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Performance Level of the Public Transportation in the West Bank

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Abstract

Developed countries pay great attention to Public Transport (PT), their development, and evaluation as it is one of the bases of success for that nation. In the West Bank (WB), the PT is generally neglected and worn out. There is no periodic study about the service quality, the passengers' satisfaction, and their needs. Despite the relatively large number of daily passengers, only 19% use buses because they lack confidence in the service. This study aims to investigate passengers' satisfaction with the PT to identify strengths and weaknesses and evaluate their Level of Service (LOS), which consists of reliability and performance. Required data were collected through field surveys in the WB governorates, from the relevant official authorities or previous studies, interviews with service providers, and a questionnaire to measure passengers' satisfaction with all intercity bus lines (22 lines). Generally, the PT system in Palestine is inefficient and non-productive. There is an imbalance between demand and supply, the number of buses and shared taxis, poor infrastructure, low LOS, non-efficient management, and the number of ridership is low; therefore, productivity is low. Passenger trust in buses should be revamped by modernizing the fleet, adopting a regular schedule, providing a smart service system, and providing services at all times where demand is available. It is also essential to carry out periodic studies for this sector and collect statistical information.

Keywords: *Efficiency; Performance Level; Productivity Level; Public Transportation; West Bank*

INTRODUCTION

The Public Transport (PT) system is one of the most important axes in urban planning in all its issues and urban planning development in developing countries. Transport development is probably one of the most difficult issues confronting the future development of the Palestinian economy. There are various reasons for this statement, not least the context of deep economic, social, and political uncertainty in which Palestinian institutions operate. Furthermore, the transport sector also faces particular unique challenges in the existence of the Israeli occupation, in addition to physical constraints (roadblocks, poor roads, security checkpoints, etc.) and the lack of a coherent strategy on the part of the central government that prevents actors in the sector from being able to propose and implement sectorial improvements.

The Ministry of Transport (MOT) has the authority to regulate the West Bank (WB) passenger bus sector. Bus services are provided by fragmented private companies, comprising 86 companies of various sizes operating their own buses on a limited number of routes. More than 90% of the bus fleet is over 12 years old (MOT Directorate of Planning and Studies, 2017), resulting in high maintenance and running costs and low reliability, thus severely affecting the level of service (LOS) offered to customers and the financial sustainability of the bus companies.

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The percentages of all types of vehicles in the West Bank in 2017 are presented in Figure 1. Passengers mostly use private vehicles or shared taxis to travel. Only 19% of daily passengers use buses (Rebel Economics & Transactions bv, 2016). The PT system in the WB, in general, faces several problems. The system is not capable of attracting individuals to use buses. This can be attributed to several factors, including the absence of time schedules, low frequencies, and low LOS for bus service. In addition, based on field observation, many of the working buses now suffer mechanical problems, inadequate safety measures, and low comfort levels. At the same time, there were no comprehensive evaluation criteria for the service.

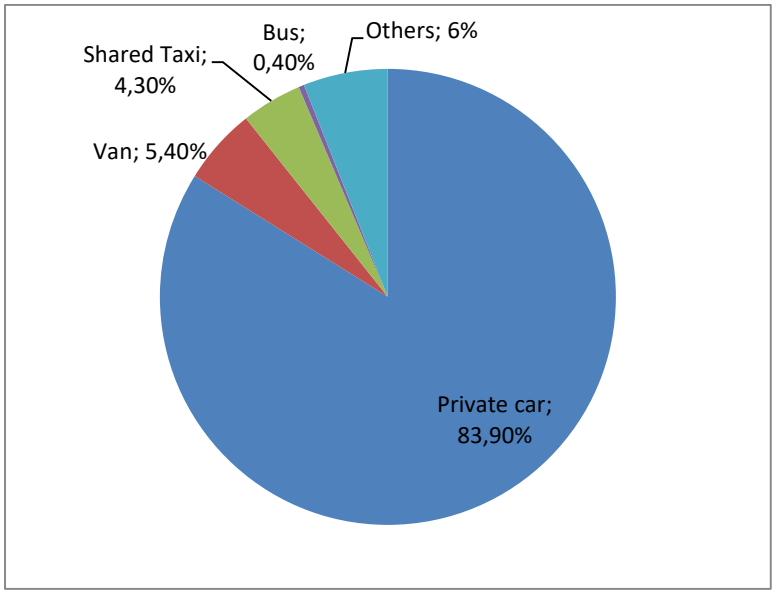

Figure 1. Percentage of Registered Vehicles Types in the West Bank in 2021 (MOT, 2022)

An efficient system is needed to provide the desired services in the WB, as the need for PT is considerable. Increasing ridership for the PT will reduce reliance on private vehicle usage, thus reducing the number of vehicles on the road, reducing delay, and improving the LOS. Therefore, it is important to study the current situation to make recommendations on how to develop the system to provide better service to encourage passengers to use buses instead of shared taxis and private cars at an affordable price and reasonable travel time by applying some set standards to evaluate passengers' confidence and LOS. The main objectives of the study are:

1. Evaluate the performance level of the existing PT system in the WB by identifying evaluation criteria for LOS to improve the current system and encourage passengers to trust the PT system.
2. Investigate the user's opinion about the present PT system, its effectiveness, and the acceptability of such development to the PT system.

The study area is the ten major cities in the WB (Hebron, Bethlehem, Ramallah/Al-Bireh, Jericho, Salfit, Nablus, Jenin, Tubas, Qalqilya, and Tulkarm). This study will focus on all bus routes in the WB except Jerusalem, a total of 22 routes, as shown in Figure 2.

LITERATURE REVIEW

Many types of research and studies have been conducted worldwide in this field, addressing different points of view regarding PT performance. A summary of selected studies is presented here. The service quality in PT is determined by standards. Service quality standards are processed to be used by the providers to deliver and monitor their services and measure the LOS in PT (Olivková, 2011). Performance measurement can be defined as the assessment of an organization's output as a product of the management of its internal resources (money, people, vehicles, facilities) and the environment in which it operates (Transportation Research Board, 1994).

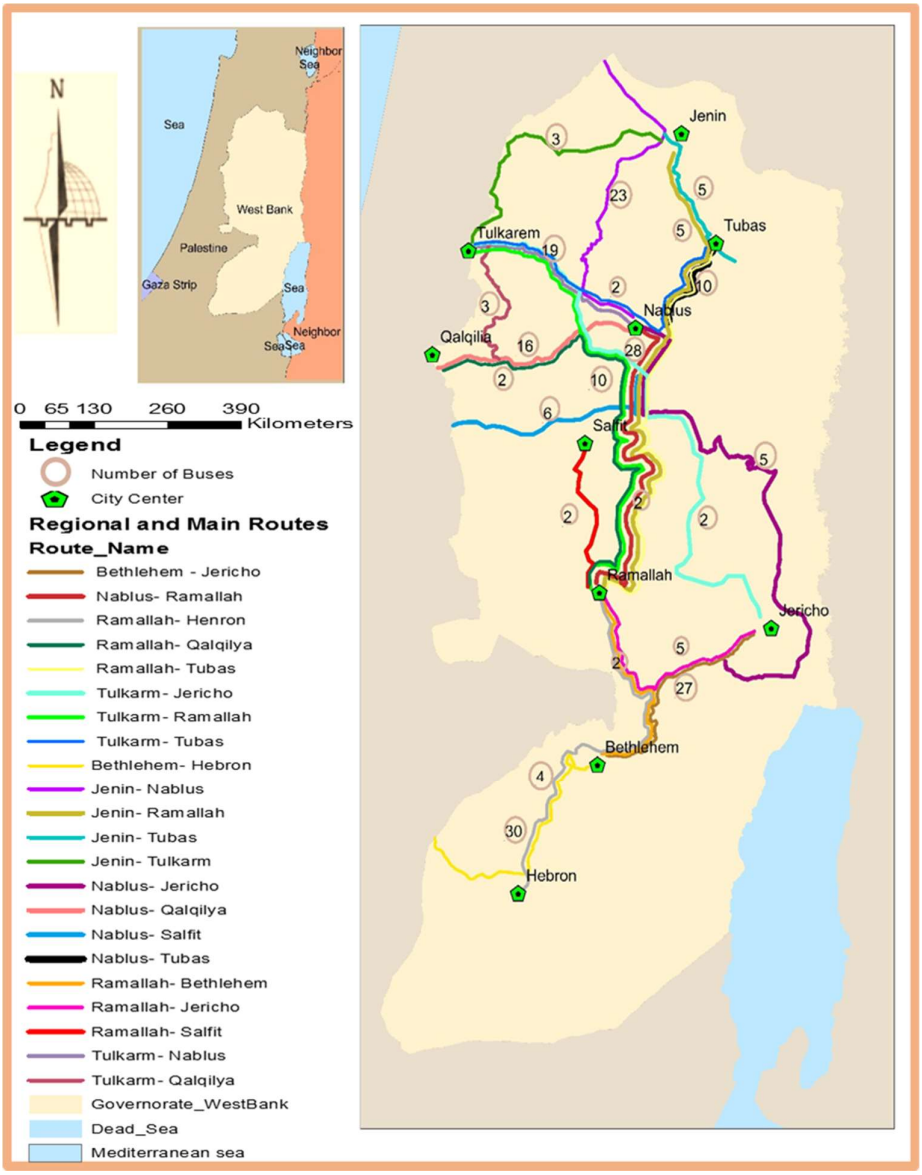

Figure 2. Main Bus Routes of Area Study

The transit service quality could be measured by a range of simple disaggregate performance measures for measuring the ability of a transit agency to offer services that meet customers' needs (Transportation Research Board, 1999). Performance measures are quantitative measures expressed as numerical value, which provides no information about how "good" or "bad" a specific result is. For this reason, it must be compared with a fixed standard or past performance. These measures could be considered objective measurements (Eboli and Mazzulla, 2012).

Transit improvement has four general categories (Litman, 2017): increasing service by providing more transit vehicle miles; improving service for more comfortable, convenient, and reliable service; incentives in transit use through lower fares and commuter financial incentives; and providing transit-oriented development in the form of land use patterns designed to support transit including more compact, walkable, and mixed development around transit stations and corridors.

Meyer (2000), Florida Transit Agencies (2014), and the European Standards (2002) in (EN13816) were more detailed in the selection of performance indicators and classified them into three comprehensive categories:

1. General performance indicators such as service area population, passenger trips, and effectiveness measures.
2. Efficiency measures were divided into cost efficiency, vehicle utilization, operating ratios, and labor productivity.
3. Reliability is influenced by several factors, among which (Saberi et al., 2013): traffic conditions and road construction, vehicle and maintenance quality and availability, schedule achievability, evenness of passenger demand and route familiarity, adherence to schedule and wheelchair lift and ramp usage (generally dwell time), route length, number of stops, weather, and incidents.

Barabino et al. (2012) developed an evaluation tool to verify the service quality standards offered to measure the service quality in urban bus transport by applying a modified SERVQUAL model. Based on the data collected during two weeks, various attributes were confirmed, including bus reliability, on-board security, cleanliness, and bus frequency.

For evaluating system reliability, transit agencies used on-time performance as a key measure of schedule adherence. The TCQSM considered on-time performance to be an arrival no more than five minutes after the scheduled time; that meant a bus was late when it was more than five minutes behind schedule. Therefore, there is a difference between late and early buses; the cost is different, so it is necessary to know how late and early buses are (Saberi et al., 2013). Some standards limited route deviations to a maximum number of minutes (5 to 8 min) of additional travel time for a one-way bus trip (Benn, 1995).

Reliability can be measured in different ways; the most widely used were on-time performance and headway adherence, which means the consistency of the scheduled interval between transit vehicles (Transportation Research Board, 2003).

RESEARCH METHOD

The methodology is based on field data collection and data from official sources and field surveys. The study's methodology will be based on the following steps, as summarized in Figure (2). Several criteria will be considered for the evaluation of LOS, as mentioned in Figure 3.

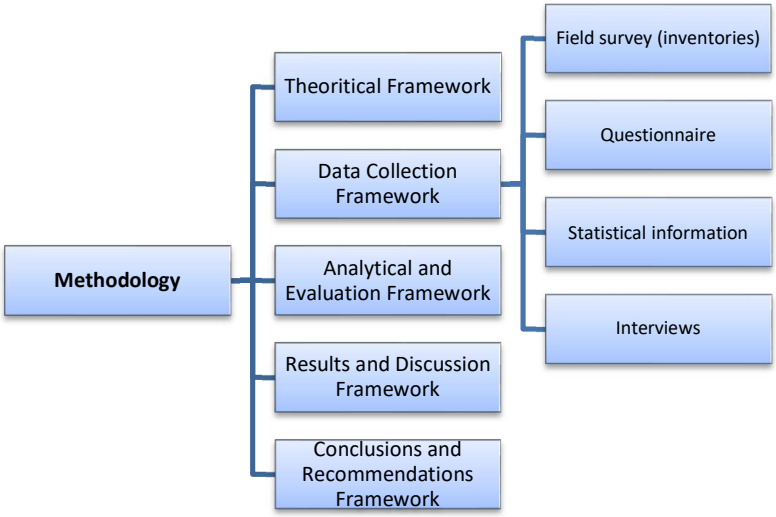

Figure 3. Study Methodology Flowchart

FINDINGS AND DISCUSSION

Data Collection

First, it should be mentioned that data about bus services considers the direct service (from terminal to terminal). The data collection is composed of the followings:

Reliability

This is an important criterion for users' satisfaction with the provided service. This includes several elements.

On-time Performance: There are two ways to measure this criterion:

1. Percent of routes scheduled to clock headways
2. Delay time

As there is no fixed schedule, the delay time will be used for the evaluation. Delay time is considered the time difference between a bus and a shared taxi for the same trip. Table 1 summarizes that and the journey time and the percentage of delay, which will be discussed later. Information was collected based on field data and interviews with bus operators and route managers.

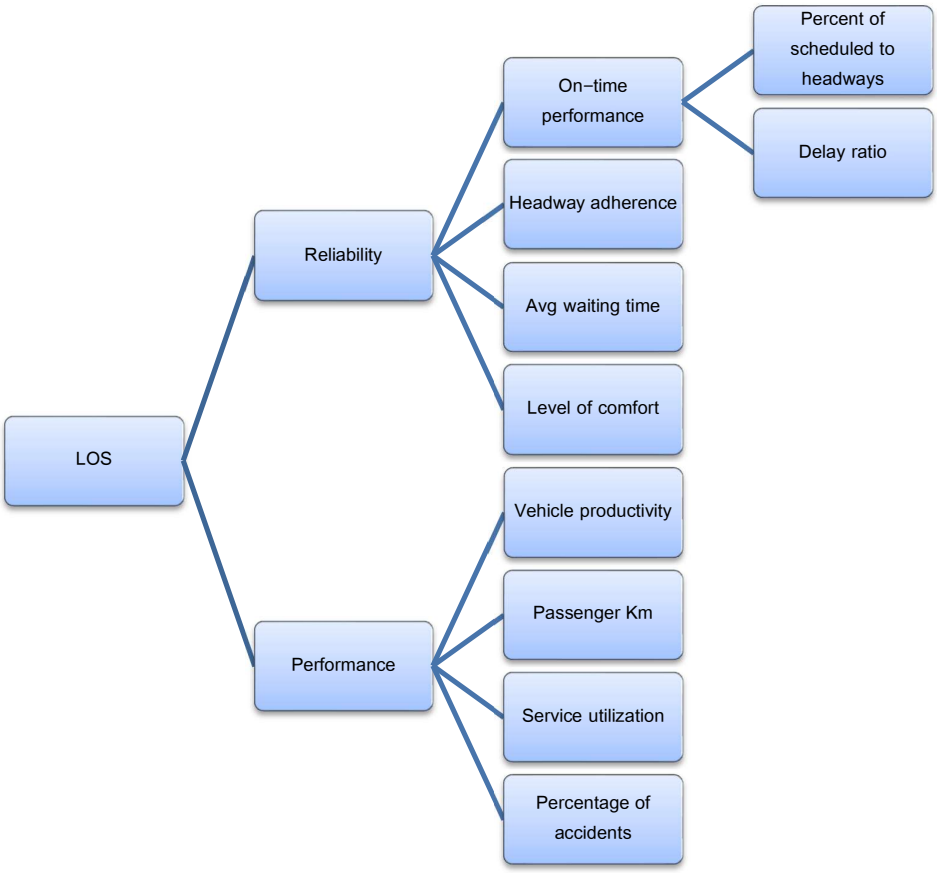

Figure 4. Criteria for Evaluation PT LOS

As shown in Table 1, the minimum delay was zero for the Tulkarm-Qalqilya route, and the maximum was 30 min for Jenin-Ramallah and Ramallah-Hebron routes; the average delay was 11 minutes. When the journey lasts 30 minutes, the 11-min delay can't be overlooked. This item might explain why passengers prefer shared taxis to buses. The minimum percentage difference for bus travel time related to shared taxis is the Tulkarm-Qalqilya route, which is zero, and the maximum difference is 50% for the Nablus-Tubas route. Both results indicate bus trip frequencies and headways for the two routes.

Average Journey Time. It is the total time needed to travel from one city to another. The worst case will be taken for the first passenger to ride the bus; therefore, the dwell time will be used and not the average waiting time. This equals to:

Journey Time = Dwell Time + Travel Time by Bus.....(1)

From Table 1, the journey time is relatively high compared to the distance between cities and the travel time by shared taxis. The average dwell time for buses is 30 min, but shared taxis have less dwell time. The delay percentage is also high; it differs between (30-50) % of shared taxi travel time. This is considered a significant loss of the journey's time, caused by the bus's lower speed and frequent stopping.

Table 1. Delay Time and Average Journey Time (in minutes)

Route	Bus Travel Time	Shared Taxi Travel Time	Relative Delay	Average Dwell Time(*)	Average Journey Time for Bus	Percentage Difference (**)
Jenin- Tulkarm	45	35	10	35	80	29
Jenin- Nablus	60	45	15	35	95	33
Jenin- Ramallah	120	90	30	40	160	33
Jenin- Tubas	30	20	10	20-40	50-70	50
Tulkarm- Nablus	40	30	10	35	75	33
Tulkarm- Ramallah	100	80	20	35	135	25
Tulkarm- Qalqilya	30	30	0	35	75	0
Tulkarm- Jericho	-	70	/	/	/	/
Tulkarm- Tubas	60	-	/	35	80	/
Nablus- Ramallah	75	55	20	35	110	36
Nablus- Salfit	40	30	10	35	75	33
Nablus- Qalqilya	35	25	10	35	75	40
Nablus- Jericho	80	60	20	35	95	33
Nablus- Tubas	45	30	15	35	80	50
Ramallah- Tubas	100	80	20	20-45	120-145	25
Ramallah- Qalqilya	100	75	25	20-40	120-140	33
Ramallah- Salfit	45	35	10	20-40	65-85	29
Ramallah- Hebron	150	120	30	30-45	180-195	25
Ramallah- Bethlehem	90	80	10	30-45	120-135	13
Ramallah- Jericho	60	45	15	35	95	33
Bethlehem- Hebron	60	45	15	15-35	75-95	33
Bethlehem - Jericho	90	70	20	35	125	29

(*) Dwell time refers to the time the bus spends at a scheduled stop without moving, plus the time needed for merging traffic.

(**) Percentage difference for bus according to shared taxi time = (Delay time/ Shared Taxi Travel Time) *100%.

Level of Comfort. This is a measure of the elements found in the PT that earns the passengers comfort during travel and encourages them to use or limit their use of the PT. This item is related to several points that pertain to passengers' assessment of the trip. This can be evaluated through a questionnaire. A questionnaire was done for the Ministry of Transportation to know the passengers' satisfaction with bus service as a means of transport (Rebel Economics & Transactions bv, 2016).

In this questionnaire, about 400 interviews were carried out through the project of Improving PT Infrastructure in the State of Palestine (Rebel Economics & Transactions bv, 2016). The interviews were held at 8 locations (Hebron, Bethlehem, Ramallah, Nablus, Jenin, Tubas, Qalqilya, and Tulkarm) near the bus stations (both arriving and departing passengers); only users were interviewed.

The results showed that about 75% of the passengers were males, and 60% were younger than 30 years old. About 45% of the journeys were for work, 28% for education, and about 46% of bus passengers traveled daily. In several countries, seniors and students are given a discount on

tickets when using buses. If employees and students are granted discounts for using PT, this will help increase the percentage of bus users.

As for some of the negative points towards the current bus service, the passengers listed the following points:

1. Lack of PT services in the evening (24%)
2. Waiting too long before departure (23%)
3. Bus tickets too expensive (22%)
4. Travel time too long (21%); this is raised more in the southern part and is related to the unfavorable and limited road system.
5. Walking distance to the bus terminal or stop too long (21%)
6. Bad behavior and driving style of drivers in general (21% and 19%, respectively).
7. Buses not comfortable (20%).

Furthermore, about 80% of passengers indicated that the buses are not comfortable because of their design; narrow space. Therefore, by upgrading the fleet and making them more comfortable, the users are expected to increase.

It is important to increase drivers' skill, as mentioned by 77% of the passenger. Bus license is granted after completing a driving and skills course approved by the MOT, and the applicant must have two years of owning a light truck license. The age must be 21 or older.

Performance

PT performance might be expressed in the following measures:

Average Kilometers per Bus per Year. This is the distance in km traveled by bus every year and results are summarized in Table 1. This equals to:

$$\frac{\text{Average Km per day} \times 313\ (365 - 52\ \text{Fridays})}{\text{Number of buses}} \quad \text{……………………}(2)$$

Table 2. Average Kilometers per Bus per Year

Route	Km per 24 Hours for All Journeys	Average Km per Year	Total Number of Buses	Average Km per Bus per Year	Passengers-Km per Bus per Year
Jenin- Tulkarm	728	227,864	3	75,955	1,063,370
Jenin- Nablus	1,806	565,278	23	24,577	319,501
Jenin- Ramallah	612	191,556	5	38,311	498,043
Jenin- Tubas	144	45,072	5	9,014	189,294
Tulkarm- Nablus	1,680	525,840	19	27,676	553,520
Tulkarm- Ramallah	712	222,856	10	22,286	401,148
Tulkarm- Qalqilya	93	29,109	3	9,703	164,951
Tulkarm- Jericho	/		2		/
Tulkarm- Tubas	192	60,096	2	30,048	/
Nablus- Ramallah	2,700	845,100	28	30,182	543,276
Nablus- Salfit	56	17,528	6	2,921	62,802
Nablus- Qalqilya	640	200,320	16	12,520	70,738
Nablus- Jericho	152	47,576	5	9,515	161,755
Nablus- Tubas	440	137,720	10	13,772	110,176
Ramallah- Tubas	280	87,640	2	43,820	284,830

Route	Km per 24 Hours for All Journeys	Average Km per Year	Total Number of Buses	Average Km per Bus per Year	Passengers-Km per Bus per Year
Ramallah- Qalqilya	168	52,584	2	26,292	525,840
Ramallah- Salfit	216	67,608	2	33,804	676,080
Ramallah- Hebron	148	46,324	4	11,581	463,240
Ramallah- Bethlehem	192	60,096	2	30,048	1,201,920
Ramallah- Jericho	920	287,960	5	57,592	1,727,760
Bethlehem- Hebron	540	169,020	30	5,634	101,412
Bethlehem - Jericho	884	276,692	27	10,248	112,728

As an example of the number of daily passengers, a total of 501,423,000 kilometers were driven by London buses (as part of a scheduled journey) (Manocha, 2014). For Singapore, it is 8,569,000 Km per year (Ministry of Trade and Industry, 2015). This is different from one place to another related of the types of transportation modes available and the road network lengths. As shown in Table 2, the maximum km per bus per year is 75955.

As stated before by Eboli and Mazzulla (2012), the performance measures could be considered objective measures, which provide no information by themselves about how "good" or "bad" a specific result is. For this reason, it must be compared with a fixed standard or past performance. Therefore, for the Palestinian case, this value must be compared annually to check if the performance is getting better and the reasons for that. Furthermore, three criteria are suggested to evaluate performance and productivity (World Bank, 2008):

1. The bus utilization of less than (3-4 trips/day) is low by any standard.
2. The number of passengers per vehicle per day equals or less than 120, and the revenue per vehicle is (280-400) NIS is low by any standard.
3. Less than 100 km/day for a bus is low by any standards.

Table 3 and Figure 5 summarize the results.

Table 3. Productivity of Intercity Buses According to the World Bank Standards

Route	Journeys/Day	Number of Working Buses(*)	Passenger/Bus/Day	Bus Km/Day
Jenin- Tulkarm	14	3	196	243
Jenin- Nablus	42	14	897	130
Jenin- Ramallah	6	3	130	187
Jenin- Tubas	6	3	210	48
Tulkarm- Nablus	40	8	1900	209
Tulkarm- Ramallah	8	5	288	142
Tulkarm- Qalqilya	3	1	153	93
Tulkarm- Jericho	No service	3	/	/
Tulkarm- Tubas	4	2	102	96
Nablus- Ramallah	50	26	969	103
Nablus- Salfit	2	3	86	18
Nablus- Qalqilya	20	9	201	71
Nablus- Jericho	2	1	170	150

Route	Journeys/Day	Number of Working Buses(*)	Passenger/Bus/Day	Bus Km/Day
Nablus- Tubas	20	8	200	55
Ramallah- Tubas	4	1	52	280
Ramallah- Qalqilya	2	3	27	56
Ramallah- Salfit	4	2	80	74
Ramallah- Hebron	2	2	160	46
Ramallah- Bethlehem	4	2	160	60
Ramallah- Jericho	20	3	1000	247
Bethlehem- Hebron	20	25	432	19
Bethlehem - Jericho	17	20	252	45

(*) Source: (General Directorate of General Traffic Controller/ MOT, 2022).

Shaded cells are inconsistent with the World Bank standards.

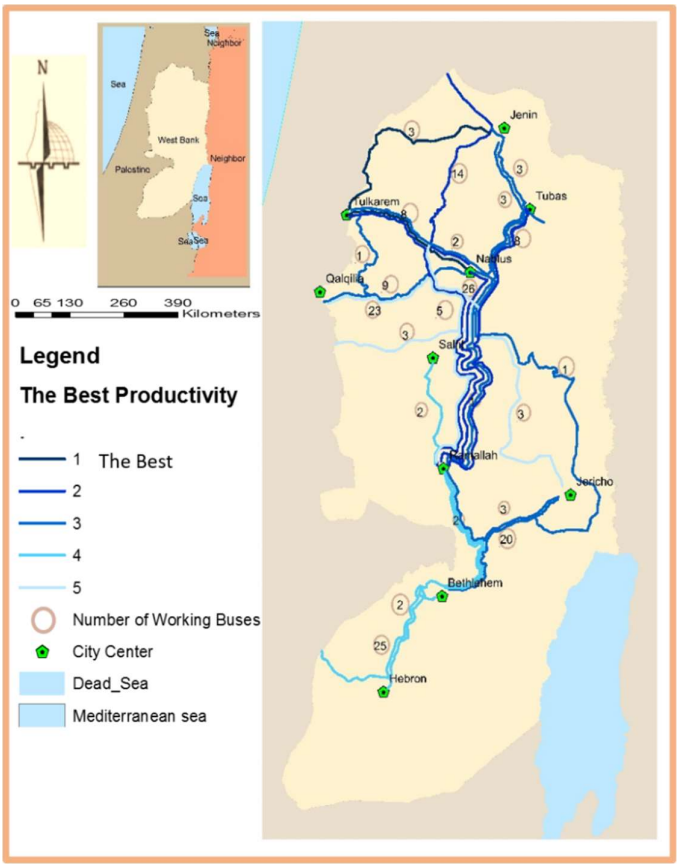

Figure 5. The Best Bus Productivity Routes

Service Utilization/Effectiveness

It is the average number of passengers traveled per day in a bus; Table 4 summarizes the results. The routes from/to Nablus generally have the highest values; of course, the existence of An-Najah National University is one of the main reasons. On the other side, the number of journeys is also high. These values are important to consider when determining the number of needed buses. Another important criterion is the percentage of seat occupancy. The percentage of seat occupations ranges from (24% – 88%) with an average of 63%. Comparing this with the European Union, which has an average of approximately 70% (European Environmental Agency, 2017), the seating occupancy for buses in the WB is fair.

Table 4. Percentage Seat Occupation.

Route	Average Number of Passengers per Bus (*)	Total Number of Buses	Percentage Seat Occupation (%)(*)
Jenin- Tulkarm	14	3	56
Jenin- Nablus	13	23	52
Jenin- Ramallah	13	5	52
Jenin- Tubas	21	5	84
Tulkarm- Nablus	20	19	80
Tulkarm- Ramallah	18	10	72
Tulkarm- Qalqilya	17	3	68
Tulkarm- Jericho	/	2	/
Tulkarm- Tubas	/	2	/
Nablus- Ramallah	18	28	72
Nablus- Salfit	22	6	88
Nablus- Qalqilya	6	16	24
Nablus- Jericho	17	5	68
Nablus- Tubas	8	10	32
Ramallah- Tubas	7	2	28
Ramallah- Qalqilya	20	2	80
Ramallah- Salfit	20	2	80
Ramallah- Hebron	40	4	80
Ramallah- Bethlehem	40	2	80
Ramallah- Jericho	30	5	60
Bethlehem- Hebron	18	30	72
Bethlehem - Jericho	11	27	44

Source: Service Providers, 2022.

(*) Percentage of Seat Occupation = (# of Passengers per bus / 25) * 100%; the number of passengers was calculated for small buses with 25 seats.

It is also important to know the percentage of bus users from all transport modes between cities. The Orio Project (Rebel Economics & Transactions bv, 2016) conducted a survey at 14 locations distributed in the WB between 06:00 A.M and 6:00 P.M for all types of transportation modes, and for seven days. Figure 6 summarizes the results.

About 34% of the passengers use private cars and 66% use PT with different modes and only 19% use buses. This means that the percentage of bus users is not high. It is essential to study the reasons for that; some are presented as part of the questionnaire results.

Percentage of Accidents

In a meeting with the traffic police director in Ramallah, statistics showed that the highest percentage of accidents in 2017 was for private vehicles, which accounted for 65% of the total traffic accidents, and in the second place came illegal vehicles by 20%. The less common percentages were for shared taxis by about 10%, and for trucks, buses, and tractors with a rate of only 5%. There are no official statistics with specific numbers and no analysis of the causes of accidents; this percentage was published later in Al-Hayat Newspaper1. Figure 7 summarizes these percentages.

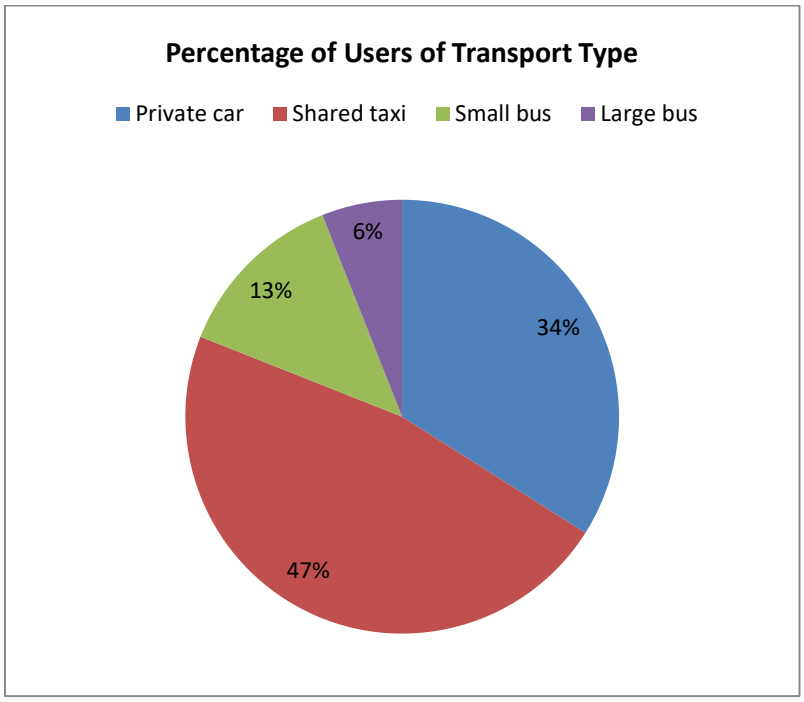

Figure 6. Percentage Users of Type of Vehicles (Rebel Economics & Transactions bv, 2016)

[1] Al-Hayat Newspaper, No. 7760, 30 June 2017, page 5

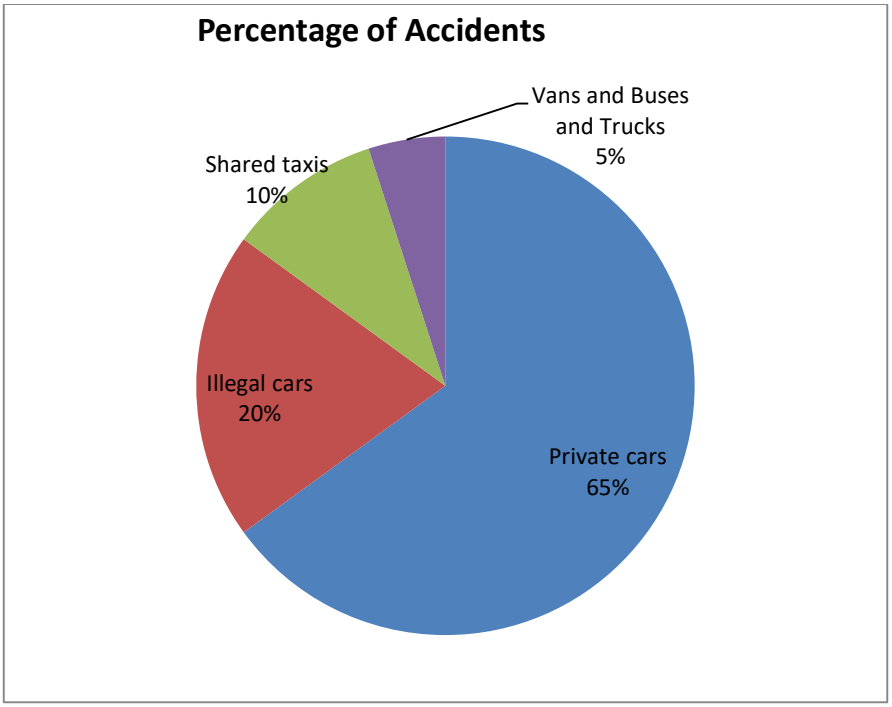

Figure 7. Percentage of Traffic Accidents in the West Bank by Vehicle Type, 2022 (Interview with Traffic Police Director, 2022).

About 5% of the accidents were for buses, vans, and trucks. Buses constitute only 0.4% of the total vehicle mix in the WB. Traffic Police pointed out that 2% of the 5% accidents were for buses. Therefore, the percentage of bus accidents is relatively high compared to that of the bus fleet in the vehicle mix.

Discussion

The average daily traffic volume was 72656 passengers in the WB in 2016 (Rebel Economics & Transactions bv, 2016). About 85% of passengers don't prefer buses because of delays. The average delay for all routes was 27 minutes, and the minimum was zero for Tulkarm-Qalqilya because both buses and taxis travel at a slow average speed on this path due to the poor route, which involves frequent humps and curves. In addition, the bus frequency is high, and its headway is low, particularly during the morning peak hours. The maximum delay was for Jenin-Ramallah and Ramallah-Hebron, with 30 minutes due to repeated stops to download passengers.

The bus journey time was (30%-50%) compared to shared taxi travel time. There is no timetable and about 95% of buses are old and uncomfortable. As a result, the passengers don't rely on bus service.

The average percentage of seating occupancy was 63%. Therefore, bus waiting time is relatively long (waiting for seats to be filled). As a result, the performance is not suitable.

It is known that most of the routes pass Palestinian villages and towns; therefore, buses will pick up passengers on the road; buses would stop frequently. If stations for loading and unloading along the roads between the cities in determined at fixed places, then the delay will be reduced.

The percentage of bus accidents was 2%; this percentage is high enough to say that there is a problem (in bus drivers, bus maintenance, etc.). It is also important that the traffic police have a complete database to find out the causes of these accidents.

CONCLUSION

This study aims to evaluate public transportation (PT), particularly buses, and give recommendations that can help competencies provide an efficient and reliable service in the West Bank (WB). This is the first comprehensive study to evaluate PT performance in the WB. Therefore, the situation of PT should be re-examined periodically to compare the progress in the industry.

Generally, the PT system in Palestine is inefficient and non-productive. The study concluded the followings:

1. All the buses do not have a designed schedule, and the average waiting time is long, ranging from 20 to 60 minutes. In addition, on some routes, the buses are not always available, such as Salfeet.
2. Almost 27% of the routes are non-productive as they don't have enough passengers; approximately 19% don't have an acceptable number of daily journeys, and 60% don't cover enough distances.
3. On average, 33% of the bus journey time is a delay as compared to the shared taxis, and in some routes, the time difference is up to 50%, as the case for Jenin-Tubas and Nablus-Tubas.
4. Buses are involved in 2% of the annual vehicle crashes, while they constitute only 0.4% of the registered vehicles in the WB. This means that their involvement in crashes is relatively high.
5. Bus service in the southern part of the WB is generally rated lower than the northern one.
6. There is a monopoly on the routes from service providers (concession rights), and this weakens the service because of the lack of competition. In addition, there is no system in the MOT to provide incentives or apply punitive to improve the service. The conditions for granting a license to drive a bus are weak and must be modified.
7. There is an imbalance between the number of buses and shared taxis. There is also a poor infrastructure, low level of service (LOS), non-efficient management, and low ridership; therefore, productivity is low.

Based on these results, it is recommended to:

1. Update the bus fleet and provide buses for people with special needs, focusing on the quality of buses to be more comfortable; the MOT should establish a bus life allowance of fewer than 20 years, as it is now.
2. Increase the productivity of buses by attracting more passengers through providing services in the evening, decreasing waiting time at terminals using the various available intelligent system techniques, and suitable and satisfactory tickets with categories and discount cards for those who use the system constantly (such as students and employees) and for elderly.
3. Conduct a comprehensive study of demand and supply and balance it between buses and shared taxis for Palestine, and establish a clear strategy by MOT in this regard. The Government must also support the PT sector as it is essential for the national economy.
4. To encourage productive competition in the industry and improve the level of service, it is recommended to retender concessions between bus companies so that it will not remain a monopoly.

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