

BUS AND SUBWAY STATIONS' UBIQUITY: A CASE STUDY FOR STATIONS ALONG ISTANBUL METRO LINE

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PRESENTATION PLAN

- ◆ DEFINITION & METHODS FOR ACCESSIBILITY MEASUREMENT
- ◆ STUDY EXPLANATION & METHODOLOGY
- ◆ PTAL APPROACH
- ◆ ACCESSIBILITY ANALYSES OF ISTANBUL
- ◆ CONCLUSION AND RECOMMENDATIONS

DEFINITION

- ◆ By definition ubiquity means, the state of being everywhere at once (or seeming to be everywhere at once).
- ◆ Considering public transportation systems, ubiquity can be interpreted as using the network and the services it offers in a satisfactory level.
- ◆ Ubiquity which can be defined also as the amount of accessibility to the system is a prominent issue that defines the level of service for public transportation systems in metropolitan cities.

METHODS FOR ACCESSIBILITY MEASUREMENT

- ◆ *CAPITAL* (Calculator of Public Transport Accessibility in London) is an accessibility model developed by Transport for London.
- ◆ The usage of *GIS analysis* in order to illustrate walk distances to public transport stations provides a visual representation which enhances perception.
- ◆ *ACCMAP* is a journey access and travel time mapping software package that measures accessibility to and from any point based on travel costs through highway and public transport networks.
- ◆ *Accession* is a GIS based application designed to analyse the accessibility of locations to local services such as doctors, surgeries and local schools, etc.
- ◆ *PTAL* (Public Transport Accessibility Level) is an approach that deals with the accessibility of a point to the public transport network by taking into account walking times and service frequency.

STUDY EXPLANATION

- ◆ This study is dedicated to compare the accessibility level of Istanbul's -so far- only metro line and the bus service supplied along this line.
- ◆ We believe this comparison is crucial for the city provided that several high profile public transportation projects have already proceeded without any significant assessment with regard to accessibility.
- ◆ In order to analyse and compare the accessibility level of the metro and bus services along the metro line in Istanbul, PTAL approach is preferred.
- ◆ The calculation process is of this approach is compact, well-defined and generally accepted without bearing in mind its limitations.

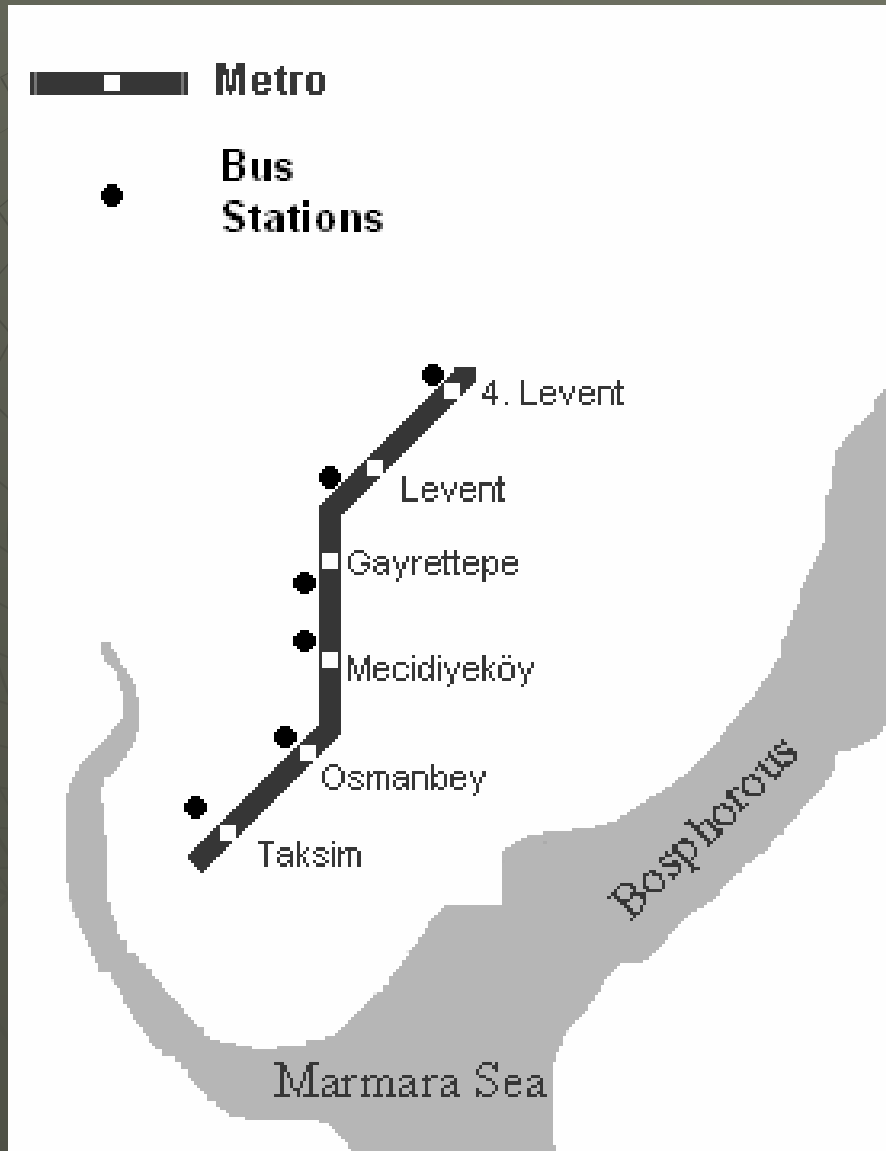


Fig. 1: Istanbul Metro Line and Bus Stations

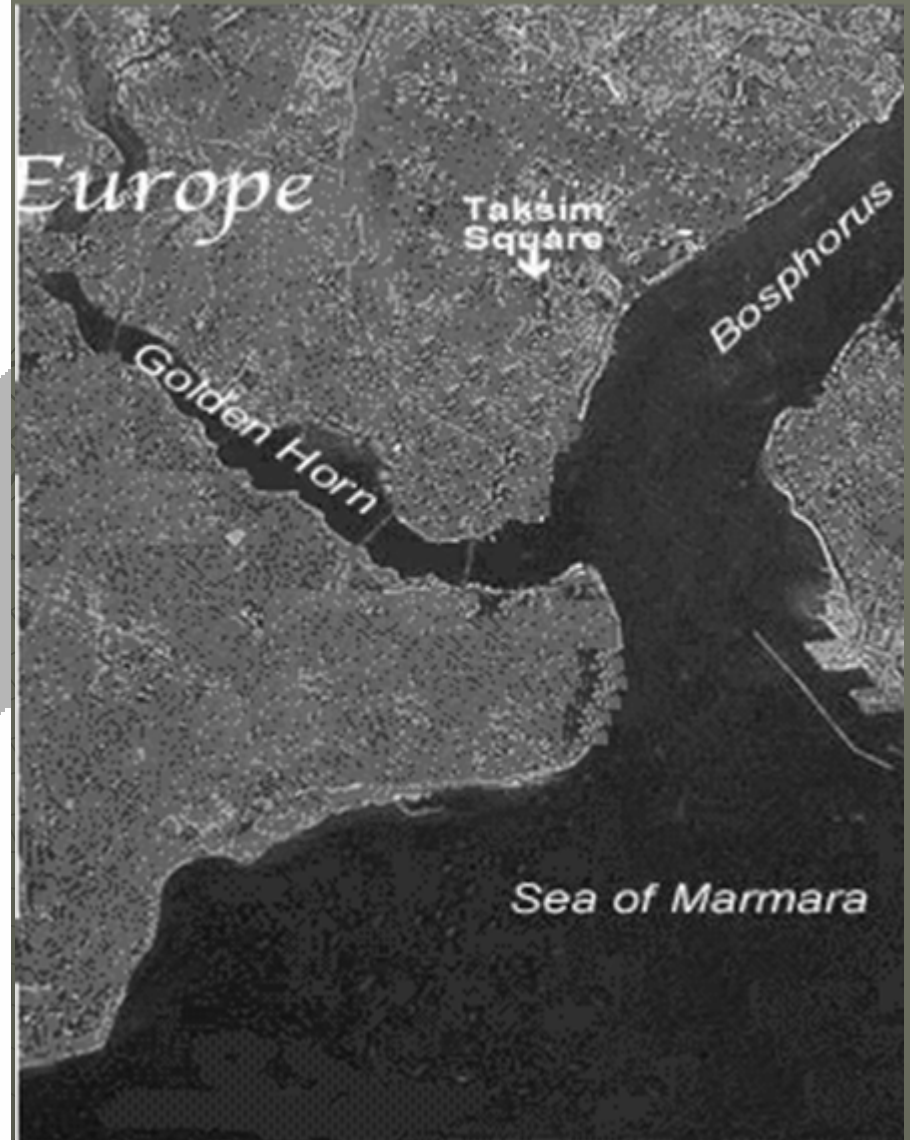


Fig. 2: Istanbul from Satellite

METHODOLOGY

- ◆ The methodology of PTAL approach has been presented in numerous studies such as Wu and Hine (2003), Gent and Symonds (2005), London Borough of Havering (2003), Transport for London (2006).
- ◆ The introduction is a review of these studies.
- ◆ The case study which is a comparison of bus and metro stations' accessibility studied in details.
- ◆ The paper is concluded with assessment of the results and several recommendations.

PTAL APPROACH

- ◆ PTAL method is essentially a way of measuring the density of the public transport network at a particular point.
- ◆ This particular point is called the Point of Interest (POI) which can be existing or new attraction centers such as malls, schools, stadiums, etc.
- ◆ During the analysis the choice of POI may have a substantial affect on the PTAL index and therefore should be determined carefully.

Calculation of PTAL Index

- ◆ **Total Access Time = Walking Time + Average Waiting Time [1]**
- ◆ **Average Waiting Time = k + Scheduled Waiting Time [2]**
- ◆ **SWT = 0.5 * (60/Frequency per hour) [3]**
- ◆ **EDF = 30 / Total Access Time [4]**

PTAL APPROACH

- ◆ PTAL index is a function of the walk time to a bus stop or train/metro station and the average wait time at that stop.
- ◆ Walk times are calculated from the specified point of interests to the public transport stops which are named as Service Access Points (SAP).
- ◆ Walking time refers to the time spent in order to reach the station.
- ◆ In the case of metro, time spent in order to reach the underground facility should be taken into consideration as well.

Table 1: PTAL index and associated accessibilities

PTAL Index Interval	PTAL Index	Accessibility Level
0,00 – 2,50	1a	VERY POOR
2,51 – 5,00	1b	
5,01 – 10,00	2	POOR
10,01 – 15,00	3	MODERATE
15,01 – 20,00	4	GOOD
20,01 – 25,00	5	VERY GOOD
25,01 – 40,00	6a	EXCELLENT
> 40,01	6b	

Pros and Cons of PTAL

◆ ADVANTAGES

- Easily Calculated
- Popular Among Policy Makers
- Data availability

◆ DISADVANTAGES

- Limited ability to determine true accessibility
- Only measures the level the analyzed station
- Does not consider speed, utility of accessible services, crowding including the ability to board services and ease of interchange

ACCESSIBILITY ANALYSES OF ISTANBUL

- ◆ The bus schedules are gathered from the web site of IETT.
- ◆ Underground walk time data are measured by the authors on site.
- ◆ The POI is specified for the most attracted places 1km radius around the stations.
- ◆ The POI is constant for each mode's station.
- ◆ The distances are measured from a common internet based map tool.
- ◆ The PTAL calculation flow and some basic algorithms are tabulated as follows.

Table 2: PTAL Calculation Steps

STEP 1			STEP 2	STEP 3	STEP 4	STEP 5
Stop	Route	Distance (metres)	Frequency (vph) (8:15-9:15)	Weight	Walk Time (mins) <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;">Step2 / 80</div>	Underground Walk Time (mins)

Table 2: PTAL Calculation Steps

STEP 6	STEP 7	STEP 8	STEP 9	STEP 10	STEP 11
Total Walk Time (mins)	Service Wait Time (SWT) (mins)	Reliability Factor (mins)	Access Time (mins)	Equivalent Doorstep Frequency (EDF)	Accessibility Index
Step 4 + Step 5	$(0,5 * 60) / \text{Step 2}$		Step 6 + Step 7 + Step 8	30 / Step	Step 3 x Step 10

Table 2: PTAL Calculation Steps

STEP 12	STEP 13
<p>Total Bus Services PTAI</p> $(EDFB_{max})$ $+$ $(0,5*(EDFB_1 +$ $EDFB_2$ $+$ \dots $+$ $EDFB_n))$	<p>Total Metro PTAI</p> $(EDFM_{max})$ $+$ $(0,5*(EDFM_1 +$ $EDFM_2$ $+$ \dots $+$ $EDFM_n))$

Accessibility of Taksim

- ◆ Table 3 shows Taksim bus and metro stations' accessibility level.
- ◆ In Taksim, the bus station and the metro entrances are far from the "entrance" of the Istiklal Street which is assumed as POI.
- ◆ Therefore, this causes a direct reduction in accessibility level. Low frequency is the other parameter which affects the low PTAL for bus.
- ◆ On the other hand, long underground walking time, which rises up to 6 minutes; cause a decrease in accessibility level.
- ◆ Eventually, the accessibilities in both mode has "poor" level according to the model.

Table 3: Taksim Bus and Metro Service PTAL Results

Bus Services			STEP 2	STEP 3	STEP 4	STEP 5
STEP 1						
Gezi	66	267	9	1	3,34	-
Gezi	69 A	267	9	1	3,34	-
Gezi	74	267	9	1	3,34	-
Gezi	74 A	267	9	1	3,34	-
STEP 6	STEP 7	STEP 8	STEP 9	STEP 10	STEP 11	
3,34	3,33	2	8,67	3,46	3,46	
3,34	3,33	2	8,67	3,46	3,46	
3,34	3,33	2	8,67	3,46	3,46	
3,34	3,33	2	8,67	3,46	3,46	

Table 3: Taksim Bus and Metro Service PTAL Results

Metro Services			STEP 2	STEP 3	STEP 4	STEP 5
STEP 1						
Meydan1	4. Levent	93	13,33	1	1,16	5,90
Meydan2	4. Levent	102	13,33	1	1,28	5,92
Gezi	4. Levent	337	13,33	1	4,21	3,50
Talimhane	4. Levent	270	13,33	1	3,38	3,65
STEP 6	STEP 7		STEP 8	STEP 9	STEP 10	STEP 11
7,06	2,25		1	10,31	2,91	2,91
7,19	2,25		1	10,44	2,87	2,87
7,71	2,25		1	10,96	2,74	2,74
7,03	2,25		1	10,28	2,92	2,92

Table 3: Taksim Bus and Metro Service PTAL Results

Taksim (POI: Istiklal Avenue Entrance)

Total Bus Services PTAI	8,65	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	7,18	Total Metro PTAL / Description	2	Poor

Accessibility of Other Stations

- ◆ The same calculations are executed for the other stations respectively;
 - Osmanbey,
 - Şişli-Mecidiyeköy,
 - Gayrettepe,
 - Levent,
 - 4. Levent.
- ◆ General PTAL's can be considered as "poor" according to the results.
- ◆ The model is directly adopted from London and it may need to modify to get more precise results.

Table 4: Bus and Metro Stations' Public Transport Accessibility Levels along Metro Line

Taksim (POI: Istiklal Avenue Entrance)				
Total Bus Services PTAI	8,65	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	7,18	Total Metro PTAL / Description	2	Poor
Osmanbey (POI: Nisantasi Rumeli Avenue)				
Total Bus Services PTAI	9,54	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	10,8 9	Total Metro PTAL / Description	3	Moderate
Sisli-Mecidiyekoy (POI: Mecidiyekoy Downtown)				
Total Bus Services PTAI	7,16	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	4,46	Total Metro PTAL / Description	1 b	Very Poor
Gayrettepe (POI: Sisli Municipality)				
Total Bus Services PTAI	7,37	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	5,03	Total Metro PTAL / Description	2	Poor
Levent (POI: Metrocity Shopping Mall)				
Total Bus Services PTAI	6,88	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	11,1 1	Total Metro PTAL / Description	2	Moderate
4. Levent (POI: 4. Levent Downtown)				
Total Bus Services PTAI	6,13	Total Bus Services PTAL / Description	2	Poor
Total Metro PTAI	9,02	Total Metro PTAL / Description	2	Poor

CONCLUSION AND RECOMMENDATIONS

- ◆ The PTAL approach has broad assumptions and this makes the model easily applicable.
- ◆ This convenience can not be considered as the model is the most appropriate one for accessibility level measurement.
- ◆ Unfortunately, PTAL or another model can be used for the same aim but the fact is Istanbul needs ***more accessible, comfortable, fast and effective public transit network.***
- ◆ The unique Metro Line would be connected in 2010 with MARMARAY PROJECT in Yenikapı Station.
- ◆ Besides constituting new infrastructures, the existing systems should be used in more effective way.
- ◆ The new metro line route surveys should include accessibility analyses within the framework of existing metro, LRT and tramway.