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Assessment of Passenger Obstruction-Related Risk Factors in an Urban Metro Rail Transit System and Their Countermeasures †

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Abstract

Modern metro rail systems have problems concerning the safety of passengers and the operational efficiency. Among these, passenger obstruction is a major challenge which refers to the unintentional or intentional interference of passengers in train and platform screen doors, while boarding or alighting from the trains. This paper provides a risk assessment of passenger obstruction at Orange Line Metro Rail Transit System (OLMRTS) in Lahore, Pakistan. This study adopted structured observations, incident analysis and review by experts to control the obstruction cases. Both quantitative and qualitative data analyses of obstruction cases were performed to evaluate the key risk factors associated with passenger obstructions in OLMRTS. Based on the risk assessment framework, prioritized countermeasures with higher risk reduction impacts have been proposed. The effectiveness of the countermeasures was evident in the substantial reduction in obstruction cases by 80%. This research paper will present a reduction in safety risks by reducing the likelihood of incidents and without compromising the passenger service of OLMRTS.

Keywords: passenger obstruction cases; urban metro rail systems; risk assessment; platform screen doors; countermeasures; passenger behavior

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1. Introduction

In the modern era, urban metro rail systems have emerged as a primary mode of transportation, which offer a safe, reliable, and efficient travel experience, and significantly contribute towards urban development [1]. By providing a secure and efficient mode of travel for the public, metro systems play a critical role in addressing the needs of growing populations [2]. Metro systems operate as independent rail networks, delivering societal benefits through their efficiency, safety, and reliability [3]. A critical feature of modern metro systems aimed at ensuring passenger safety is the integration of mechanized train doors and platform screen doors (PSDs) on station platforms [4]. PSDs are essential for enhancing passenger safety and operational efficiency by creating a physical barrier that separates the track area from the platform waiting zone [5–7]. They operate in synchronization with train doors, opening and closing in unison to facilitate safe boarding and alighting [8]. Passenger obstruction is a major problem experienced in metro systems that is defined as

the interference of passengers between PSDs and train doors. This often leads to delays, accidents, and sometimes loss of lives [9].

The risk management of such features of metro systems poses a challenge because of the variability of metro systems in urban cities [10]. There exists limited research work directly related to the assessment of passenger obstruction-related risk factors and their countermeasures for urban rail transit services. Different mitigation strategies have been mentioned including increasing train frequency, station layout modification, and the implementation of efficient passenger education initiatives [11–13]. The role of risk assessment in metro operations is especially important for identifying and addressing human-related factors that increase the risk of congestion [14–17].

Despite the fact modern metro systems have been equipped with obstacle detection and alarm functions in train doors and PSDs, an increase in obstruction incidents can still adversely impact passenger safety, operational punctuality, and the overall travel experience [18,19]. While passenger behavior and dwell time-related factors in metro systems have been widely studied, the specific effects of passenger obstruction have received considerably less research attention [20]. This research focuses on the analysis of passenger obstructions, essential for evaluating and improving metro system safety and performance.

2. Problem Statement

The interaction of passengers with train doors and PSDs is one of the key factors in terms of safety. A major issue has been obstruction in the form of passengers' bodies or belongings between train doors, platform screen doors, or the gap between train doors and PSDs also termed as a danger zone [13,21], posing significant risks to both human and operational safety. Figure 1 illustrates monthly reported occurrences of passenger obstructions in OLMRTS from January 2022 to July 2024. The passenger obstruction cases started increasing from November 2022 and peaked through the first half of 2023. Later, a significant decrease in obstruction cases is observed in the year 2024, attributed to the effectiveness of newly implemented countermeasures.

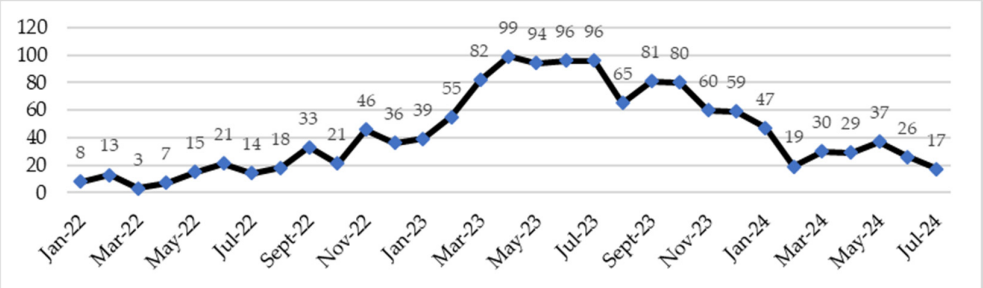

Figure 1. Total cases of passenger obstruction.

To analyze the primary cause of the increase in obstruction cases since the end of 2022, monthly ridership trends were compared with the number of passenger obstruction incidents. Figure 2 illustrates the comparison between ridership and passenger obstruction cases in 2022 and 2023. Notably, November and December 2022 saw a significant rise in passenger flow compared to January 2022. Correspondingly, obstruction cases peaked at 47 in November and 36 in December, substantially higher than the 8 cases reported in January 2022. This trend shows that the OLMRTS faced growing challenge related to passenger obstruction due to steadily increasing ridership. It is to be mentioned that the obstruction cases are not directly proportional to the passenger ridership. The increase in the obstruction cases is due to the absence of countermeasures in the presence of increased

ridership. As ridership continues to rise, so do potential life safety risks in the event of an accident [22].

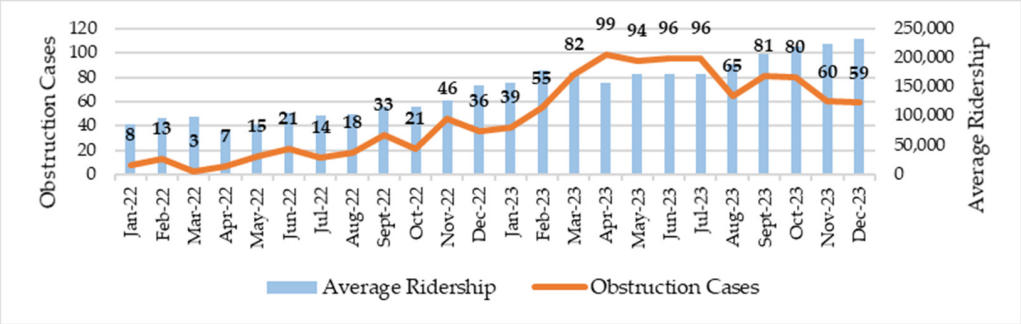

Figure 2. Comparison of passenger obstruction/month between 2022 and 2023.

3. Objective of the Study

The study objectives include the following:

- To identify the reasons for passenger obstruction in OLMRTS.
- To provide risk assessment of obstruction cases and examine countermeasures.
- To highlight the efficiency of proposed countermeasures using DEMATEL (Decision Making Trial and Evaluation Laboratory) method.
- To provide recommendations for ensuring safer and reliable transit experiences.

4. Passenger Obstruction Analysis

4.1. Data Collection

Passenger obstruction data is primarily obtained from daily reports submitted by Train Operators. Obstructions mostly result in operational anomalies affecting train doors or PSDs, requiring prompt intervention, thus Train Operators play a crucial role in documenting these incidents, providing valuable insights that enable researchers and stakeholders to conduct quantitative analyses of obstruction trends and patterns.

4.2. Data Analysis

Focusing on the data of obstruction cases based on individual stations which took place in 2022 and 2023 as highlighted in Figure 3, it is evidently concluded that the highest number of cases have occurred on station 10, station 13 and station 17, both in 2022 and 2023. Further, it was observed that these stations have the highest ridership volume along with terminal stations 01 and 26.

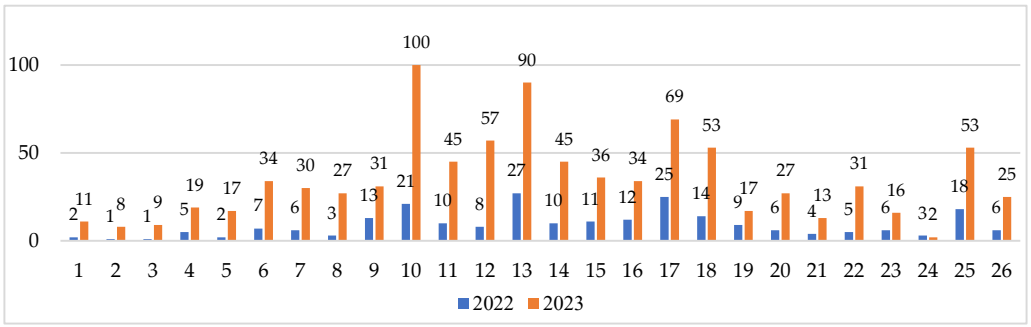

Figure 3. Annual passenger obstruction cases at individual stations.

In Figure 4, it can be observed that the average monthly ridership of 2022 was 152,279, whereas for 2023 it was 233,406. Further, as seen in Figure 3, there were more obstruction cases in 2023 compared to cases in 2022 at all stations. Therefore, it can be safely concluded that increase in obstruction cases is attributed to increase in passenger volume, further requiring the identification and implementation of countermeasures to reduce the obstruction cases, so that risks associated with passenger safety can be reduced.

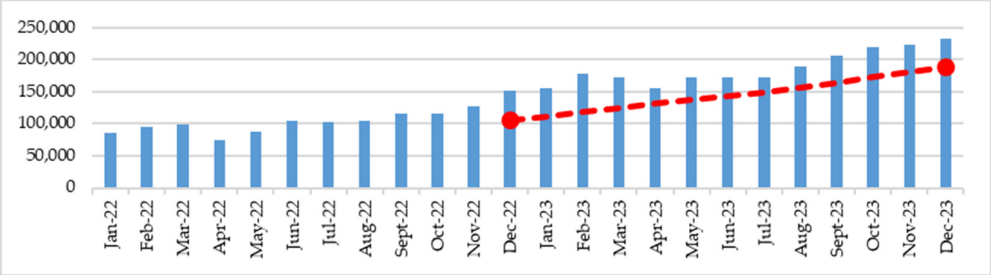

Figure 4. Monthly ridership trends.

Based on a quantitative analysis of the time of occurrence of obstruction cases, more valuable insights can be derived, as illustrated in Figure 5. The highest number of obstruction cases in both 2022 and 2023 were reported between 12:00 and 13:00 h and between 18:00 and 20:00 h. Further analysis of these time periods in relation to peak operational hours, during which headway is reduced from 7 min to 5 min due to increased frequency of passenger trains, indicates a distinct pattern. The frequency of passenger obstruction cases tends to rise 1 to 1.5 h before the start of peak hours, decreasing once all additional trains are operational, and then to rise again towards the end of peak hours, continuing the higher trend for about 1 to 1.5 h afterwards. These findings further highlight an already established correlation between passenger volume and obstruction cases. The time intervals from 12:00 to 14:00 h and 17:00 to 20:00 h typically coincide with the closing hours of schools, colleges, universities, and offices, resulting in increased passenger volumes at Orange Line stations.

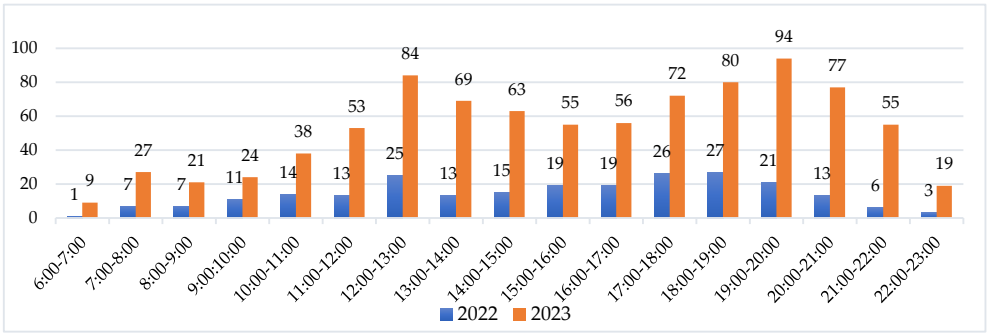

Figure 5. Time-based statistics of passenger obstruction.

As shown in Figure 6, the majority of obstruction incidents occurred during boarding rather than alighting. This consistent difference across both years is attributed to several factors, including the non-uniform distribution of passengers across the platform, the tendency of female passengers to board the first dedicated female saloon, sudden boarding from doors located in front of escalators, stairs, and elevators, unfamiliarity with door opening times, difficulty boarding crowded trains during peak hours, and a lack of effective crowd and passenger management by platform staff.

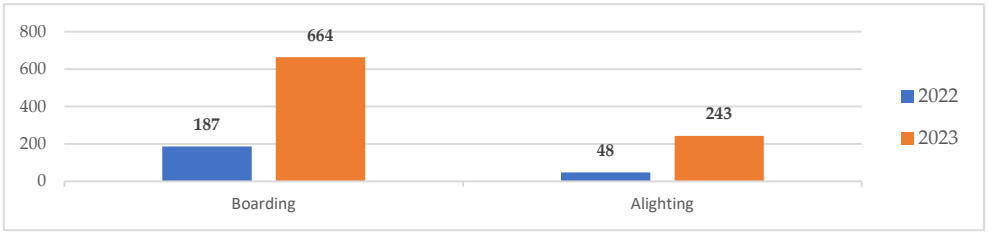

Figure 6. Comparison of boarding and alighting-related obstruction.

4.3. Types of Passenger Obstructions

Passenger obstructions have been categorized into four general types.

4.3.1. Unintentional Obstruction

Unintentional passenger obstruction occurs when individuals become trapped between train doors and PSDs, often due to a lack of awareness or understanding of how door operations are managed. One common cause is the unfamiliarity of new passengers with the metro system, which can lead to delayed actions and result in obstruction. Unattended individuals with disabilities may require more time for safe boarding or alighting, and if not attended carefully, they may end up in the dangerous zone during closure. Behavioral patterns of female passengers and families slowly moving towards reserved saloons after the train has arrived can also lead to obstruction, as when train doors are closed, they start to rush through the closing doors. Similar risks are present while alighting, as train operators do not have visibility inside the train before initiating door closure.

Another critical and particularly hazardous form of obstruction occurs when passengers' hands or fingers become trapped between the door leaf and the train body, inside door retraction slots, during the train door opening process.

4.3.2. Intentional Obstruction

These obstructions refer to situations where passengers deliberately interfere with the closing of train doors or PSDs, since they are fully aware that such actions will trigger a response from the train operator, typically leading to the doors being reopened. Some passengers intentionally place their arms, luggage, or other objects in the door path to delay closure, often to allow themselves or their companions additional time to board. Additionally, instances have been observed where children in groups or mischief-makers deliberately obstruct the doors purely to cause disturbance or delay.

4.3.3. Administrative and Design Constraints

Apart from passenger behavior, administrative and station design-related factors also contribute to increased risks of obstruction. One such scenario involves passengers who are still on staircases, either ascending at elevated stations or descending at underground stations, when the train is present at the platform. As the Train Operator initiates door closure, these passengers rush onto the platform and head straight for the train doors in an attempt to board, often leading to obstruction. Similarly, elevators positioned in close proximity to the platform edge can also contribute to obstruction in a similar way. Another significant factor is the inability of the Train Operator to view inside the train before closing the doors. The absence of organized guidance on platforms, such as properly trained Station Attendants, can lead to crowding and unstructured flow, thus increasing the likelihood of obstructions. Additionally, passengers tend to gather in front of the train doors nearest to platform entry points, leading to uneven distribution and excessive reliance on limited doors, resulting in bottlenecks and obstruction.

4.3.4. Obstructions Caused Due to Behavior of Train Operator

Nonstandard actions of Train Operators (TOs) can also contribute towards obstructions, i.e., when the train doors are closed early, before the defined time, due to the careless behavior of TOs or if they close the doors while passengers are standing between them. Another contributing factor could be the operational requirements of the mainline, which may demand that the doors are closed earlier to avoid delays.

The reasons for different types of passenger obstructions can be summarized as explained in Table 1.

Table 1. Types of passenger obstructions and corresponding reasons.

Passenger Obstruction Types	Reasons
Unintentional Obstruction	R01: Lack of Passenger awareness R02: Passengers do not know about the direction of the train R03: Passengers appear relaxed while boarding and alighting R04: Unattended disabled passengers R05: Passengers do not know the expected time of "open door" status of the train R06: Behavior of female passengers and families to get on board in reserved saloons
Intentional Obstruction	R07: Passengers intentionally put an obstacle in the doors. R08: Personal observance
Administrative and Design Constraints	R09: Platform design R10: Lack of management of Station Attendants
Negligence of Train Operator	R11: Careless behavior of Train Operator R12: Early closing of train doors

4.4. Selected Countermeasures (CM)

Based on a qualitative analysis of various causes of passenger obstruction, supported by video reviews of actual incidents, nine countermeasures were developed by the management experts from the relevant operations teams. These countermeasures detailed are designated as CM1 through CM9 and are aimed at enhancing Passenger awareness, improving operational compliance, ensuring station staff support, and optimizing platform management. Table 2 presents a comprehensive linkage between identified reasons of passenger obstruction, as outlined in Table 1, and corresponding mitigation strategies developed to address each specific issues. For every listed reason, relevant countermeasures have been proposed to reduce the occurrence of obstructions.

Table 2. Countermeasures against each reason of passenger obstruction.

Reason	Countermeasures to Reduce Passenger Obstruction
R01: Lack of Passenger awareness	CM1: Enhanced presence of security staff CM2: Passenger awareness CM4: Warning stickers on doors
R02: Passengers do not know about the direction of the train	CM1: Enhanced presence of security staff CM2: Passenger awareness
R03: Passengers appear relaxed while boarding and alighting	CM2: Passenger awareness CM5: Safety awareness campaigns at stations using videos CM8: Manual Broadcasting to stay away from doors
R04: Unattended disabled passengers	CM6: Support from station staff for boarding and alighting of the disabled

Table 2. *Cont.*

Reason	Countermeasures to Reduce Passenger Obstruction
R05: Passengers do not know the expected time of "open door" status of train	CM2: Passenger awareness CM4: Warning stickers on doors CM5: Safety awareness campaigns
R06: Behavior of female passengers and families to get on board in reserved saloons	CM3: Station staff guiding female passengers CM2: Passenger awareness
R07: Passengers intentionally put obstacles in doors.	CM4: Warning stickers on doors CM5: Safety awareness campaigns
R08: Personal observance	CM1: Enhanced presence of security staff CM2: Passenger awareness
R09: Platform design	CM9: Installation of barricades in front of stairs and elevators
R10: Lack of management of Station Attendants	CM3: Station staff guiding female passengers CM6: Support from station staff for boarding and alighting of the disabled
R11: Careless behavior of Train Operator	CM7: Train Operator compliance with Standard Platform Operation
R12: Early closing of train doors	CM7: Train Operator compliance with Standard Platform Operation

5. Verification of Measures and Their Allocation Using the DEMATEL Method

The DEMATEL method analyses and visualizes the relationships and impacts between different factors [23]. It is particularly useful for understanding cause-and-effect relationships and prioritizing actions based on their influence and effectiveness [24]. It is an informative analytic technique in dealing with complex systems with interconnected elements, especially in scenarios such as passenger obstruction [25]. This method provides insight into the nature of the problem and directs the prioritization of interventions accordingly [26]. Overall, DEMATEL is useful in illustrating and prioritizing countermeasures; the limitations imposed by its assumptions and methodology require its use to be very attentive. This research takes advantage of the usefulness of the DEMATEL method.

To evaluate the relationship among selected countermeasures CM = {CM1, CM2, . . ., CM9} for reducing passenger obstruction, five experts and five specialists of a decision group were tasked to evaluate the direct influence countermeasure CMi has on the other countermeasure CMj, by utilizing a scale of "no influence (0)," "low influence (1)," "medium influence (2)," "high influence (3)," and "very high influence (4)."

Step 1: Create the Group Direct-Influence Matrix (Z): Using the data, a Direct-Influence Matrix Z is acquired using Equation (1) [23,26].

$$zij^n = \frac{1}{l}\sum_{k=1}^{l} z_{ij}^k, \qquad i, j = 1, 2, 3, \ldots\ldots n \tag{1}$$

Step 2: Generate the Normalized Direct-Influence Matrix (X): Normalized Direct-Influence Matrix X is calculated using Equations (2) and (3) [23,26].

$$X = \frac{Z}{s} \tag{2}$$

$$s = max\left(max\sum_{j=1}^{n} z_{ij}^k\right) \tag{3}$$

Step 3: Calculate the Total-Influence Matrix (T): Total-Influence Matrix T is calculated, using Equation (4) [23,26].

$$T = X(I - X)^{-1} \tag{4}$$

Step 4: Generate the Influence Relation Map (IRM): By using Total-Influence Matrix T, vectors R and C, representing the sum of the rows and the sum of the columns, respectively, are calculated, using Equations (5) and (6) [23,26].

$$R = [r_i]_{nx1} = \left(\sum_{j=1}^{n} t_{ij}\right)_{nx1} \tag{5}$$

$$C = [c_j]_{1xn} = \left(\sum_{j=1}^{n} t_{ij}\right)^{T}_{1xn} \tag{6}$$

where r_i is the sum of the ith row in matrix T. Similarly, c_j is the sum of the jth column in matrix T. Meanwhile, i = j and i, j ∈ {1,2, …, n}; the horizontal axis vector (R + C) is calculated, which represents the extent of the central role that a countermeasure plays in the system. Similarly, the vertical axis vector (R − C) is calculated which shows the overall effect of that countermeasure on the system. If $(r_i - c_i)$ is positive, then the countermeasure has a net influence on the other countermeasures and if $(r_i - c_i)$ is negative, then the countermeasure is being influenced by the other countermeasures. The evaluated results of the Influential Relation Map (IRM) are presented in Table 3 and the Influential Relation Map is shown in Figure 7, and provide valuable insights for decision making regarding the most influential countermeasures.

Table 3. IRM Matrix results.

Implemented CM	R_i	C_i	$R_i + C_i$	$R_i - C_i$
CM1 Enhanced presence of security staff	9.892248	8.162627	18.05488	1.729621
CM2 Passenger awareness	8.052951	9.09504	17.14799	−1.04209
CM3 Station staff guiding female passengers	8.647722	8.32454	16.97226	0.323182
CM4 Warning stickers on doors	8.453611	8.799546	17.25316	−0.34594
CM5 Safety awareness campaigns	7.911378	8.715405	16.62678	−0.80403
CM6 Support from station staff for the boarding and alighting of the disabled	9.554676	9.684313	19.23899	−0.12964
CM7 Train Operator compliance with Standard Platform Operation	9.061725	8.857792	17.91952	0.203932
CM8 Manual Broadcasting to stay away from doors	8.370432	9.142676	17.51311	−0.77224
CM9 Installation of Barricades in front of stairs and elevators	9.276854	8.439656	17.71651	0.837199

The positive $(r_i - c_i)$ values of countermeasures CM1, CM9, CM3, and CM7 with values 1.729, 0.837, 0.323, and 0.203, respectively, reflect that the countermeasures such as the enhanced presence of security staff, station staff guiding female passengers, Train Operator compliance with Standard Platform Operation and installation of barricades in front of stairs and elevators have an influence on the other countermeasures. Meanwhile, countermeasures CM6, CM4, CM8, CM5, and CM2 having $(r_j - c_j)$ negative values as −0.129, −0.345, −0.772, −0.804, −1.042, respectively, indicate that these countermeasures are being influenced by the other factors and may not be highly effective to control passenger obstruction cases.

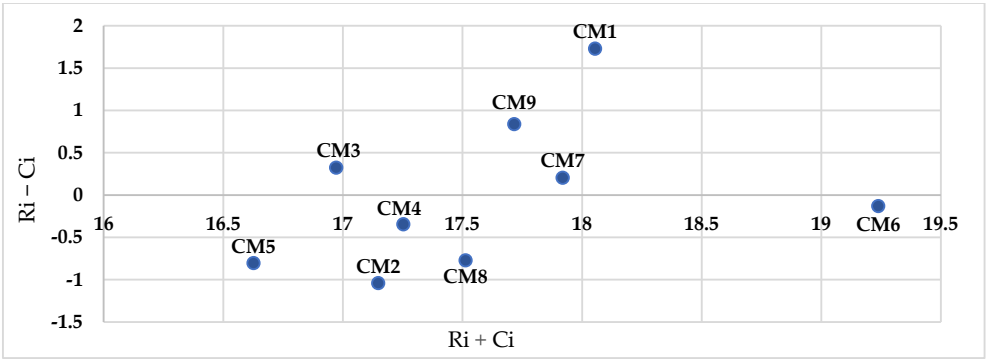

Figure 7. Influential Relation Map (IRM).

6. Results and Risk Assessment

6.1. Results

Following the implementation of countermeasures derived from the DEMATEL method in mid-2023, a significant and sustained reduction in passenger obstruction cases was observed; refer to Figure 8. The first half of 2023 saw obstruction cases steadily increasing, peaking at 99 in April, with levels remaining high through July. However, during the same period, average ridership remained consistently high, demonstrating high passenger demand despite operational inefficiencies. After mid-2023, with the adoption of targeted interventions, obstruction incidents dropped drastically, falling to 19 by February 2024, while ridership stayed at a stable average of 200,000 daily passengers. This clearly demonstrates that the measures not only improved safety but also maintained public confidence and system efficiency.

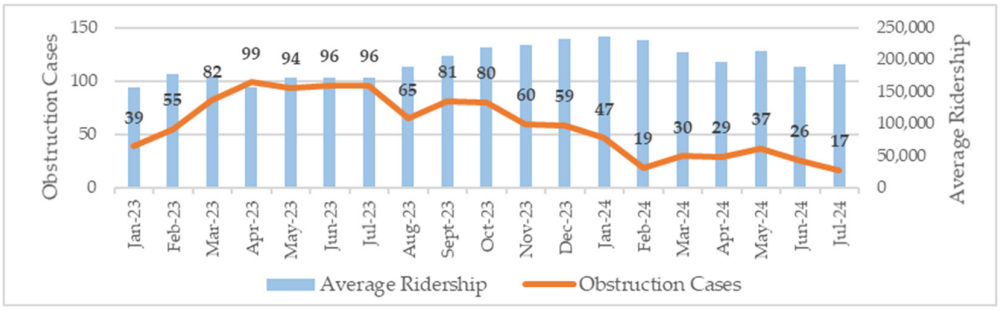

Figure 8. Comparison of passenger obstruction/month between 2023 and 2024.

The effectiveness of this improvement can be attributed to four countermeasures (CM1, CM3, CM7, CM9) identified through the DEMATEL analysis, as explained further, which were implemented strategically to address specific issues related to passenger obstructions.

CM1: Enhanced deployment of security personnel at station platforms played a critical role in managing crowd behavior and minimizing obstruction incidents.

CM3: The placement of station staff at key locations proved instrumental in supporting female passengers during the boarding process. Staff were tasked to guide females to designated areas in a timely manner, ensuring safe and orderly boarding.

CM7: Train Operators were systematically trained and monitored for strict adherence to Standard Platform Operation protocols. By maintaining consistent and predictable operations, operators helped reduce uncertainties that typically lead to last-minute boarding attempts and consequently passenger obstructions.

CM9: Physical barricades were installed in front of staircases and elevators to prevent crowd build-up in these sensitive areas.

In addition to the four highly impactful countermeasures, another five countermeasures such as strategically placed warning signs, informative stickers, and frequent passenger announcements, etc., also played a supportive role in reducing obstruction cases. These measures reinforced Passenger awareness and compliance with platform safety requirements complementing the efforts of staff and physical enhancements. These low-cost and impactful CMs contributed to sustained improvements in passenger obstruction cases.

6.2. Risk Assessment

To validate the effectiveness of the CMs described earlier, a detailed risk assessment of passenger obstruction incidents was conducted. This assessment identified critical hazards contributing to obstruction events, including passenger misbehavior, lack of awareness, and non-compliance with operational protocols. These hazards can result in a range of adverse consequences such as minor injuries, operational delays, boarding/alighting issues, passenger discomfort, equipment damage, reputational damage, and in extreme cases, fatalities. A calibrated risk assessment matrix was developed, based on the principles outlined in EN 50126-1 [27] and further elaborated in [28–30], adapted to reflect the frequency and severity characteristics relevant to the OLMRTS risk acceptance criteria. The calibrated matrix, as described in Table 4, classifies risk levels by combining frequency/likelihood classes (F1 to F6) with severity levels (S1 to S4). This matrix was calibrated using incident data and context-specific thresholds.

Table 4. A Risk acceptance criterion for passenger obstruction cases.

			Severity Classes			
			S1	**S2**	**S3**	**S4**
			Insignificant Minor Injury	**Marginal Major Injury**	**Critical Single Fatality**	**Catastrophic Multiple Fatalities**
Frequency/Likelihood Class	F1	Frequent (81 to 100 Cases/Month)	Undesirable	Intolerable	Intolerable	Intolerable
	F2	Probable (61 to 80 Cases/Month)	Tolerable	Undesirable	Intolerable	Intolerable
	F3	Occasional (41 to 60 Cases/Month)	Tolerable	Undesirable	Undesirable	Intolerable
	F4	Rare (21 to 40 Cases/Month)	Acceptable	Tolerable	Undesirable	Intolerable
	F5	Improbable (1 to 20 Cases/Month)	Acceptable	Acceptable	Tolerable	Intolerable
	F6	Highly Improbable (1 Case/Year)	Acceptable	Acceptable	Acceptable	Tolerable

Red color represents intolerable risk level, orange color represents undesirable risk level, yellow color represents tolerable risk level, whereas green color represents acceptable risk level.

Before implementing corrective actions in mid-2023, the risk associated with passenger obstruction was evaluated as "Undesirable". This classification was based on the following:

- Frequency Class F1 (Frequent): With a peak of 99 cases/month recorded in April 2023, passenger obstruction events occurred at a high rate.
- Severity Class S1 (Insignificant/Minor Injury): While several incidents were reported, they predominantly involved minor injuries, thanks to timely staff interventions and safety protocols.

As shown in the matrix, the F1-S1 intersection yields an "Undesirable" risk level (orange zone). It is important to mention that the risk could jump into the intolerable

region of the risk matrix, given that risks were not studied and countermeasures were not implemented on a timely basis.

Following implementation of the countermeasures (CM1, CM3, CM7, CM9) identified through the DEMATEL analysis outlined earlier, a notable improvement was observed. By February 2024, monthly obstruction cases dropped significantly to below 20 (80% reduction), corresponding to the following:

- Frequency Class F5 (Improbable)
- Severity Class S1 (unchanged due to continued effectiveness in incident response)

This shift brought the overall risk classification down to "Acceptable", as reflected in the updated F5-S1 intersection in the risk matrix (green zone). The risk mitigation was achieved without compromising ridership, which remained consistently high, confirming the efficacy and sustainability of the interventions. This transition from an undesirable to an acceptable risk level demonstrates the substantial impact of targeted, data-driven safety measures and reinforces the importance of proactive crowd management in high-density public transportation environments.

7. Conclusions and Future Outlook

This research comprehensively examined the issue of passenger obstructions in the Orange Line Metro Rail Transit System (OLMRTS) in Lahore, Pakistan. By leveraging real-time operational data, qualitative assessments, and the Decision Making Trial and Evaluation Laboratory (DEMATEL) method, the study identified core causes of passenger obstructions, ranging from passenger behavior to administrative limitations. Subsequently, a series of targeted countermeasures were identified and implemented effectively.

The effectiveness of these countermeasures was evident in the substantial reduction in obstruction cases from a peak of 99 in April 2023 to 19 by February 2024. This decline occurred while the average monthly ridership remained consistent. These findings underscore the value of systematic, data-driven risk management strategies in enhancing both passenger safety and operational efficiency in high-capacity urban transit systems. It is also important to note that the absence of control over the effective implementation of such countermeasures, or their ineffective implementation, could potentially reverse these risk reductions.

To maintain and further enhance the risk reduction benefits, the following future directions are proposed:

- Establish a dynamic risk management framework that regularly analyzes obstruction data and adjusts countermeasures in response to evolving passenger behaviors and system demands.
- Re-evaluate the positioning of designated compartments (e.g., female saloons) to central train cars to facilitate even passenger distribution.
- Utilize time-based obstruction data to optimize train schedules and increase service frequency during periods of high demand.
- Continue capacity-building programs for security staff, Station Attendants, and Train Operators to strengthen passenger flow management and prevention of obstructions.
- Deploy intelligent monitoring systems, such as AI-enabled CCTV analytics, to detect and respond to potential obstruction behaviors in real time.
- Enhance platform accessibility and flow by refining station design elements, such as improved pathways for boarding and alighting, etc.
- Management must ensure that safety protocols are integrated into standard operating procedures (SOPs), monitored through key performance indicators (KPIs), and supported with dedicated resources and accountability mechanisms.

By institutionalizing these improvements and reinforcing them with ongoing data-driven oversight, OLMRTS can maintain low obstruction levels while preparing for future service demands.

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