PLANNING OF GAZIANTEP PROVINCE GAZIRAY SUBURBAN LINE FEEDING LINES

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Abstract - The Gaziray suburban rail project in Gaziantep aims to enhance urban mobility by integrating the city's transportation network with industrial zones and outer residential areas. This study focuses on the development of feeder lines to improve access to the Organized Industrial Zone (OSB), addressing the transportation needs of workers and reducing traffic congestion. By utilizing spatial analysis, surveys, and stakeholder feedback, various feeder line configurations were evaluated to determine the most efficient and cost-effective solutions. The findings highlight the potential of feeder systems to streamline urban transport, lower emissions, and support sustainable city growth. The study underscores the critical role of intermodal connections in creating a more accessible and efficient public transportation network.

Keywords - GAZIRAY, Feeder Line Planning,Organized Industrial Zone,Suburban Rail Systems.

I. INTRODUCTION

The rapid growth of cities and populations increases the need for efficient public transportation systems. Buses, trams, metros, and suburban trains are essential for sustainable urban mobility, with suburban rail systems playing a key role in reducing congestion and emissions. The Gaziray project in Gaziantep integrates suburban rail with industrial zones to improve access to the Organized Industrial Zone (OSB). Expanding cities require robust transport infrastructure to meet rising passenger demand and ensure environmental sustainability (Cano et al., 2021). Urban rail not only facilitates mobility but also drives social and economic transformation (Turnheim and Geels, 2019). Policymakers promote rail systems to address urbanization, traffic, and integration challenges (Beier, 2020).

The link between transportation, industrial growth, and sustainable development is vital. Expanding industrial zones heightens transport demand, necessitating strong connections with residential areas. Poorly planned networks can lead to congestion and inefficiencies, while effective planning enhances accessibility and quality of life. Insufficient public transit restricts mobility and worsens urban traffic. Rail projects alleviate congestion, especially during peak hours, by enhancing public transport networks. Key factors for effective transit include accessibility, reliability, security, comfort, and affordability. Addressing these elements improves transport efficiency and reduces congestion. This study evaluates feeder lines to maximize Gaziray's capacity, integrating it with existing infrastructure and worker services to facilitate transport between Gaziantep city center and OSB.

II. DETAILS EXPERIMENTAL

2.1. General Information About Gaziantep Osb

As of 2022, Gaziantep OrganizedIndustrialZone (GAOSB) hosts 1479 companies across 43.25 millionsquaremeters, employingover 240,000 workers and exportingglobally. In 2019, exportsrose by 9% to $5.487 billion, with electricityconsumptionincreasing by 434 million kWh, covering 3% of Turkey's total (Tercan et al., 2022).

Gaziantep has fiveOrganizedIndustrialZones (OSB) providingessentialinfrastructure like roads, water, gas, electricity, and wastetreatment, ensuringefficientoperations. Details on area, firms, employment, and utilities are shown in Table 1.

Bilgiler	I. BÖLGE	II. BÖLGE	III. BÖLGE	IV. BÖLGE	V. BÖLGE	TOPLAM
Alan (Ha)	210	450	540	1.200	1.925	4.325
Parsel Sayısı (Adet)	167	284	287	132	590	1460
Doğalgaz Tüketimi (m^3)	2.600.000	10.700.000	4,900.000	14.100.000	3.700.000	36.000.000
Enerji Tüketimi (kWh)	31.000.000	100.000.000	119.000.000	172.000.000	101.000.000	523.000.000
Su Tüketimi (Ton)	123.152	345.477	361.479	116.435	58.607	1.016.104
Çalışan İşçi (Kişi)	27.000	48.000	50.000	59.000	56.000	240.000

Table1: Chemical Composition of 2024 AA

The Gaziray suburban line began passenger service on November 5, 2022, with four three-wagon E23000 train sets capable of 140 km/h, operating at 25 kV, 50 Hz AC. In 2023, eight more TÜRASAŞ-manufactured train sets are planned for service. As of July 2023, Gaziray operates 33 daily trips every 30 minutes between 06:00 and 22:00, maintaining the same frequency during peak hours. Each three-wagon train carries up to 750 passengers, with a maximum hourly capacity of 2250 passengers.

The project focuses on transporting workers from nearby businesses to OSB stations. The study area covers a 500-meter radius around the three stations, detailed in Figures 1 and 2.

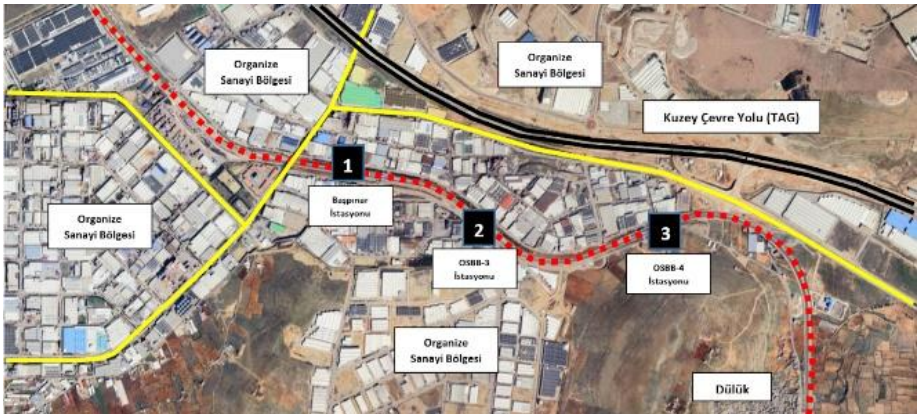


Fig.1. Gaziray OSB stations

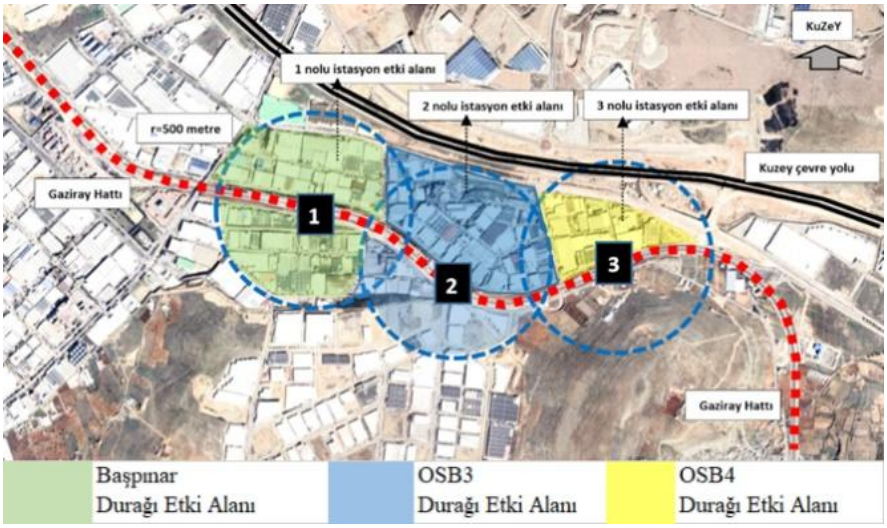


Fig.2. 10 minutes walking distance to Gaziray OSB station

2.2. Data Collection Method

The GAOSB Gazirayintegrationprojectanalyzedvarioustransportationtypes to gatherpassengerdata. Worker transportation by road, rail, public transport, car sharing, motorcycle, bicycle, and walking was evaluated, focusing on passengernumbers, routes, vehiclemodels, and fuelconsumption. Airtraveldata was also collected for white-collarworkers.

Urban public transport data for linesreaching GAOSB was examined in collaboration with GAOSB Directorate and Gaziantep Metropolitan Municipality. Since somedata was unavailable, additionalinformation was sourcedfrom Giray Turizm, a key worker transport provider.

In 2022, 2760 worker shuttlesoperated in OSB, with 1127 managed by Giray Turizm. Theirvehicles are tracked using the Mobiliz system (Figure 3). Thisdatasupported the evaluation of GAOSB's transport infrastructure and the planning of Gaziray'sintegration.



Fig.3. Mobiliz program interface used

2.3. Creation Of Beginning-End Matrices

Publictransportationmodelseffectivelycover main lines, but flexible, localizedapproaches are needed for feederlines, which oftenserveareasoutside main networks. As a result, fieldobservations and OD (origin-destination) matrices are essential for planning.

Mobiliz vehicletrackingdata for GAOSB feederlineslackedsufficientdetail to create an OD matrix, as service stops and passengerpick-up/drop-offpointswereunclear. To addressthis, 3230 workers' homeaddresseswerecollectedfrom 35 companies in OSB, mappingtheirstartingpoints, with OSB stops set as destinations.

In the absence of passengerdata, it was assumed that minibuses operate at full 16+1 capacity and ISUZU buses at 27+1 capacity.

2.4. Inscription Of Worker Shuttle Routes On The Road Network

In the first phase of the study, the demand for laborservicesduringpeakhours on the main corridors in Gaziantep was examined. Thisdata was obtained using Mobiliz software. The labor service routes between December 19-24, 2022 weredownloadedfrom Mobiliz in .kml format and analyzed. According to the analysisresults, the service densitymap of the Gaziantep citycenter was prepared and published at https://gaziray.3dcitymodelling.com/index.html (Figure4).

ArcGIS Pro 3.1.0 and the Network Analysis pluginwereused in the mapanalyses. Thissoftwareallows the mostappropriateroutes to be determined by makingdetailed routing on transportationnetworks. The routing process was carriedout based on factorssuch as distance, time and cost.

The obtaineddatacovers the routes of 1127 laborservicesservingthroughout Gaziantep. By integrating the service routesinto the urban road network, densitymapsduringpeakhourswerecreated. These mapsprovide an important resource for determining main transportationlines and planningfeederlines.

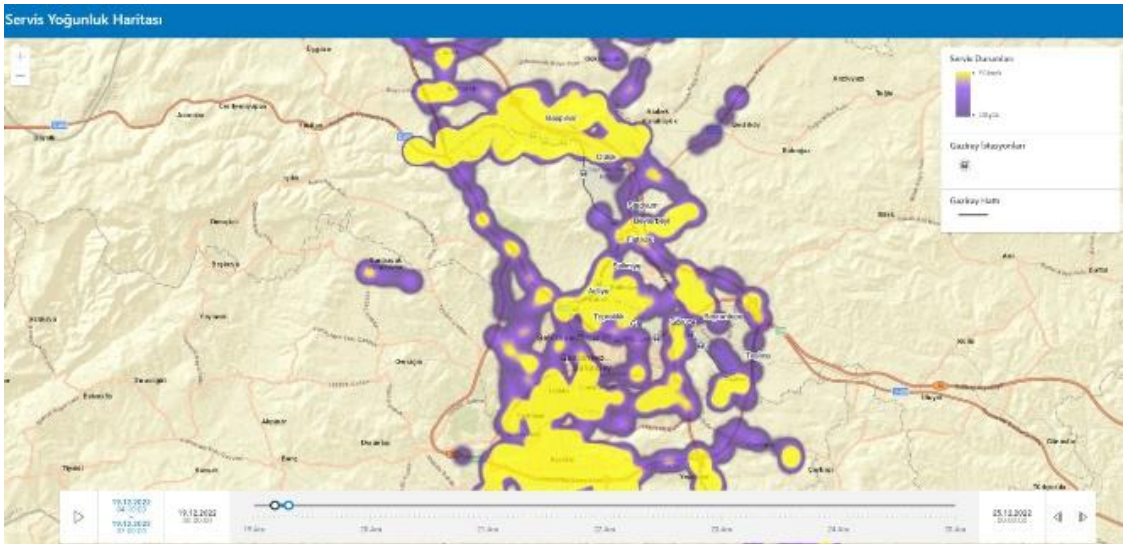


Fig.3. Gaziantep shuttle density map

2.5. Spatial Current Situation

The information of the companies close to the stops in GAOSB was provided by the OIZ Directorate. Worker service data was tried to be collectedfrom 35 enterprises in Table 2, but due to lack of data, the analysis was made using worker addresses.

STATION NO. 1	STATION NO. 2	STATION NO. 3
GAZİANTEP CAM	YENİÇAĞ OTOMOTİV	HEMAKS
TUTEKS TEKSTİL	ZÜMRÜT GIDA	ÖZNUR TEKSTİL
MUSTAFA MURAT ERSARAÇ	YURBAY TEKSTİL	CYS KİMYA
KARAR TEKSTİL	S.VAKKAS ERDOĞAN	GAZDAŞ
KARAR HALI	S.VAKKAS ERDOĞAN	ADAM TİCARET
ARKİM BOYA	DAYIOĞLU BULGUR	ERDAL TEKSTİL
ER-JÜT TEKSTİL	HASIRCI TEKSTİL	SAFYÜN TEKSTİL
MARATON HALI	MOTOSAN GIDA	KÖKBOYA KİMYA
ÖRYÜN TEKSTİL	ŞİRVAN TEKSTİL	ISIMATİK DAY.
ZER YAĞ	KONMED SAĞLIK	ESKA METAL
BÜNYAN HALI	KADİR SERTTAŞ	ELYAF İPLİK
BCS METAL	KEMAL KİMYA	

Table2: Information on the companies close to the stops in GAOSB

From 2006 to 2016, pedestrian rates in Gaziantep dropped from 53.68% to 46.15%, while worker and student shuttle use rose from 13.43% to 16.38% (GBB, 2016). This indicates growing reliance on public transport and shuttles, with reduced pedestrian mobility.

Urban Transportation Modes	2006 (%)	2016 (%)
Pedestrian	53,68	46,15
Bicycle	0,28	0,11
Private Vehicle	9,51	18,71
Taxi	0,07	0,43
Motorcycle	1,04	1,03
Shuttle Services (worker and student)	13,43	16,38
Municipal Bus	2,97	3,12
Minibus and Private Public Bus	18,18	11,28
Tram (operational since 2011)	-	2,07
Others (panel van, tractor, truck, etc.)	0,84	0,72
TOTAL	100	100

Table3: Gaziantep 2006 and 2016 Trip Distribution Ratios by Urban Transportation Types (GBB Transportation Master Plan 2006-2016)

In 2022, Gaziantep Organized Industrial Zone (GAOSB) had 1092 businesses employing 240,000 workers. Worker transportation is managed by factory shuttles, mainly operated by companies like

Giray Turizm, which uses the Mobiliz tracking system. Through Mobiliz access, trip data such as start/end times, distances, speeds, and daily trips were obtained for analysis.

Data Obtained from Trip Computer Report:

Brand, model, fuel type and class of vehicles

Distance covered, speed, fuel consumption and engine speed

Total driving time, idle time, gas pedal position and engine temperature

Lack of Sensor Data:

Since the vehicle sensors are turned off in the Mobiliz system, data could not be obtained from indicators such as seat belt, air conditioning, brakes and headlights. Giray Turizm stated that the activation of sensors causes disruptions in the system. For this reason, data originating from sensors could not be included in the reporting.

2.5.Creating Current Start-End Matrices

The factories in Table 2 were visited with an official letter from the OSB and Gaziantep Metropolitan Municipality, and the personnel residence addresses were received in Excel format. The address data obtained during the visit is presented in Table 4.

	A	B	C	D
1	ESKA METAL SAN TİC. A.Ş.			
2	P1	MAVİKENT MAH.135006 NOLU SOK.MAVİKENT 1. ETAP M BLOK NO:1M/8	ŞAHİNBEY	GAZİANTEP
3	P2	KARACAOĞLAN MAH. 40065 NOLU SK. NO: 25 İÇ KAPI NO: 3	ŞEHİTKAMİL	GAZİANTEP
4	P3	İSTİKLAL MAH. 76087 NOLU SK. 5 1	ŞAHİNBEY	GAZİANTEP
5	P4	BÜLBÜLZADE MAH 136096 NL.SK.BEREN SİT.B BLOK MURAT İNCİK APT KAT:4/20	ŞAHİNBEY	GAZİANTEP
6	P5	GÜNEŞ MAH.87018 NOLU SOK. NO:68/1	ŞAHİNBEY	GAZİANTEP
7	P6	ONAT KUTLAR MAH. 55006 NOLU SK. NO: 49 İÇ KAPI NO: 1	ŞEHİTKAMİL	GAZİANTEP
8	P7	ŞAHİNTEPE MAH. 133392 NOLU SOKAK NO:15/1	ŞAHİNBEY	GAZİANTEP
9	P8	FISTIKLIK MAH. 152064 NOLU SOKAK NO:25 B BLK KAT:1/3	ŞEHİTKAMİL	GAZİANTEP
10	P9	MÜCAHİTLER MAH. 52078 SOKAK NO:18/8	ŞAHİNBEY	GAZİANTEP
11	P10	SERİNEVLER MAH. 99081 NOLU SK. NO: 5 İÇ KAPI NO: 1	ŞAHİNBEY	GAZİANTEP
12	P11	EYÜPSULTAN MAH.21048 NOLU SOK. NO:98/1	ŞEHİTKAMİL	GAZİANTEP
13	P12	AKKENT MAH.134023 NOLU SOK.MY PARK SİT. C BLOK NO:2C/20	ŞAHİNBEY	GAZİANTEP
14	P13	GÜNEŞ MAH. 87022 NOLU SK. NO: 26 İÇ KAPI NO: 3	ŞAHİNBEY	GAZİANTEP
15	P14	KARATAŞ MAH.ŞEHİT MEHMET DEMİR SOK. YAYLA SİTESİ A BLOK NO:4A/15	ŞAHİNBEY	GAZİANTEP
16	P15	BEYKENT MAH. 2. ETAP TOPLU KNT. F-14 A BLOK KAT:7/16	ŞEHİTKAMİL	GAZİANTEP
17	P16	BEYBAHÇE MAH.91003 NOLU SOK. NO:20	ŞAHİNBEY	GAZİANTEP
18	P17	BARAK MAH. 100242 NOLU SK. NO: 48 İÇ KAPI NO: 1	ŞAHİNBEY	GAZİANTEP
19	P18	ŞAHİNTEPE MAH.133392 NOLU SOK. BİLGE SİTESİ BLOK NO:25/A İÇ KAPI/3	ŞAHİNBEY	GAZİANTEP
20	P19	ÇAMLITEPE MAH. 153040 CAD. F29 BLOK SİTESİ TOKİ BLOK NO: 12A İÇ KAPI NO: 15	ŞAHİNBEY	GAZİANTEP
21	P20	BÜLBÜLZADE MAH.136098 NOLU SOKAK NO:18/13	ŞAHİNBEY	GAZİANTEP
22	P21	GAZİLER MAH. 154041 NOLU CAD. NO:44/17	ŞEHİTKAMİL	GAZİANTEP
23	P22	İSTİKLAL MAH. 76045 NOLU SOKAK NO:1/2	ŞAHİNBEY	GAZİANTEP
24	P23	MÜCAHİTLER MAH. 52015 NOLU SOKAK A BLOK SİT.NO:3/10	ŞEHİTKAMİL	GAZİANTEP
25	P24	KOLEJTEPE MAH. MÜHENDİS EVLERİ SK. EGEMEN APT. BLOK NO: 21 İÇ KAPI NO: 1	ŞAHİNBEY	GAZİANTEP
26	P25	MÜCAHİTLER MAH.52008NOLU SOK. NO:6/7	ŞEHİTKAMİL	GAZİANTEP
27	P26	ÖZGÜRLÜK MAH. 57085 NOLU SOK. NO:32/3	ŞEHİTKAMİL	GAZİANTEP

Table4: Anonymous address information obtained from companies

According to Giray Turizm'sMobiliz vehicle tracking system data in Gaziantep, there are approximately 2,000 service vehicles in traffic daily, 1,127 of which belong to Giray Turizm. The average number of stops (passenger drop-off/pick-up) of vehicles between 19-24 December 2022 is shown in Figure 4.

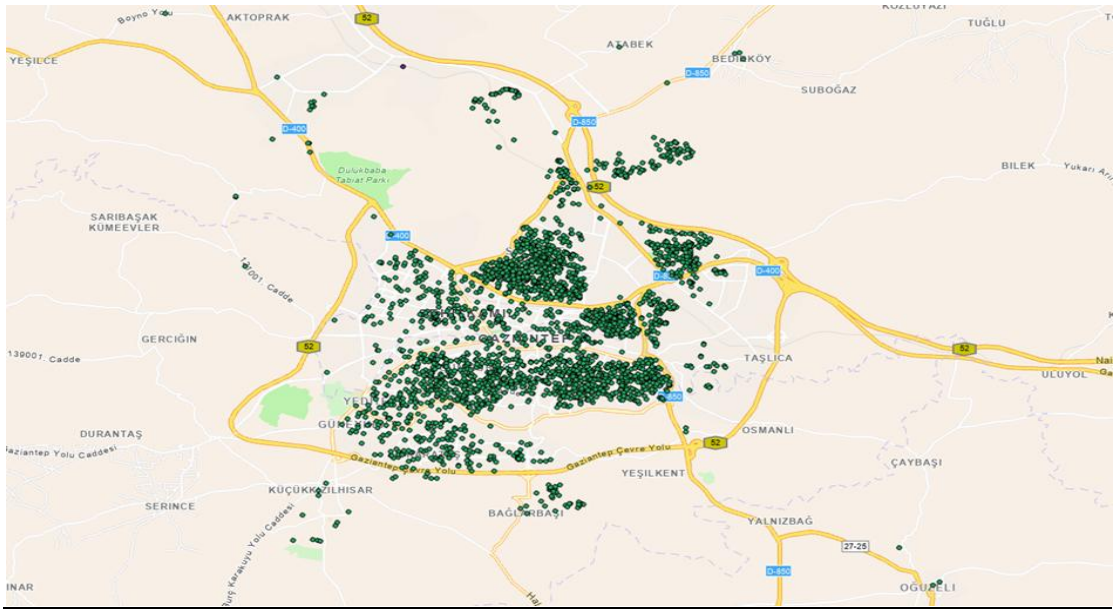


Fig.4. Distribution of 3230 workers within the city, based on address data from 35 interviewed companies.

2.6.Distance Of Workers In The Work Area To Urban Gaziray Stops

The locations of 3230 workers from 35 companies near 3 OSB stops were mapped, and their distances to Gaziray stops were calculated. Walking, micro-mobility, and feeder lines were considered, using 250, 500, 750, and 1000-meter distances. Figure 5 shows the radius circles and worker address data.

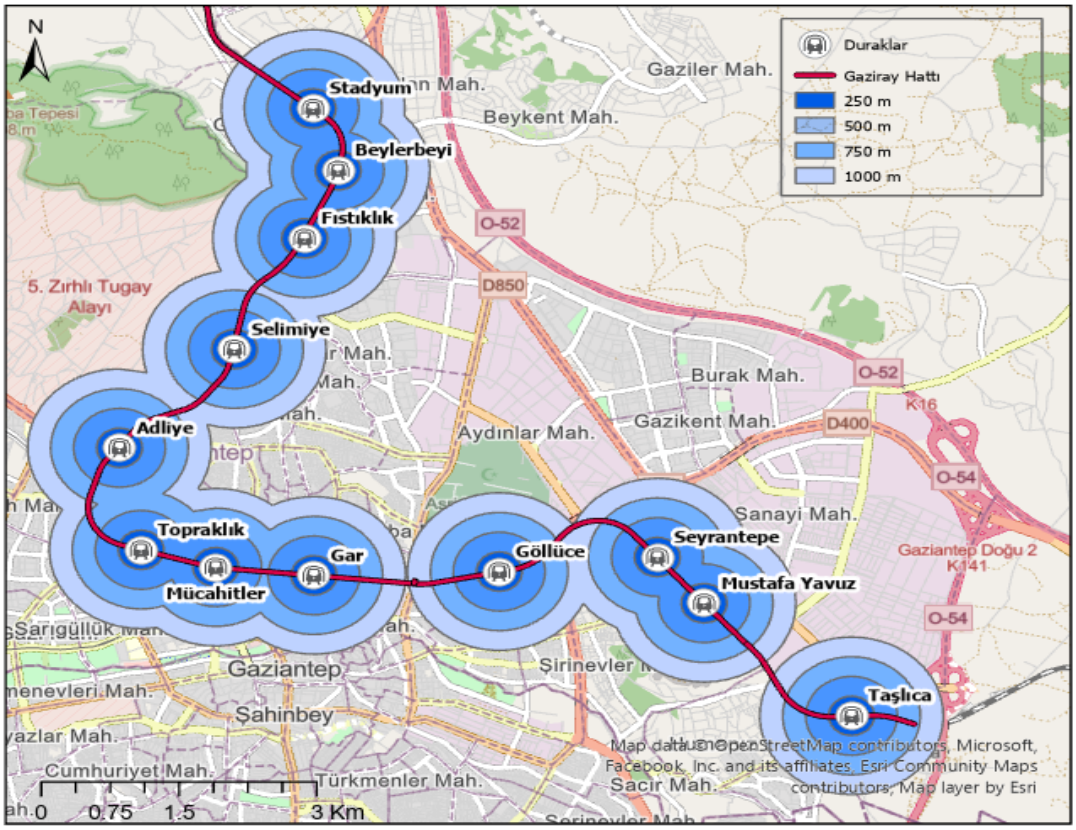


Fig.5. Radius circles created according to distances of 250-500-750 and 1000 meters and above.

The number of workers within a 10-minute or 500-meter walking distance to Gaziray's urban stops was determined as 177. The locations of these workers according to their address data are shown in Figure 6.

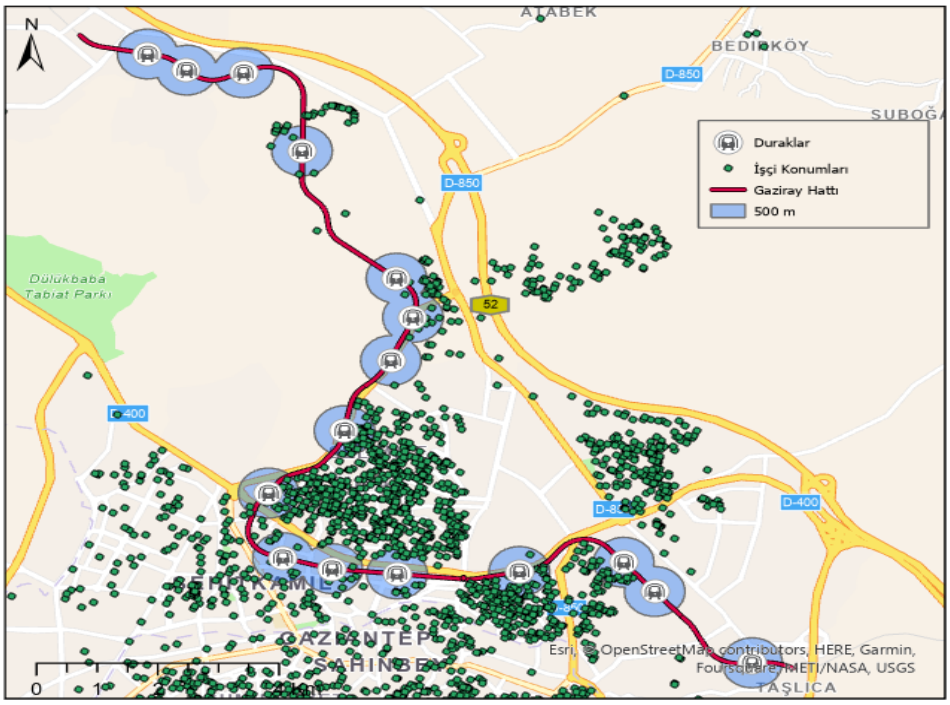


Fig.6.Number of workers within 500m.

1688 workers, about 50% of the total, live within 2500 meters of Gaziray urban stations. Figure 7 shows this area along with worker address data

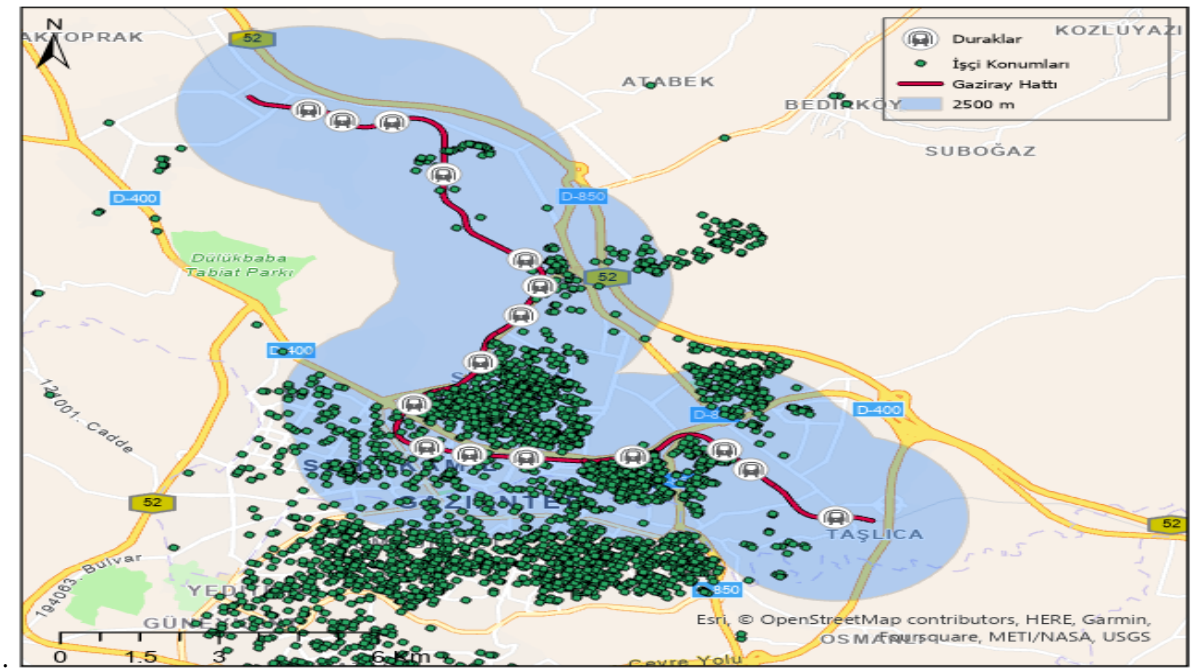


Fig.7. Workers located within a 2500 m radius of Gaziray

Table 5 shows the number of workers within 500-1000 and 2500 m. distance to the Gaziray stops within the city, according to worker address data. As can be seen from Table 5, the stops with the highest density of workers are Göllüce, Gar, Mücahitler, Topraklık, Adliye and Selimiye.stations

Row	Station Name	Staff Numbers		
		500 m	1500m	2500m
1	Taşlıca	0	18	26
2	Mustafa Yavuz	1	106	348
3	Seyrantepe	28	136	470
4	Göllüce	30	316	622
5	Gar	18	298	875
6	Mücahitler	7	254	775
7	Topraklık	15	220	619
8	Adliye	20	198	643
9	Selimiye	39	261	561
10	Fıstıklık	0	77	263
11	Beylerbeyi	8	63	170
12	Stadyum	6	50	104
13	Dülük	7	51	55
14	OSB4	0	15	50
15	OSB3	0	0	24
16	Başpınar	0	0	0

Table5: Number of workers within 500-1000 and 2500 meters distance to Gaziray station

2.7.Shortest Route Routing Analysis

A shortest route analysis assessed 4 feeder line alternatives to evaluate Gaziray's impact on urban transport by passenger-km.

Alternative Route I:Workers are picked up from their homes and transported to MücahitlerGaziray Station. The vehicle capacity is 45 people and a total of 350 workers were transported. The total distance covered is 77.04 km. The map is shown in Figure 8.

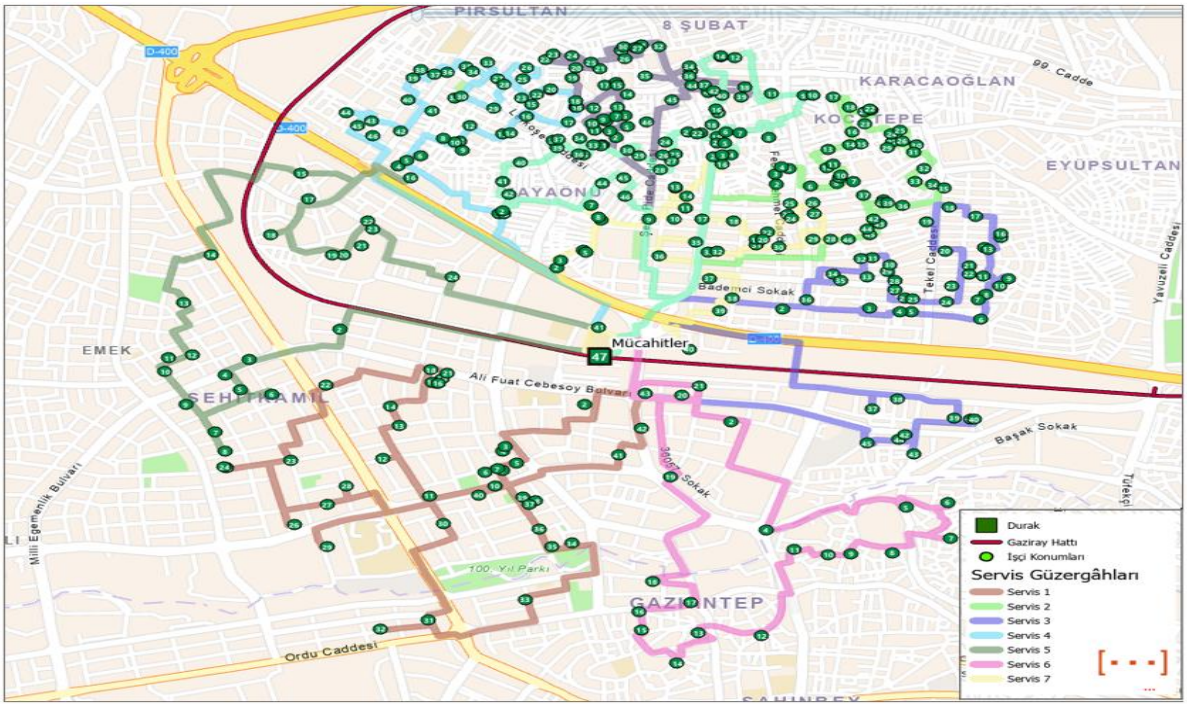


Fig.8. Alternative Route I

Alternative Route II:Workers are transported to Mücahitler and SelimiyeGaziray Stations. The vehicle capacity is again 45 people and 630 workers were transported. The total distance covered is 113.03 km. The map is given in Figure 9.

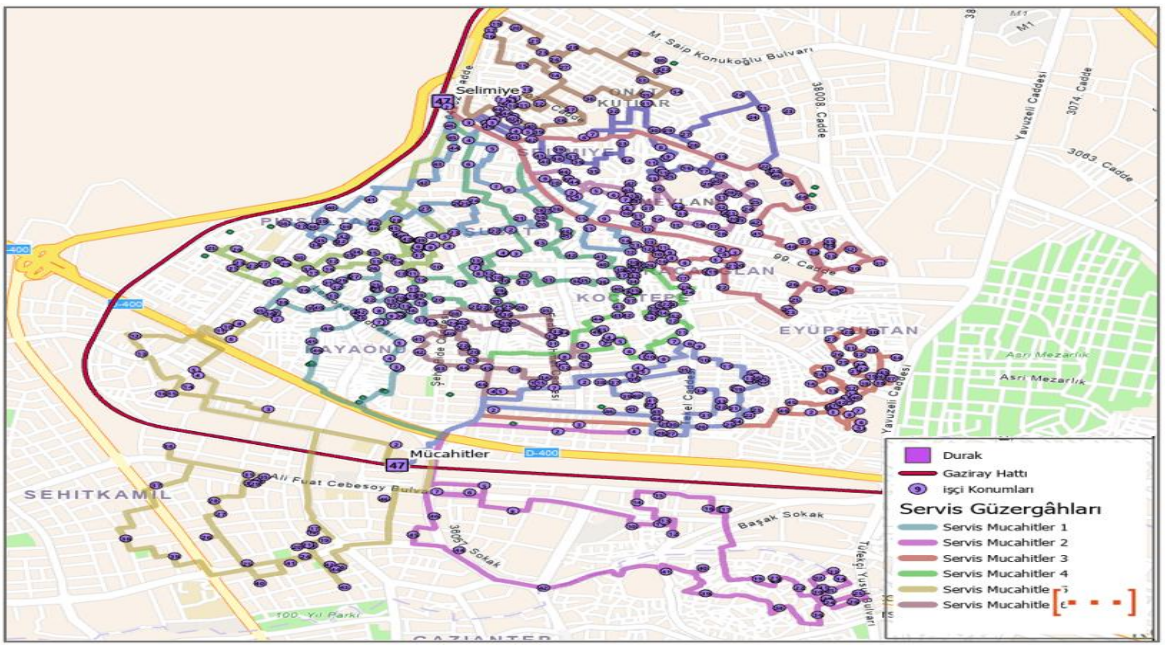


Fig.9. Alternative Route II

Alternative Route III:Workers are transported to factories (Gaziray OSB Stations). The vehicle capacity is 19 people and 350 workers are transported. The total distance covered is 554.58 km. The shortest route map is shown in Figure 10.

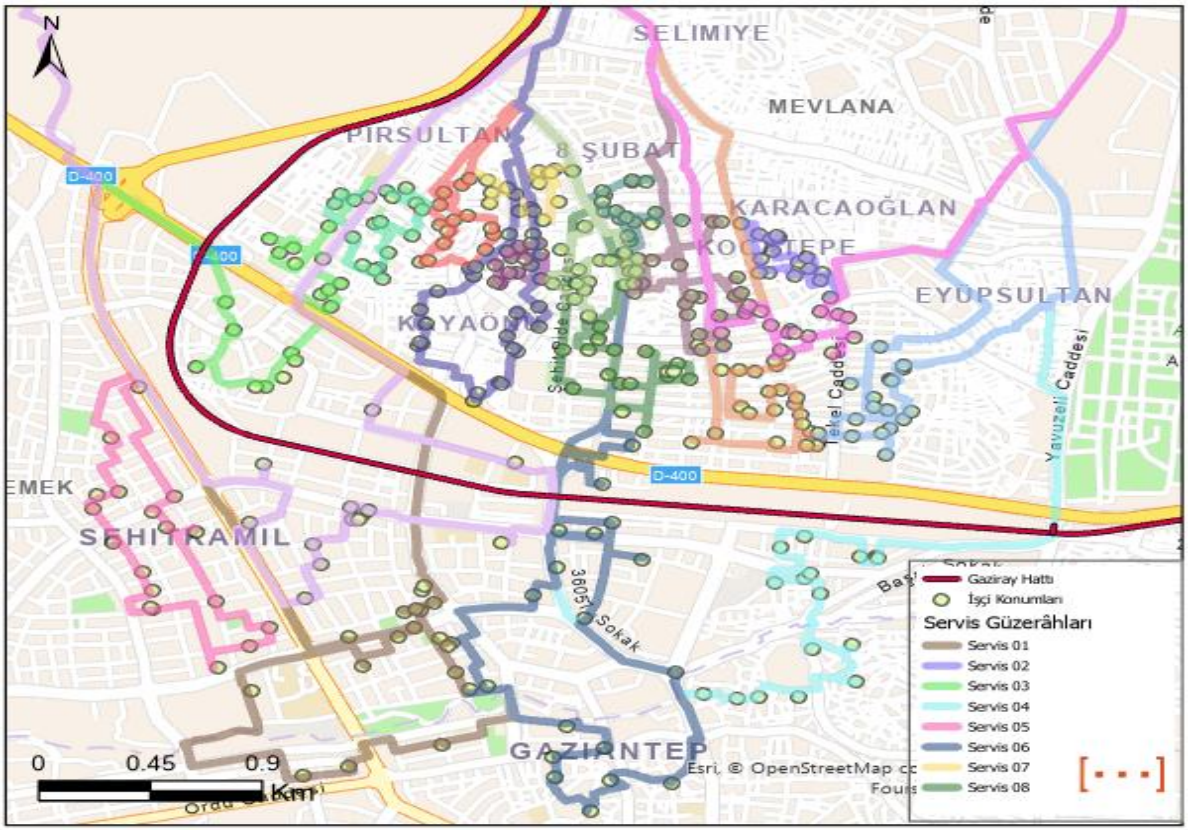


Fig.10. Alternative Route III

Alternative Route IV:Workers are transported to factories. The vehicle capacity is 19 people and 630 workers are transported. The total distance covered is 965.93 km. The map is presented in Figure 11.

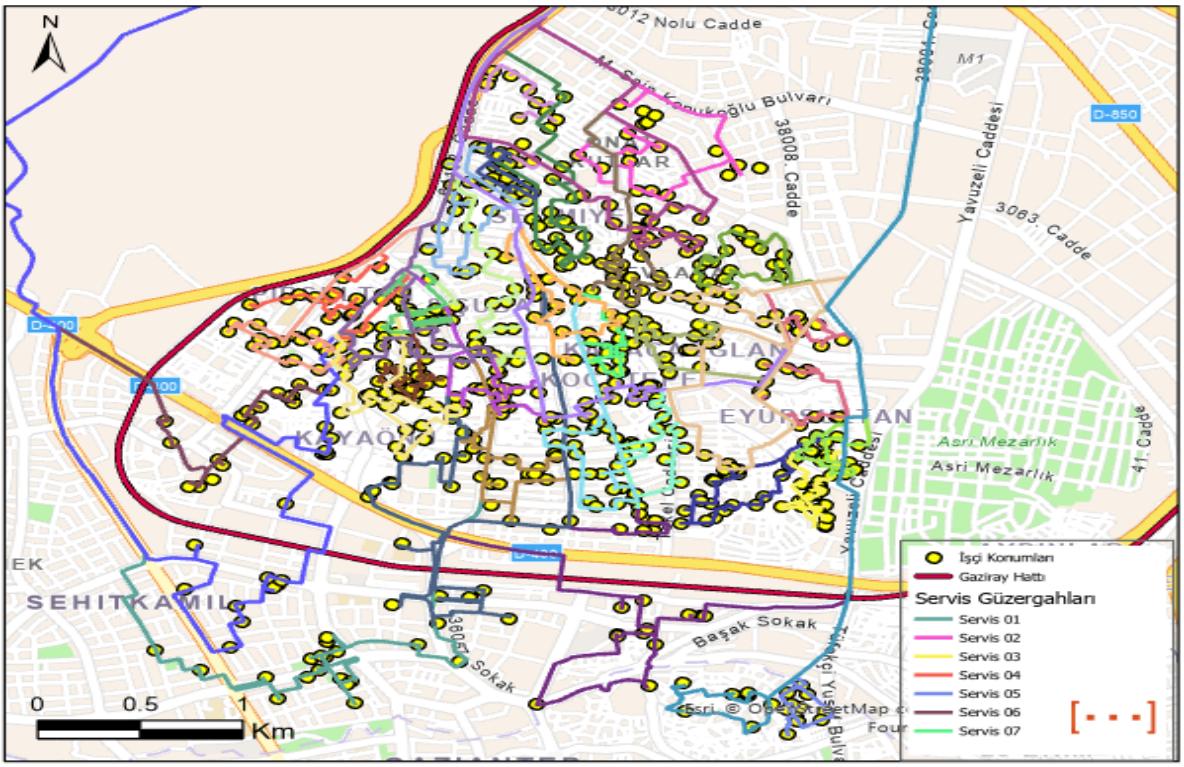


Fig.10. Alternative Route IV

The analysis compares shuttle routes for Gaziray integration. Alternatives I and III were excluded due to low capacity. Table 6 shows Alternative II, transporting 630 workers to Mücahitler and Selimiye with 14 shuttles (113.03 km), is more efficient than Alternative IV, which uses 34 shuttles to factories (965.9 km).

Scenario (DoorPick-up)	VehicleCapacity	Total Number of PassengersCarried	Route length (km)	Total DistanceTraveled (km)	Total Pass * km
Alternatif Rota 2 (14 servis)	45 person	630	8,07	113,03	5.084
Alternatif Rota 4 (34 servis)	19 person	630	28,41	965,93	17.898

Table6: Comparison of alternative routes

The planned feeder lines will use existing service vehicles, with potential operation by Gaziantep Metropolitan Municipality. The Menderes Feeder Line model was chosen over the Fishbone model to ensure broader worker access by utilizing existing bus routes and stops along main roads.
Determined Feeder Lines:
Selimiye Stop Line – 4.64 km
Adliye Stop Line – 4.24 km
Topraklık Stop Line – 7.4 km
Mücahitler Stop Line – 5.51
Gar Stop Line – 5.2 km
Göllüce Stop Line – 5.3 km
These routes are planned for the 6 Gaziray stops with the highest passenger transport potential. The lines will operate at 10-15 minute intervals, each bus will have a capacity of 50 passengers and will be able to carry 200 passengers per hour. In total, it is planned to transport 1200 passengers per hour on 6 lines. The planned lines cover 71% of the workers within 2500 m. If necessary, additional lines can be created depending on the demand in the field.The distances and details of all lines are presented in Table 7.

Scenario (DoorPickup)	VehicleCapacity	Total PassengersCarriedHourly	Route length (km)	Total Road Traveled (km)	Total Pass* km
Selimiye	50	200	4,64	18,56	928
Adliye	50	200	4,24	16,96	848
Topraklık	50	200	7,4	29,6	1.480
Mücahitler	50	200	5,5	22	1.100
Gar	50	200	5,2	20,8	1.040
Göllüce	50	200	5,3	21,2	1.060
Total		1200	32,28	129,12	6.456

Table7: Feed line data.

According to Table 8, the most advantageous scenario for 1200 workers is the feeder lines with 6,456 passenger-km. While transportation to Gaziray stops with 45-person shuttles comes in second place, transportation of workers to the factory with 34,092 passenger-km is the most costly option and should not be preferred.

Scenario (DoorPickup)	VehicleCapacity	Total PassengersCarriedHourly	Route length (km)	Total Road Traveled (km)	Total Pass* km
Alternatif Rota 2 (24 servis)	45	1200	8,07	209,82	9.684
Alternatif Rota 4 (63 servis)	19	1200	28,41	1.789,83	34.092
Total		1200	32,28	129,12	6.456

Table8: Comparison of door pick-up and feed line usage

Feeder lines will align with Gaziray schedules, with buses running four times per hour. GUAP targets 19% public transport use by 2030, though light rail projects are delayed. As of October 2023, Gaziray fares are 50% lower than worker shuttles,

highlighting the need for cost analyses and incentives with OSB and the municipality.

CONCLUSIONS

In this project, the design of the necessary feeder lines was carried out so that approximately 250,000 workers working in the Gaziantep Organized Industrial Zone (OSB) could be transported by the Gaziray Commuter Line as of 2023. Within the scope of the study, the six most used stops of Gaziray in terms of density were determined. Data on worker shuttles were analyzed and alternative solutions were produced to develop the most suitable feeder lines.
As a result of the analyzes, it was seen that 71% of the examined worker sample could be transported using feeder lines. The project aims to integrate the existing transportation systems in Gaziantep with the OSB and offers concrete suggestions to strengthen the city's public transportation infrastructure. The findings obtained provide significant contributions to reducing urban traffic and facilitating access to the industrial zone.

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