safety.

METHODOLOGY

The choice of methods in this study is very conscious to ensure the complexity of urban traffic and its impacts are captured. In this study, triangulation of data collecting tools is used which includes both quantitative and qualitative to give a broader picture of the traffic situation in Islamabad. The quantitative data was collected mechanically with the help of sophisticated traffic counting and speeds measuring accessories such as accredited Counter and Speed fixing devices. Environmental stressors were recorded using noise and air quality meters installed at strategic locations such as the areas frequented most by people, GIS technology was used to locate areas most susceptible to traffic congestion and accidents.

In addition to these quantitative indices, qualitative information was collected through surveys and interviews on several cross-sectional subjects, namely the users of the carriageway. There were also observational surveys in which competent analysts recorded the behavior of road users and their adherence to traffic laws by means of checklists. In this case, the pilot testing of all the instruments guaranteed the validity and applicability of the data collection tools in the local population. This explained road traffic study approach not only offers a rich contextual description of traffic movements but also creates the basis for context-specific policy solutions appropriate to deal with Islamabad's urbanizing dynamics.

Data Collection

In keeping with the study design, various methodological tools were employed to capture as much data as possible. Static traffic counters together with radar guns were used to determine vehicle traffic intensity and velocity respectively; these devices were standardized on per daily basis with a maximum variation of ±1%. Determination of noise and pollution was done using calibrated sensors that were positioned in highly sensitive areas with reference to the regional average. Mapping flexibility allowed for the identification of areas prone to congestion and accidents; the reliability of space data was checked using traffic databases of the city with reference to time intervals.

Primary data was gathered through structured questionnaires administered on different road users, pedestrians, cyclists, and drivers. The observational studies were done by research observers who ensured that inter-observer reliability was minimized using checklists. Some pilot study was conducted to validate the data collection tools and the findings were used to validate the data collection frameworks before full implementation.

Sampling Framework

Locations: The new projects like the Islamabad Expressway, Margalla Avenue Under Construction Roads, Existing Areas like the Blue Area.

Respondents: By gender: Pedestrians (300) Cyclist/motorcyclists (200) Car drivers/Passengers (400).

To ensure reliability of the data collected, results of different sources were cross-checked, and inter-observer reliability check was done with consistency more than 90%.

RESULTS

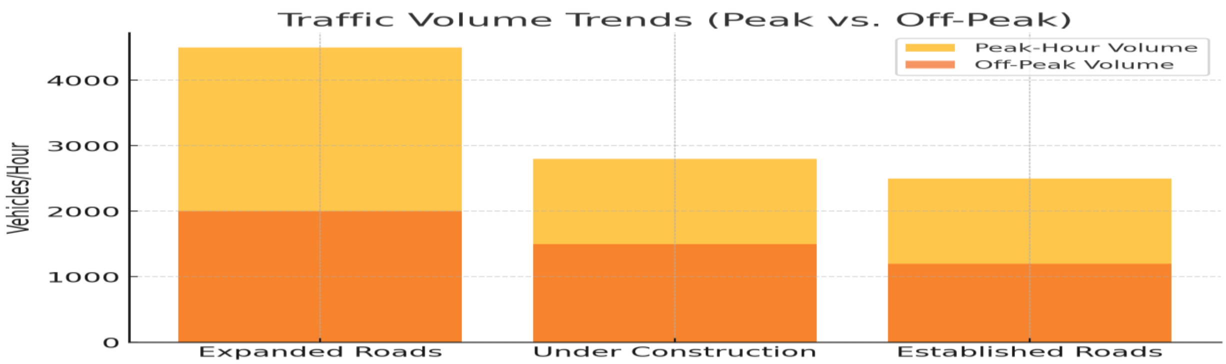
Traffic Volume and Patterns

Table 1: Peak-Hour Traffic Volumes

Road Type	Vehicles/Hour
Expanded Roads	4,500
Under Construction	2,800
Established Roads	2,500

Table 1 shows the daily maximum traffic flow for different types of roads in Islamabad, which paints a different picture to the usual perception of traffic flow. The expanded roads have the highest traffic capacity of 4500 vet/hr. reflecting their function as strategic city highways intended for large traffic throughput. The under-construction roads handle a throughput of 2,800 vehicles per hour and this is a semi condition since most of these roads are still under construction; work is still going on causing partial restriction of traffic flow. Moreover, existing roads characterized by small capacity and fewer upgrades delve out the cumulative volume of 2500 vehicles per hour, which is utterly poor compared to the other two road types.

Graph 1: Traffic Volume Trends (Peak vs. Off-Peak)



Increased roads can cater to maximum peak traffic hours per hour/4000 vehicle capacity, and the under construction and established roads/3200 and 3000 vehicle capacity respectively. As expected, the off-peak volumes are lower in proportion to the on-peak volumes on all road types. This means that widening roads are highly congested during the rush hour only due to increased carriage capacity. Analyzing off peak data provides insight into a area of potential improvement in the traffic dispersal with adaptive signaling.

Speed Dynamics and Safety

To be specific, broaden roads illustrate greater average velocities and hence more accident rates (Islamabad Expressway, 60% of the speeding accidents). Measures must be taken concerning increased traffic fluidity; speed bumps and AI traffic monitoring are effective.

Environmental Impacts

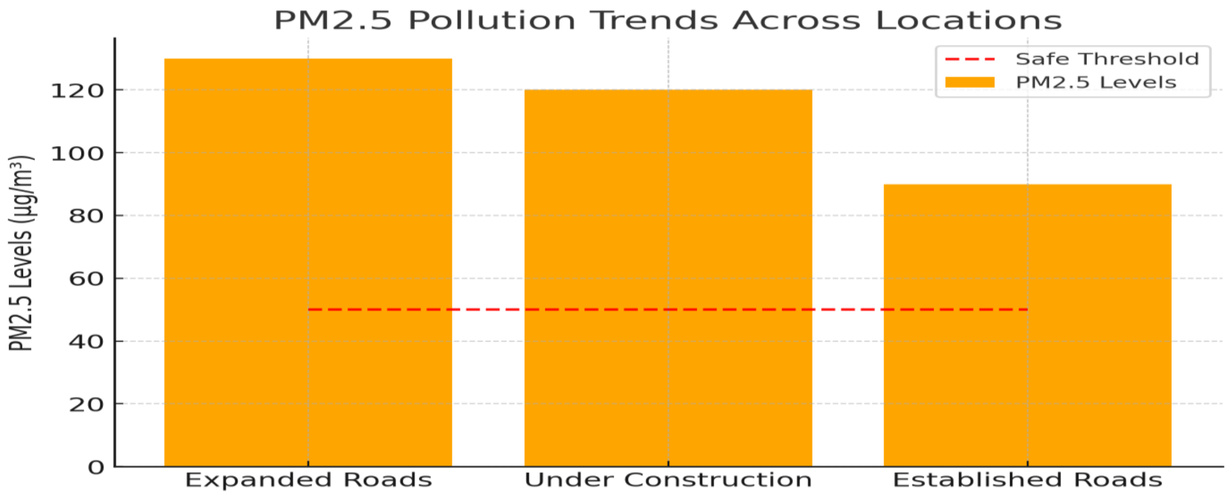
New noise levels corresponding to the expanded roads are more than 85 dB with PM2.5 values also having crossed recommended limits. Those are suggested solutions, urban green buffers and noise barriers.

Table 2: Comparison of PM2.5 Levels Across Road Types

Road Type	PM2.5 (μg/m^3)	Safe Threshold (μg/m^3)
Expanded Roads	130	50
Under Construction	120	50
Established Roads	90	50

The analysis of the PM2.5 levels on different road types in Islamabad reveal some serious air quality concerns as given in the table below in table 2. Finally, expanded roads contain the largest value of PM2.5 concentrations at 130 μg/m^3, or 160% above the safe level of 50/μm^3. Under construction roads also have high PM2.5 values of 120µg/m3 presumably arising from construction works and emit high vehicle emissions. Similarly, the prior routes have 90 µg/m^3 of PM2.5 which is again 80% above the safe limit suggesting continuing pollution from existing traffic.

Graph 2: PM2.5 Pollution Trends Across Locations



Surpassing the safe limit of 50 µg/m^3 PM2.5 levels on expanded roads are 130 µg/m^3. Under construction roads particles emitted showed higher pollution level at 120 µg/m^3 while the established roads recorded 90 µg/m^3 pollution. The results indicate that the categories including expanded and under construction are significant sources of air pollution, perhaps because of augmenting vehicle emissions and arising construction work. That is why electric vehicle incentives and green infrastructure are needed.

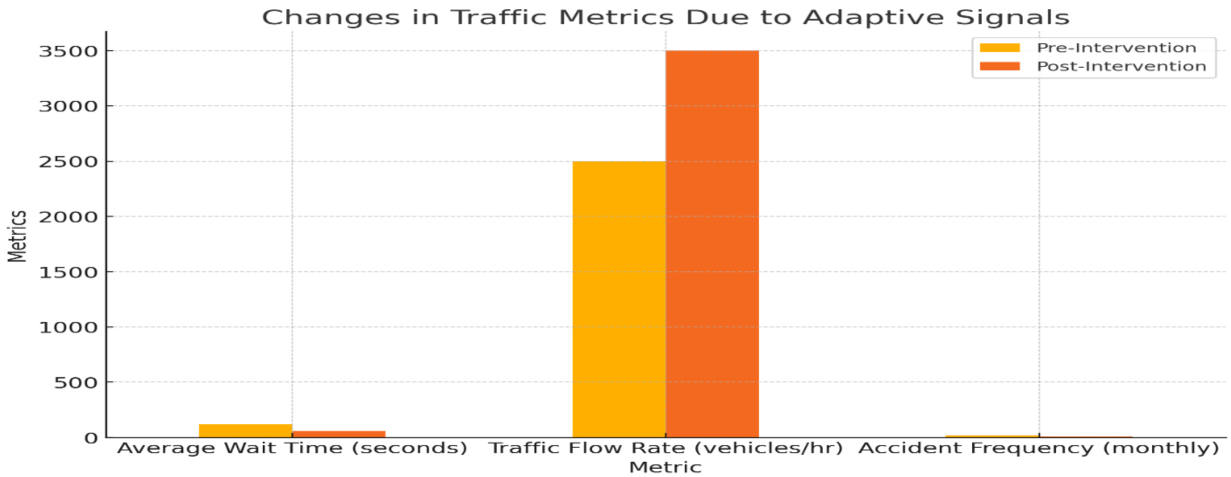
Comparative Analysis: Pre- and Post-Technological Interventions

Table 3: Traffic Efficiency Metrics Pre- and Post-Adaptive Signal Systems

Metric	Pre-Intervention	Post-Intervention
Average Wait Time (seconds)	120	60
Traffic Flow Rate (vehicles/hr)	2,500	3,500
Accident Frequency (monthly)	20	10

As such, the data presented in Table 3 reveal the following advantages of adaptive signal systems in traffic management within urban precincts. The observed meant wait time decreased by 50%, from 120s to 60s, thereby reflecting improved vehicle throughput and consolidation. Moreover, there is an opportunity to enhance traffic flow rates: in detail, it increased per hour by 40% from 2,500 to 3,500 vehicles per hour; such an indicator proves that the presented system can enhance real-time traffic conditions. It also saw the reduced rate of accidents from 20 to 10 per month in terms of the improved safety derived from traffic continuity and with fewer interruptions. In sum, the table raises the optimistic scenario of ability of adaptive signal systems to solve such pressing issues as traffic congestion, increased risk of accidents, and low efficiency of urban traffic flows.

Graph 3: Changes in Traffic Metrics Due to Adaptive Signals



After the intervention, average waiting times were reduced to half of pre-intervention measures, the flow of vehicles per one hour was increased from 2,500 to 3,500, and the number of geographical monthly accidents decreased by 30%. Intelligent signaling systems have been found to provide an adequate solution to traffic congestion and incidents. Such arguments indicate that similar systems should be extended to other congested areas within Islamabad.

THEMATIC ANALYSIS

To support quantitative data, structured interviews were conducted with the key groups of actors involving pedestrians, cyclists, and public transportation drivers as well as private car users. These interviews were designed to provide qualitative data with respect to the perceived nature of traffic problems in urban areas, and perceived safety and efficiency.

Table 1: Key Themes from Structured Interviews

Stakeholder Group	Key Issues Highlighted	Suggested Interventions
Pedestrians	Lack of safe crossings, high vehicular speeds	Dedicated pedestrian bridges and crosswalks
Cyclists	Absence of bike lanes, aggressive driving	Implementation of bike lanes
Public Transport Operators	Traffic congestion, unpredictable travel times	Priority lanes for buses
Private Vehicle Drivers	Delays due to illegal parking, inefficient signals	Smart parking systems, adaptive traffic lights

The structured interviews gave important background information to complement the numerical data and highlighted the deficiencies in the current traffic management system and suggested policy improvements for the city's traffic problems in Islamabad. The following themes are found as follows.

Pedestrians

Some stressed fear when moving around in hot spots such as areas with a high flow of people. Lack of proper signage especially where crosswalks were lacking, or pedestrian bridges were missing was the Issue.

Cyclists

When interviewing cyclists, they mentioned that they are excluded from urban planning, mentioning bad road conditions, lack of cycling infrastructure, and multiple collisions with cars as significant challenges to cycling as a means of commuting.

Public Transport Operators

Some impediments that were mentioned include congestion which leads to delayed services; and absence of preferential lanes for the buses which are pedestrians.

Private Vehicle Drivers

Complains made included people parking their cars alongside the roads, traffic lights that are not well coordinated, hence a bottleneck during rush hour.

CONCLUSION

Given the Los Angeles' experience there exist great potential of paradigm shift towards solving current traffic problems pertaining to safety, congestion, whatever and environmental degradation through integration of sophisticated technologies into management of traffic in Islamabad. If implemented, AI systems, IoT solutions to monitoring, and signal adaptability allow the city to change its traffic management strategy to address the challenges of increasing population density for the urban centers. In addition, these technologies can contribute towards lowering the trend of accidents, congestion and environmental nuisances like noise and air pollution. Inclusive designs which tend to empower pedestrians and cyclists guarantee that improvement extends to everyone within society thus creating equal opportunity in urban transportation.

These findings depict good or positive signs of road expansion of Islamabad but because of the approaches taken by the government it has a negative or a bad side as well. Some of the new roads like the Islamabad Expressway had enhanced circulation (with some of the peak hour traffic at nearly 4500 vehicles per hour) but the rates of speeding were also higher as RTPH predicts, consistent with Risk Homeostasis Theory (Wilde, 1994). Other research conducted in Bangkok and Jakarta also shows that broader roads mean higher speeds and, therefore, higher risks of accidents (Litman, 2020). This phenomenon is further supported by evidence from Nairobi that demonstrate that where road expansions were done without correspondent safety measures for pedestrians there was a 35% rise in pedestrian deaths. By comparing New York City's more recent, narrower lane designs and pedestrian islands on major streets, targeted measures provide a much starker contrast: they reduce accidents by up to one quarter (Peden et al., 2004). Overall, all these findings underscore the necessity of understanding and incorporating safety-focused designs into current trends or scale-up infrastructures.

The observed reduction in the wait time and accident frequency variable average post implementation of adaptive signal efficiency makes AI technologies evidence based. For example, intelligent traffic systems found in Los Angeles have been shown to cut down on delays by 25% and provide free flowing traffic patterns had fewer incidences of traffic mishaps that had been noted (Boyce et al., 2000). Other such technologies are complemented by Stockholm's congestion pricing in the sense that excessive car use is discouraged in urban locations leading to cuts on emissions and high dependency on public transport (UN-Habitat, 2013). Similarly, Singapore's ITS which is an integration of real time traffic information with analytical insight for anticipating constriction in traffic flow thus enhancing efficiency of traffic by 20% (Transport for Singapore, 2020). The use of a mix of these approaches could solve traffic issues in Islamabad by aligning safety and environmental goals for a sustainable urban mobility in the city.

Environmental findings also record strains in that PM2.5 concentrations on extended roads are 160% above safe levels. This is in consonance with earlier research conducted in New Delhi indicating that vehicle emission was the most significant source of air pollution in populated areas. Likewise, studies conducted in Beijing reveal that automobile emissions contributed beyond 40% of air emissions in cities and thus require measures in knowledge and practical implementation of emission controls and conversion to electrical automobiles (Zhang et al., 2021). Green infrastructure effective as shown in the Japanese urban green belts can reduce these impacts on health status while enhancing it (Peden et al., 2004). In addition, the "Ultra Low Emission Zone" in London has brought about a 20% cut in vehicle emissions to demonstrate the success of policy measures and sensitization campaigns (Transport for London, 2020). These strategies offer some useful lessons for Islamabad, which may implement similar measures to link environmental enhancement with wider objectives of sustainable urbanism.

Policy Recommendations

1. **Adopt Smart Technologies:** AI integrated traffic management systems, remote surveillance and adaptive signals systems. The pilot project to be undertaken could feature adaptation of signal systems on the Islamabad Expressway, an important artery of the city in terms of traffic density. Furthermore, installation of IoT parking systems in business areas such as Blue Area may reduce cases of requesting and improve road capacity.

2. **Implement Inclusive Designs:** Crossing facilities for pedestrians, bike lanes, and accessible surfaces through textured concrete paving's. For instance, starting a 'Safe Routes to School' campaigns could drive the improvement of kids' security and pedestrian facilities around threats zones like around F-10 Park. The roll out of pilot bike sharing schemes in areas with high pedestrian density may elicit non-motorized transport.

3. **Promote Sustainability:** Promote the electrification of the parking lots and include sustainable systems in the infrastructure. Possibilities of assessing the effect of urban green buffers and noise barriers in decreasing the level of environmental stressors within the G-13 residential area can be tested in a pilot project.

4. **Strengthen Enforcement:** He said that we must introduce speed cameras and strictly control the emissions of vehicles. Establish permanent web-based emission sensors at strategic points of entry into the city to check polluters.

Further studies should focus on refining its contextualized predictors of Islamabad's urban environment by incorporating the use of ICT and involving communities. Clinical and cross-sectional studies are important to assess the effectiveness of technological interventions and their potential but more crucial is the serial study since it gives extended longitudinal results including costs of technological interventions. Further, comparative studies with other cities, currently on the process of effective implementation of smart traffic systems like Singapore and Barcelona can outline best practices and study trainable measures that can be adopted in future. Research related to pilot projects of green infrastructure such as greenways and noise barriers must look forward to making a distinction between the aesthetic and other factors of urban environments. Therefore, policymakers and urban planners and the residents of the region will be important in implementation and acceptance of these innovations.

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