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### PREDICTING THE USE OF PUBLIC TRANSPORTATION SERVICE: THE CASE STUDY OF KARACHI CIRCULAR RAILWAY

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#### **ABSTRACT:**

As the population increases, so does the travel demand. In order to meet public needs, public transit networks are critical. To meet Karachi's public transportation needs, the Karachi Circular Railway is being revived. On the other hand, passengers have conflicting opinions on whether public transportation should meet their commuting needs. This study aims to look into the potential usage of public transportation (the Karachi Circular Railway) through a questionnaire survey to know attitudes and perceptions about using public transportation of commuters are related to their stated intentions. For this, a 385 sample size was selected through random sampling. The theory of planned behavior was used to predict Karachi's intentions to use KCR after its revival based on attitudes, subjective norms, and PBC. The data were analyzed using SPSS and ArcGIS tools. According to these findings, subjective norms appeared to be a key factor affecting KCR use for educational purposes. The Karachi circular railway's educational suitability is defined by whether other people near the participants believe it is acceptable. Government agencies and policymakers in Pakistan and other similar regions could find the findings useful.

#### **INTRODUCTION**

In developing and rising countries like Pakistan, transportation is a significant issue. With 216.54 million people, it is one of the world's most populous countries ("World Bank," 2021). People choose various transportation modes depending on the trip's intent and duration (Wang & Nangung, 2007). Increased mobility issues have resulted from increased active car usage in and around cities in developed countries, as evidenced by traffic congestion and parking issues (Sahito, Han, et al., 2020). Besides traffic congestion, private

cars contribute to extreme CO<sub>2</sub> emissions, global warming, and noise pollution (Abrahamse, Steg, Gifford, & Vlek, 2009; Shaikh, Memon, Memon, Laghari, & Memon, 2020). Increased public transportation use, particularly in urban areas, is widely recognized in Germany and other European countries to minimize air pollution, noise levels, traffic congestion, and parking issues (Bamberg, Ajzen, & Schmidt, 2003).

The primary aim of any public transit system is to provide a viable alternative to travel (both car owners and non-owners) (Ülengin, Önsel, Topçu, Aktaş, & Kabak, 2007). This is often a challenge because public transportation can not have a high enough service quality to persuade many drivers to use exceptionally affordable public transportation (MEMON, 2018; Paudel, 2021). If the user's expectations are well known, this approach is generally more available (Memon, Napiah, Talpur, & Hakro, 2006). Unfortunately, for various reasons, people in developing countries, especially in urban areas, tend to use private vehicles as their primary mode of transportation; public transportation's poor performance contributes to this choice (Fitriastuti & Kresnanto, 2021; Han, Nguyen, & Sahito, 2019; Manzoor, Wei, & Sahito, 2021). Different factors influence mode selection, including customer characteristics, trip type, and the service quality for various modes of transportation (García-Melero, Sainz-González, Coto-Millán, & Valencia-Vásquez, 2021; Sahito, Kalwar, Memon, Mangi, & Hussain, 2020). Several studies have shown that various factors, such as travel time, comfortable and relaxing public transportation experience, public transportation availability, etc., can influence an individual's decision to use public transportation (Ali, 2010).

In order to enable more car users to use public transport, the public transport system requires a reasonable quality of service (Redman, Friman, Gärling, & Hartig, 2013). Planners and lawmakers are attempting to address the disparity between the forms by repositioning public transportation (Memon, Kalwar, Sahito, Qureshi, & Memon, 2020). In urban areas, where the car performs the least well, its usage is limited (Axsen & Sovacool, 2019; Gill, Kalwar, & Memon, 2021; T. V. T. Nguyen, Han, Sahito, & Lam, 2019). According to another report, station walking distance, waiting time, and service frequency all affect the public service transport quality (Ali, 2010; Han, Sahito, Thi Nguyen, Hwang, & Asif, 2019). Many commuters worldwide have realized that using the train transit system is a comfortable and dependable transportation mode within cities. Rail transit services have received many positive reviews because of their higher comfort, protection, reliability, and capability. The train commute is viewed as more favorable as a result of these factors, and its prestige and popularity have skyrocketed. Despite the fact that trains were heavily promoted, one major obstacle was the number of passengers who used them. The rapid decline in train use during the latter half of the twentieth century was due to the growth of private vehicle industries (Hussain, 2020).

Commuters who use crowded public transit with restricted personal space are more anxious in general, likely due to stressful conditions and personal space invasion (Memon, Napiah, Hussain, & Hakro, 2016). Commuters who wait

longer for public transit experience more stress (Cantwell, Caulfield, & O'Mahony, 2009). Other psychological theories of attitude-behavior were used in different experiments to predict mode preference. These studies' findings revealed that choosing a particular mode is primarily a rational decision based on perceptions and perceived barriers to action (Fu, 2020). Apart from service quality and environmental effects, people's attitudes are thought to play a role in their decision to move from private cars to public transportation (Memon, Madzlan, Talpur, Hakro, & Chandio, 2014).

According to the 1991 Ajzen theory of planned behavior, an attitude refers to an overall assessment of an individual's good or bad behavior (Ng & Phung, 2020). As a result, consumer perceptions are directly related to public transit's perceived efficiency and the perceived environmental effect of private vehicles. People who believe that public transportation provides excellent service and that personal cars hurt the environment are more likely to choose to use public transportation (Borhan et al., 2014).

Choosing to use public transit is a tough choice that is informed by several factors. In a developing country like Pakistan, where car usage is increasing, this decision becomes more difficult. When commuters use their vehicles, they experience strength, independence, rank, and supremacy (Shaaban & Maher, 2020). This article explores people's attitudes and views about public transport and how those attitudes and opinions contribute to their stated purpose of using it. This study's results include important descriptions of expected consumer profiles and reasons for using the KCR service to authorities and policymakers. This data will suggest various measures to increase residents' willingness to use Karachi Circular Railway

### ***Materials and Methods***

#### ***The Research Area- Karachi Circular Railway***

Pakistan is an Asian country that is still developing. The country is dealing with high traffic demand, land scarcity, and inadequate infrastructure (Kalwar, Memon, & Qureshi, 2021). Most people living and working in Karachi, the country's financial hub, have become car dependents due to the abundance of job opportunities in the research field (Mangi, Yue, Kalwar, & Ali Lashari, 2020). Some people take taxis, and a small percentage of the population uses other public transit options (Hasan & Raza, 2015). Pakistan's government has agreed to revive the Karachi circular railway to meet the city's rapidly rising transportation demands and reduce traffic congestion on the roads. From 1964 to 1984, when 104 trains ran daily, KCR's operational performance was marginalized.

Due to a lack of investment, the operational productivity was reduced and ultimately came to a halt in December 1999. The Karachi Circular Railway was revived by the Pakistani government (GOP) in 2004-05 as a modern shuttle system for the Karachi District (Hasan, 2007). Pakistan Railways has partially reopened the Karachi Circular Railway from Pipri Station to Orangi Station on Monday, November 16. The gap between Pipri and Orangi Station

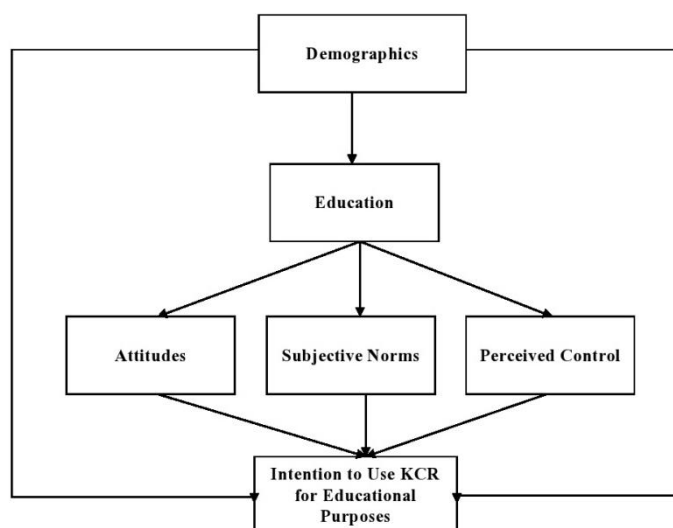
is approximately 60 kilometers, according to a Pakistan Railway press release (News, 2020), and the network has 24 stations (Hasan, 2009). Figure 1 depicts the current network. To take advantage of the city's current public transit system in reducing traffic congestion, the KCR must attract a significant number of commuters, including car users. The greater the number of travelers who use public transportation, the better the city's accessibility would be.

### *Theory of Planned Behavior*

The theory of planned behavior (TPB) is used in this study to investigate KCR decision-making. TPB is one of the most commonly used theories for predicting and describing activity-related behavior (Fu, 2020). The theory notes that three factors can influence an individual's intention to act somehow (Shalender & Sharma, 2021), in this case, using the KCR. First, the individual's overall behavioral assessment is included in the attitudes. Second, a person's perception of social influence or motivation to conduct the behavior (subjective norms) refers to a collection of convictions regarding significant others' moral standards (Shaaban & Maher, 2020). Third, a person's understanding of the difficulty or ease of attempting a particular action is shaped by various perceptions (perceived behavioral control). The TPB, as seen in Fig. 2, forecasts Karachi residents' plans to use the commuter rail for education reasons. SN and PBC were especially concerned about their attitudes.



**Fig. 1.** Existing network of KCR



**Fig. 2.** Theoretical Model

### *Data Collection*

In Karachi, a self-reported questionnaire survey was carried out to assess how the public transportation (KCR) service will be used once fully restored. There were five parts of the questionnaire used in this analysis. The first part contained demographic information; the second, third, fourth, and fifth parts contained questions concerning TPB. These are some of the questions that were adapted from (Shaaban & Maher, 2020). A random sampling technique was used to collect data on commuters' willingness to use public transportation for this study. Random sampling is a probability sampling that includes the random selection and draws solid statistical inferences about the whole population (T. D. Nguyen, Shih, Srivastava, Tirthapura, & Xu, 2020). According to (Ambak, Kasvar, Daniel, Prasetijo, & Abd Ghani, 2016), any multivariate statistical study requires a minimum sample size of 200 participants; thus, the research team used an online survey to pick a convenience sample of 500 participants (Shaaban & Maher, 2020). Only 385 forms were considered for the study. The remaining forms were discarded because they had more than 23% missing answers to questions.

### *Data analysis*

Different tools and techniques were used to analyze the collected data. Furthermore, SPSS 23.0 (Green & Salkind, 2012) is used to analyze the data obtained via the closed-ended questionnaire, while ArcGIS software 10.5 whereas; ArcGIS software 10.5 (Jovanović, 2016) is used for digitizing the current routes and location of the service. To achieve study objectives and assess the relationship between variables, descriptive statistics, correlation, independent sample t-test, and regression analysis were used. The Cronbach's alpha coefficient was determined for all variables. Ordinary least-squares (OLS) regression is used to assess the variables that greatly influenced commuters' willingness to use Karachi Circular Railway. OLS is a technique for modeling a single response variable reported on at least an interval scale.

## Results

The average variables were used to test various variables, as questions were based on one to five numerical rankings. Cronbach's alpha-coefficient was calculated for each variable. The values of Cronbach's Alpha exceeded the recommended values (Nunnally, 1994). Cronbach's alpha values are shown in Table 1.

**Table 1:** Internal Consistency of the variables for education purposes Table 3 provides an overview of the participants. A total of 261 men (68.7%) and 124 women were included in the study (32.2 percent ). Furthermore, 27 percent of the participants were Karachi natives, while 73 percent were non-Karachiites. A large percentage of the participants (59.5%) stated that they had completed their education Graduation). Finally, 83.9 percent of the sample was made up of young people under the age of 30.

Variable	Scale	Cronbach's Alpha
<b>Education Purposes</b>		
<p><b>Intention</b></p> <p>I intend to use the KCR to go out for education purposes:</p>	Strongly disagree (1)-Strongly agree (5)	N/A*
<p><b>Attitude</b></p> <p>For me to take the KCR for work education would be:</p>	<p>Extremely Unpleasant (1)-Extremely Pleasant (5)</p> <p>Extremely Bad (1)-Extremely Good (5)</p> <p>Extremely Negative (1)-Extremely Positive (5)</p>	0.93
<p><b>Subjective Norms</b></p> <p>1- Most people important to me would support my decision to take the KCR for education purposes:</p> <p>2- Most people important to me think that I should take the KCR for education purposes:</p>	<p>Extremely unlikely (1)-Extremely likely (5)</p> <p>Extremely unlikely (1)-Extremely likely (5)</p>	0.72
<p><b>Perceived Behavioral Control</b></p> <p>1- For me to take the KCR to get to education would be:</p> <p>2- My freedom to take the KCR to education would be:</p>	<p>Extremely difficult (1)-Extremely easy (5)</p> <p>Extremely low (1)-Extremely high (5)</p>	0.70

## Age

A question asking respondents about their age in four ranges was used to determine their age (18-30, 31-45, 46-65, and 66 years or more). Following that, the age was compared to the other variables to see if there was any correlation. Age used to have a weak positive relationship with the attitude towards educational use of KCR ( $r = .160$ ,  $p < 0.01$ ), followed by intention ( $r = .151$ ,  $p < 0.01$ ), PBC ( $r = .152$ ,  $p < 0.01$ ), and SN ( $r = .12$ ,  $p < 0.05$ ), as shown in Table 2.

**Table 2:** Age-related factors that affect willingness to use the KCR

Age	INT	ATT	SN	PBC
R	.151**	.160**	.129*	.152**

R Coefficient of Correlation

\* Significant at the 0.05 level (2-tailed)

\*\* Significant at the 0.01 level (2-tailed)

**Table 3:** Demographic Characteristics

Item	Percentages (%)	
<b>Gender</b>	Male	67.8
	Female	32.2
<b>Age (years)</b>	16-30	83.9
	31-45	10.9
	46-65	2.1
	66 or above	3.1
<b>Employment</b>	Govt. Employee	8.8
	Private Employee	40.3
	Un-Employee	17.4
	Daily Wager	1
	Student	32.5
<b>Education</b>	Illiterate	0
	Primary	0
	Secondary	1
	Higher Secondary	9.4
	Graduate	59.5
	Post-Graduate/PhD	30.1
<b>Native Residency</b>	Yes	27
	No	73

### *Gender*

Unless otherwise noted, all data are presented as mean and standard deviation. There were 261 males and 124 females who took part in the study. To see whether the intention, attitude, SN, and PBC differed between males and females, independent sample t-tests were used for educational purposes. Table 4 reveals that men had higher SN (male= 3.78, female = 3.37,  $p < 0.05$ ), and attitudes (male = 3.71, female = 3.43,  $p < 0.05$ ), but not PBC (male = 3.53, female = 3.47,  $p > 0.05$ ) or INT (male = 3.35, female = 3.42,  $p > 0.05$ ).

**Table 4:** Gender-related factors that are associated with eagerness to use the KCR

Gender		N	Mean	Std. Deviation	Sig. (2-tailed)	t
<b>Educational Purposes</b>						
Intention	Male	261	3.35	1.34	0.643	-0.463
	Female	124	3.42	1.53		
Attitude	Male	261	3.71	1.128	0.023	2.285
	Female	124	3.43	1.113		
SN	Male	261	3.78	0.908	0.000	4.167
	Female	124	3.37	0.905		
PBC	Male	261	3.53	0.956	0.567	0.573
	Female	124	3.47	0.911		

***Native Residency***

Unless otherwise noted, all data are presented as mean, standard deviation. There were 103 Karachiites and 282 non-Karachiites among the participants. For educational purposes, independent sample t-tests were used to see whether there was a difference in intention, attitude, SN, and PBC between Karachiites and non-Karachiites. Table 5 summarises the results. On questions of intent and attitude about using KCR for educational purposes, Karachiites exceeded non-Karachiites, but only differences in attitude and subjective norms were significant. Furthermore, the Karachiites surpassed on intention (Karachiites: 3.60, non-Karachiites: 3.29,  $p > 0.05$ ), attitude (Karachiites: 3.84, non-Karachiites: 3.53,  $p < 0.05$ ), but not on SN (Karachiites: 3.47, non-Karachiites: 3.72,  $p < 0.05$ ), and PBC (Karachiites: 3.37, non-Karachiites: 3.56,  $p > 0.05$ ).

**Table 5:** Native residency related factors that are associated with willingness to use the KCR

Locality		N	Mean	Std. Deviation	Sig. (2-tailed)	t
<b>Educational Purposes</b>						
INT	Karachiites	103	3.60	1.27	0.60	1.88
	Non-Karachiites	282	3.29	1.44		
ATT	Karachiites	103	3.84	1.15	0.020	2.33
	Non-Karachiites	282	3.53	1.11		
SN	Karachiites	103	3.47	1.12	0.019	-2.36



	Non-Karachiites	282	3.72	0.83		
PBC	Karachiites	103	3.37	0.97	0.082	-1.72
	Non-Karachiites	282	3.56	0.92		

**Ordinary least Square (OLS) regression Model**

To know factors predict that people will use the KCR for educational purposes, researchers used ordinary least square (OLS) regressions, and variables regarding demography were regressed on to the intention to use the KCR with the attitude, SN, and PBC. The regression model’s functional form is illustrated below:

$$\text{Intention to use the KCR} = \beta_0 + \beta_1 X + \varepsilon$$

Where  $\beta_0$  is the y-intercept and  $\beta_1$  is the X coefficient of the independent variable.

All demographic characteristics have been predicted in regression for educational purposes to use the KCR (Table 6). The results show that all demographic variables, except residence, are statistically significant. Furthermore, employment predicts ( $\beta = 0.137, p < 0.05$ ), followed by the gender ( $\beta = 0.131, p < 0.05$ ), and age ( $\beta = 0.120, p < 0.05$ ). This can confirm more precisely that Karachiites are more expected to use KCR for education. Besides, women have also predicted the use of KCR. The TPB-related variables were then analyzed. The TPB variables were also statistically significant except for the PBC. Moreover, attitudes are significant predictors ( $\beta = 0.419, p < 0.05$ ) followed by the SN ( $\beta = 0.249, p < 0.05$ ). The  $R^2$  value (0.654) indicates the 65.4% of the variables’ variance are the predictors explained by the model.

**Table 6:** Regression Model

Model	Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	$\beta$		
1	(Constant)	-0.382	0.464		-.823	.411
	Age	0.263	0.103	0.120	2.552	0.011
	Gender	0.393	0.136	0.131	2.899	0.004
	Nationality	-0.202	0.146	-0.064	-1.387	0.166
	Employment	0.134	0.046	0.137	2.906	0.004
	Attitude	0.521	0.074	0.419	7.023	0.000

	SN	0.378	0.099	0.249	3.806	0.000
	PBC	-0.119	0.101	-0.079	-1.176	0.240
Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate		
1	0.809	0.654	0.627	0.486		

Dependent Variable: Intention, SN= Subjective Norms, PBC= Perceived behavioral control

## CONCLUSION

This study investigates the relationship between people's attitudes and perceptions about using the KCR in Karachi and their reported intentions. Questionnaire-based research was conducted to achieve these objectives, with responses from 385 participants. As per the descriptive analysis, Karachiites scored higher in all education-related variables. These findings could mean that Karachiites have a more favorable attitude toward the KCR. The attitude, SN, and PBC toward using the KCR for educational purposes had a weak positive correlation with age. This may mean that respondents aged 31 to 45 are more likely to have a positive outlook about using the KCR for educational purposes.

According to the gender descriptive study, male respondents are expected to use KCR, have a more positive attitude, and feel more encouragement from others to use KCR. There is a significant disparity between male and female roles in a male-dominated society (Atchley, Shi, & Yamamoto, 2014). A TPB study was used to understand commuters who are likely to use the KCR service once operational. This categorizes the variables that influence the probability of acting in particular ways into categories: attitudes, perceived behavioral control, and those in their surrounding environment. These findings suggest that improving passenger attitudes is the most significant factor in deciding whether they can use the KCR. However, PBC was discovered to be unnecessary for passengers considering the KCR for education purposes.

The use of KCR for educational purposes was affected by subjective norms. The KCR's suitability for educational purposes is decided by whether or not people near the respondents think it is acceptable. A few defects in the current study should be listed. Most survey-based analyses have a significant flaw: some respondents do not provide accurate answers because they are under pressure to reply additional within society satisfactory. This does not seem to be an issue with this research since results indicate that certain people can do it whilst others are unable to. Another downside was the study's dependence on convenience sampling, requiring its small budget. The results do not reflect the general population.

In conclusion, this study's results indicate that ads and other initiatives to raise residents' intentions to use the Karachi Circular Railway should be tailored to the commute's function and demographic target. This data gives Karachi

officials and decision-makers valuable insight into commuters' perspectives and preferences for using the KCR service.

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