An Investigation to Select "Metro" as a Public Transportation Mode in Gaza City

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ABSTRACT: Gaza Strip suffers from continuous increase in the population as well as the number of taxies. The majority of Gaza Strip citizens use taxi in their movement. Relying completely on taxi, neglecting the availability of public transport, which could lead to more traffic congestion and negative impacts on the environment in the future. This study deals with a proposal to select "Metro" route as a public transportation mode in Gaza City. It discusses through questionnaire hypotheses which contribute to the approval community for this means of transportation, and the validity of these assumptions. Random sample is selected with size of 96 questionnaire papers response. The result shows that all fields of questionnaire is significant at α = 0.05, which means that there is a satisfaction by the community to select "Metro" route as a public transportation mode in Gaza City. The researcher recommends that giving more attention to solve the current traffic problem, which may worsen with time. Through formation of a committee to develop an integrated strategy to start implementing the steps to create metro project that includes members of General Authority for Investment, Ministry of Public Works and Ministry of Transport. In addition, development of preliminary studies, which include the general plan, capitalcosts and technical perceptions of the project.

Keywords: Gaza City, Metro Mode, Public Transport, Questionnaire, Traffic Problems

I. INTRODUCTION

In Gaza Strip, population exceeds two million people over an area of 365 km^2, and the number of population in Gaza Governorate is 754.321 thousand people [1]. According to Palestinian Central Bureau of Statistics (PCBS), population will double during the next 21 years [2]. This increasing will form traffic congestions in many streets of Gaza City. In addition, it can cause suspend traffic movement, especially during going to work, schools, universities, and other places. One of the most principal components of the transportation systems is public transportation. Public transportation is part of our transportation network and plays an important role in the society by transporting large number of people to jobs, schools, and community activities [3]. Encouraging public transport system can strongly reduce the use of taxis, and hence can contribute in decreasing the level of congestion leading to better levels of service in streets [4]. There are many public transport modes including buses, trolleybuses, ferries, trams, and trains, and rapid transit (metro/ subways/ undergrounds) which can realize this aim. Establishment of a Metro line in Gaza City as a public transportation network system is one of the most important projects that help to improve traffic flow, reduce congestion and save time and effort. The purpose of the Metro project is to provide the citizens of the region with the benefits of improved public transportation in a cost-effective, environmentally sensitive, and socially responsible manner [5].

II. PROBLEM STATEMENT

There are several current and future problems may occur and encourage to make a proposal to select "Metro" route as a public transportation mode in Gaza City. From these problems:

- High population density
- High number of vehicles compared with an area of Gaza City (55 km^2); total number of licensed vehicles at the end of 2012 was 72,886 vehicles [2]. This number could double in the next few years.
- There are many vitality institutions that attract high numbers of people to it, such as universities, schools, governmental and non-governmental institutions and other important places.
- Traffic problems in vital areas of Gaza City, such as traffic congestion, crashes, traffic violations that occur by drivers, disrupted traffic signals and many other problems.
- Increasing number of traffic accidents in Gaza Strip, where the total number of casualties in 2011 was 4331, 4418 in 2012 and 2921 in 2013 [6].

III. AIM AND OBJECTIVES

This research aims to make an investigation to select "Metro" route as a public transportation mode in Gaza City. To achieve this aim, the following objectives are to be considered:

- Studying the impact of establishing such "Metro" as to solve the traffic problem in Gaza City.
- Introducing the community requirements of this matter (Officials, stakeholders, people, private public transport companies, etc.).

IV. QUISTIONNAIRE DESIGN

It is needed to make measurement about possibility of the establishment of a Metro in Gaza City. For this propose, descriptive analytical method is used and data is collected by a questionnaire that is distributed randomly to people in Gaza City to achieve the results. The sample involves Government officials, stakeholders, private public transport companies, citizens, etc. The questionnaire survey seems to be most appropriate to collect data in the current study.

4.1 Population and Sample size

Equations 1 and 2 can be used to estimate sample size. Equation 1 requires $\hat{p}$ as an estimate of the population proportion p [7]. Because the population of the study can't be estimated, especially its conclude of people inside and outside Gaza City, in other words, when no estimate is known. Equation 2 is used to determine sample size.

When an estimate $\hat{p}$ is known:
$$n = \frac{[z_{\alpha/2}]^2 \hat{p}\hat{q}}{E^2} \tag{1}$$

When no estimate $\hat{p}$ is known:
$$n = \frac{[z_{\alpha/2}]^2 0.25}{E^2} \tag{2}$$

Where:

n = Sample size required.

$z_{\alpha/2}$ = Critical value.

$\hat{p} = \frac{x}{n}$ Sample proportion of x successes in a sample of size n.

$\hat{q} = 1 - \hat{p}$ = Sample proportion of failures in a sample of size n, and

E = Margin of Error (usually 0.05 or 0.1).

4.2 Questionnaire Design and Content

A questionnaire was designed in Arabic language, as most targeted population were unfamiliar with English language and to be more understandable. An English version was attached in Annex 1. Unnecessary personal data, complex and duplicated questions were avoided. The questionnaire was provided with a covering letter which explained the purpose of the study, the way of responding, the aim of the research and the confidentially of the information in order to encourage the respondents.

The questionnaire involves two groups; the first group : Demographic data and the second group: Questionnaire Paragraphs, that are divided into four issues: **(a)**General issue, **(b)**Traffic issue, (c)Economic issue, and (d)Technical issue. In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is/are an appropriate method/s that can be applied and not others. In this research, ordinal scales are used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the important (1, 2, 3, 4, 5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels based on Likert scale.

4.3 Statistical Analysis Tools

Data analysis will be made utilizing (SPSS 15). The researcher would utilize many statistical tools such as Frequencies and Percentile, Alpha- Cronbach's Test, Pearson correlation coefficients, One sample t test, One way ANOVA, and Independent sample t test.

4.4 Questionnaire Analysis

The aim of this part is to analyze the empirical data which are collected through the questionnaire in order to provide a real picture about investigation of the establishment of a "Metro" as a public transportation network in Gaza City.

V. QUISTIONNAIRE RESULTS AND ANALYSIS

5.1 Population and Sample Size

According to equation 2, when $\alpha = 0.05, z_{\alpha/2} = 1.96$, E = 0.1, random sample is selected with size 150, and the questionnaire was distributed to the research population and 96 questionnaire papers are received with (64%) response. The response is adequately enough to size the sample and consider it representative.

$$n = \frac{[1.96]^2 0.25}{0.1^2} = 96$$

5.2 The First Group: Demographic Data

Research methodology depends on the analysis of data based on the use of descriptive analysis, by using the main program (SPSS).

5.2.1 Sample - Age

Fig. 1 shows that (19.8%) from the sample ages (Less than 20 years), and (58.3%) from the sample ages (20-less than 30), and (12.5%) from the sample ages (30-less than 40), and (4.2%) from the sample ages (40-less than 50), and (4.2%) from the sample ages (50-less than 60), and (1%) from the sample ages (more than 60). It can be noted that the high rate from the sample ages is (20-less than 30), because most of the members of the sample are employed in government and private institutions, as well as university students are young people andcorrespond to this period.
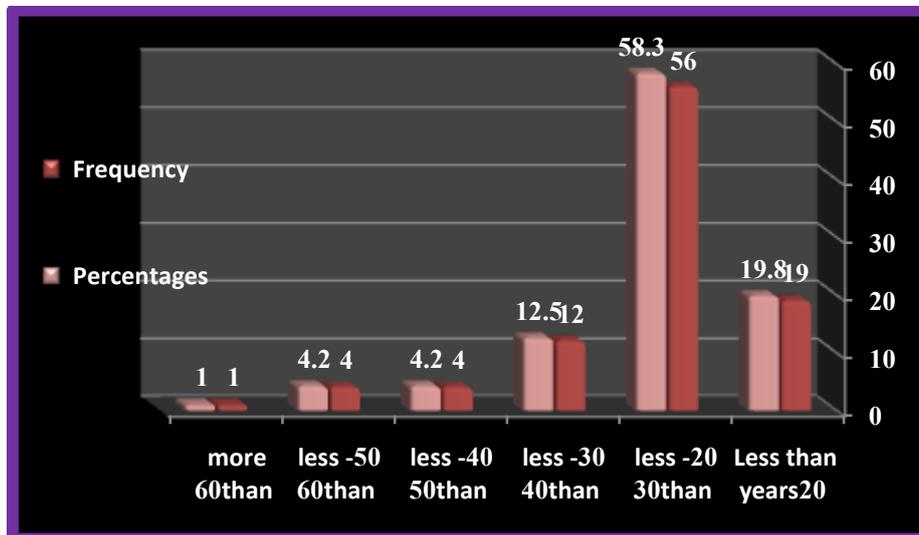

Figure 1. Distribution of sample according to age

5.2.2 Sample - Level of Education

Fig. 2 shows that (3.1%) from the sample level of education have secondary education, (89.6%) from the sample are (academy), and (7.3%) from the sample are (high education).
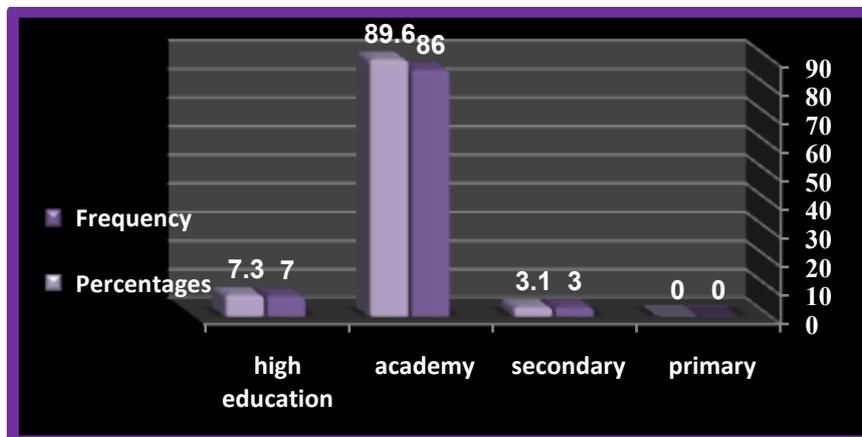

Figure 2. Distribution of sample according to level of education

5.2.3 Sample - Gender

Fig. 3 shows that (60.4%) from the sample are (male), and (39.6%) from the sample are (female). This means that the study sample is well distributed with respect to gender.
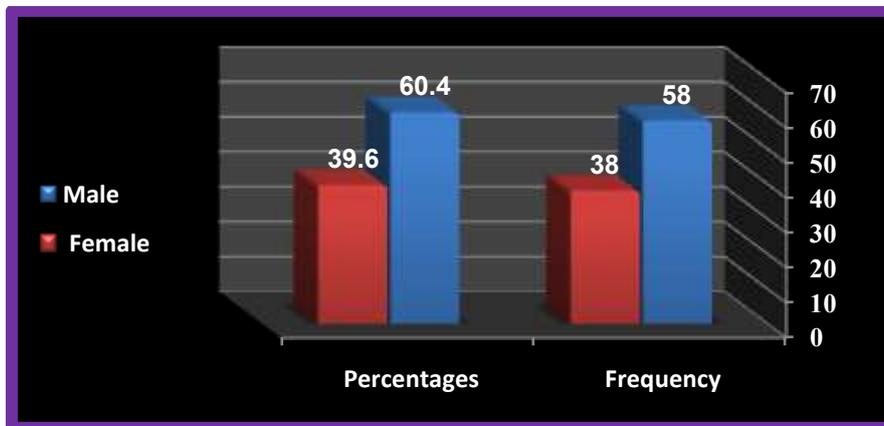

Figure 3. Distribution of sample according to gender

5.2.4 Sample - Job

Fig. 4 shows that (6.3%) from the sample work in (governmental sector), and (47.9%) from the sample in (private sector).In addition, (2.1%) from the sample are (Workers), (5.2%) from the sample are (unemployed), (37.5%) from the sample are (student), and (1%) from the sample job refers to (other than). It is obvious that the majority of the sample work is private employees and students.This is because most of institutions in Gaza City is private institutions, governmental ones and universities.
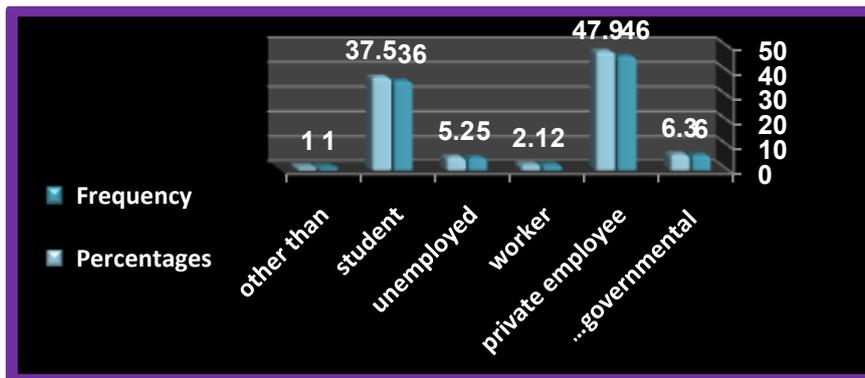

Figure 4. Distribution of sample according to job

5.2.5 Sample - Origin

Fig. 5 illustrates the distribution of sample according to origin. This indicates that the majority of the sample lives in Gaza City because the sample is distributed in it where it is considered the place of study.
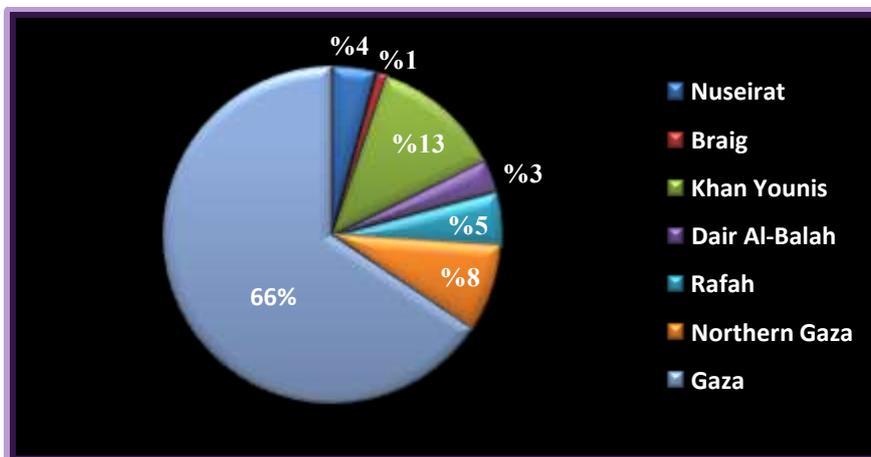

Figure 5. Distribution of sample according to origin

5.2.6 Sample - Destination

Fig. 6 illustrates the distribution of sample according to destination. This indicates that the majority of the sample are in Al-Remal and Al-Naser zones which involve many universities, private, and governmental institutions.
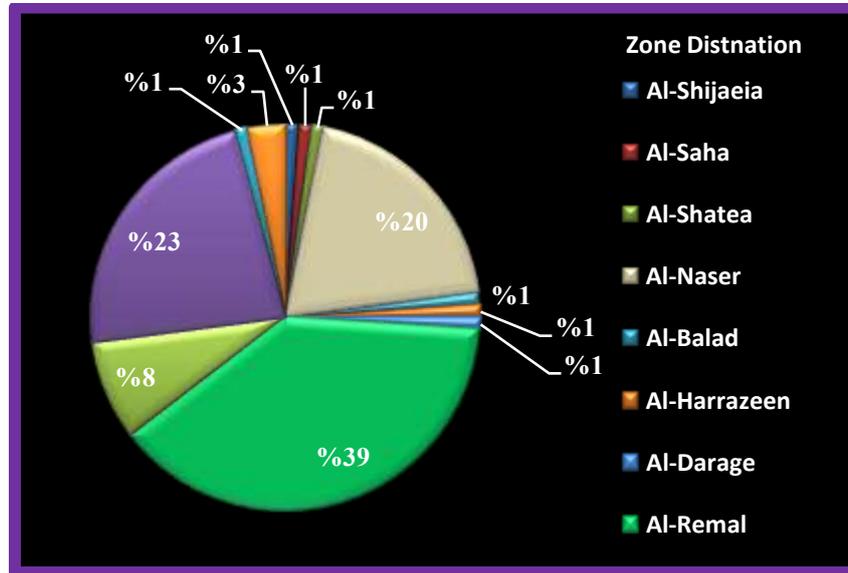

Figure 6. Distribution of sample according to destination

5.2.7 Sample - Transport Mode

Fig. 7 shows that (1%) from the sample use to their destination (Motorcycle), (95.8%) use (Taxi), and (3.2%) go to their work (On foot).
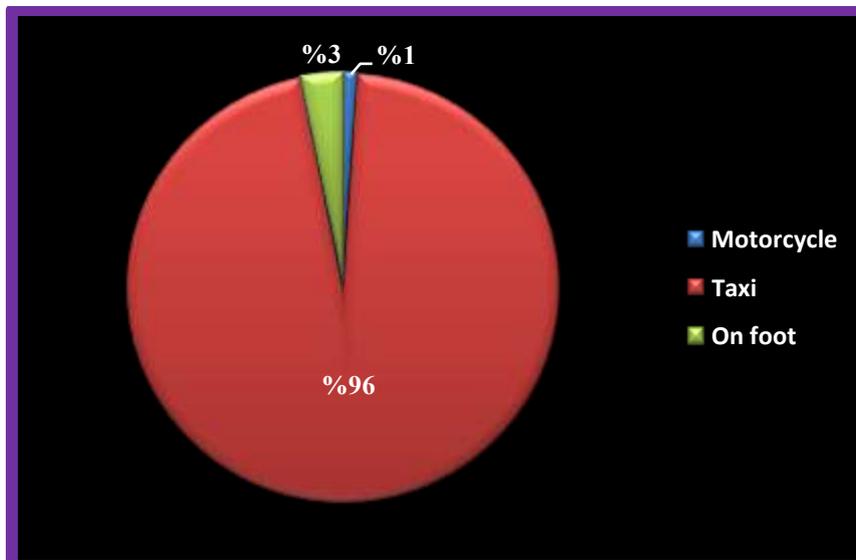
Figure 7. Distribution of sample according to transport mode

5.2.8 Sample - Trip Time

Fig. 8 shows that (7.3%) from the sample need (5 minutes) to arrive their destination, (16.7%) need (10 minutes), (15.6%) need (15 minutes), (12.5%) need (20 minutes), (2.1%) need (25 minutes), (21.9%) need (30 minutes), (3.1%) need (40 minutes), (6.3%) need (45 minutes), (1%) need (50 minutes), (10.4%) need (60 minutes), (1%) need (70 minutes), (1%) need (75 minutes), and (1%) from the sample need (90 minutes) to arrive their destination. This indicates that the majority of the sample is (22 %) need (30 minutes), which cause more delay to access the destination.
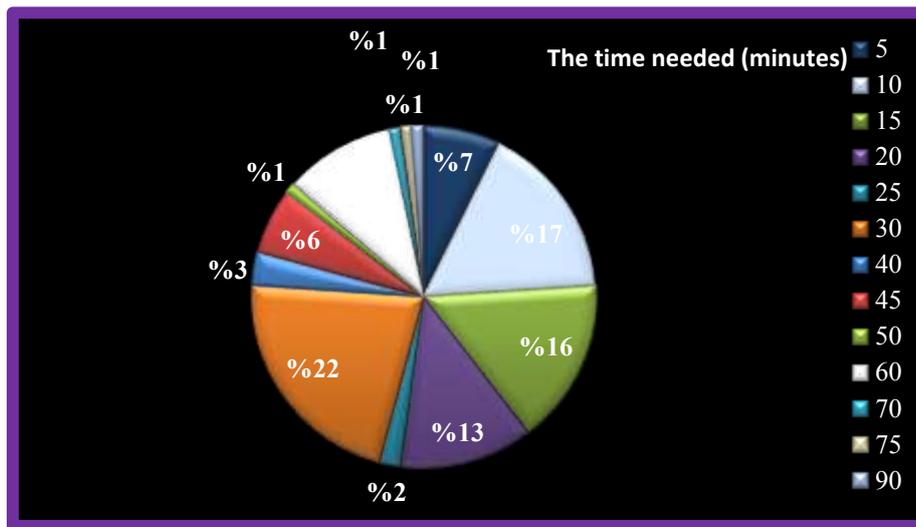
Figure 8. Distribution of sample according to trip time

5.2.9 Sample - Trip Cost

Fig. 9 shows that (19.6%) from the sample size pay (1 NIS) to arrive their destination, (28.3%) pay(2 NIS), (12%) pay(3 minutes), (5.4%) pay(4 NIS), (8.7%) pay(5 NIS), (9.8%) pay(6 NIS), (6.5%) pay(7 NIS), (3.3%) pay(8 NIS), (1.1%) pay(10 NIS), (1.1%) pay(11 NIS), (2.2%) pay(12 NIS), (1.1%) pay(15 NIS), and (1.1%) from the sample pay(16 NIS) to arrive their destination. This indicates that the majority of the sample (28.3 %) pay(2 NIS).This value is considered appropriate in the case of using a taxi, but it may cause more delay to access the destination when using a Metro.
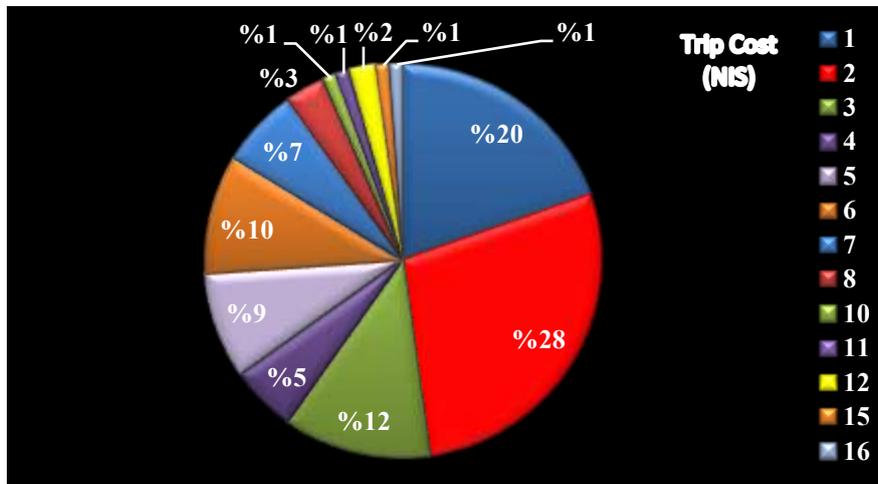
Figure 9. Distribution of sample according to trip cost

5.3 The second group:Questionnaire Paragraphs
5.3.1 The Questionnaire Validity and Reliability

Table 1 clarifies the correlation coefficient for each issue of the whole questionnaire. p-values (Sig.) are less than 0.05, so the correlation coefficients of all issuesare significant at α =0.05. It can be said that the issues are valid to be measured for what it was set for to achieve the main aim of the study.

Table 1: Correlation coefficients of the whole questionnaire

No.	Field	Pearson correlation coefficient	p-value	Cronbach's Alpha	Spearman-Brown Correlation Coefficient
1.	General issue	0.670	0.000*	0.677	0.650
2.	Traffic issue	0.856	0.000*	0.855	0.897
3.	Economic issue	0.692	0.000*	0.540	0.510
4.	Technical issue	0.408	0.000*	0.766	0.830
Average				0.852	0.894

For all issues, values of Cronbach's Alpha are in the range from 0.540 and 0.855. This range is considered high and this ensures the reliability of each issue of the questionnaire. Cronbach's Alpha equals 0.852 for the entire questionnaire which indicates an excellent reliability of the entire questionnaire. The Spearman-Brown correlation coefficients of each issue is significant at α =0.05, so it can be said that they are consistent and valid to measure what it was set for. Thereby, it can be said that the questionnaire is valid, reliable, and ready for distribution for the population sample.

5.3.2 Research Hypotheses

Hypothesis No. 1:

(General questions is significant at 0.05 level in establishment of a Metro in Gaza City).

As shown in Table 2, one concludes that the respondents agree to this paragraph and this indicates that there is an encouragement by people in Gaza to establish a Metro.

Table 2: Test values for "General Issues" questions

No.	Items	Mean	Weight mean	t-value	P-value
1.	Establishment of a Metro in Gaza City is a good idea.	3.81	76.25	6.789	0.000
2.	Establishment of a Metro in Gaza City reflects civilized face of the City.	4.30	86.04	10.145	0.000
3.	Establishment of Metro in Gaza City reduces the impact of environmental pollution in the City.	3.93	78.54	8.348	0.000
4.	Establishment of a Metro in Gaza City helps to solve the recession of fuel in Gaza Strip.	3.65	72.92	5.410	0.000
5.	Area of Gaza City needs to establish Metro.	2.83	56.67	1.302	0.196
	Total	**3.70**	**74.08**	**8.422**	**0.000**

Critical value of t at df "94" and significance level 0.05 equal 1.98

This also indicates that there is high pollution in the City which is resulted from car exhausts because of traffic congestion, and that people are interested to resolve this serious problem which increases with increasing number of vehicles in the City. There is difficulty in obtaining fuel for taxis, especially in the current situation of Gaza Strip. Thus, the establishment of Metro softens the fuel, which runs on electricity that is generated from a single source, which is easier to get fuel. For paragraph 5, t value = 1.302, and P-value = 0.196 which is greater than the level of significance α = 0.05, one can conclude that paragraph not differ statistically on neutral degree (moderate degree). This paragraph expresses responding, where the goal of the establishment of the metro is to solve the traffic problem, without considering the area of the City. In addition, there are a lot of metro projects that have been established in many cities in the world that have the same area, and the goal was to solve the traffic congestion, and there is possibility to extend the network to the south and north. The mean of the "General Issue" questions equals 3.70 (74.08%), Test value = 8.422, and P-value=0.000 which is smaller than the level of significance α = 0.05. The sign of the test is positive, so the mean of this issue is significantly greater than the hypothesized value 3. Thus, the respondents agree to this issue.

Hypothesis No. 2(Traffic issue questions is significant at 0.05 level in establishment of a Metro in Gaza City).Table 3 shows the test values for Traffic Issue questions. The mean of the filed "Traffic issue questions" equals 3.63 (72.62%), Test value = 9.501, and P-value = 0.000 which is smaller than the level of significance α = 0.05. The sign of the test is positive, so the mean of this issue is significantly greater than the hypothesized value 3. One concludes that the respondents agree to this issue.

Table 3: Test values for "Traffic Issue "questions

No.	Items	Mean	Weight mean	t-value	P-value
1.	Establishment of a Metro in Gaza City works to solve the problem of traffic at the present.	3.71	74.17	7.301	0.000
2.	Establishment of a Metro in Gaza City works to solve the problem of traffic at the future.	4.04	80.83	10.614	0.000
3.	In case of the establishment of a Metro, I would prefer it compared to the taxi.	3.53	70.53	4.239	0.000
4.	The Metro system is more comfortable for the user of taxis.	3.48	69.58	4.045	0.000
5.	Establishment of a Metro in Gaza City helps to relieve congestion.	4.02	80.42	12.065	0.000

No.	Items	Mean	Weight mean	t-value	P-value
6.	Establishment of a Metro in Gaza City helps to reduce the rate of traffic accidents.	3.80	76.04	7.074	0.000
7.	Metro is easier access to the required destination than the taxi.	3.33	66.53	2.527	0.013
8.	Establishment of a Metro reduces the waiting time of passengers compared to taxis.	3.52	70.42	4.117	0.000
9.	Traveling on a Metro is better than traveling on more than one taxi to access to the far destinations.	3.96	79.17	9.349	0.000
10.	Access to the metro stations is more easier than access to taxis.	3.15	62.92	1.222	0.225
11.	Establishment of a Metro facilitate movement of pedestrian in the overcrowding streets.	3.72	74.38	7.427	0.000
12.	Establishment of a Metro reduces noise resulting from overcrowding streets.	3.91	78.13	9.667	0.000
13.	Establishment of a Metro helps to reduce the numbers of traffic police at intersections.	3.38	67.50	3.572	0.001
14.	Metro accidents caused loss of human life more than taxi accidents.	3.27	65.42	1.955	0.053
	Total	**3.63**	**72.62**	**9.501**	**0.000**

Critical value of t at df "94" and significance level 0.05 equal 1.98

In addition, this indicates that there is a real problem of traffic at the present. There is also difficult to obtain taxi to access the required destination and in using taxi especially when using more than taxi to access the required destination. This also indicates there is a real problem relating to traffic congestion in Gaza City and a high number of vehicles causes many accidents, while one metro line doesn't cause those accidents. Table 3 reveals that using one mean of transport as a Metro is easier access to the required destination than using more than means of transport as a taxi. This indicates that there are more delay when using taxi compared to use Metro. This means if Metro line has been established, the traffic congestion will decrease and lead to facilitate movement of pedestrian in the overcrowding streets. The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agree to this paragraph. This shows that if Metro line has been established, the traffic congestion will decrease and lead to reduce the number of traffic policemen at intersections.

Hypothesis NO. 3

(Economic questions is significantly significant at 0.05 level in establishment of a Metro in Gaza City)

Table 4 shows the test values for Economic Issue questions. The mean of this issue equals 3.50 (70.00%). Test value = 7.873, and P-value = 0.000 which is smaller than the level of significance α = 0.05. The sign of the test is positive, so the mean of this issue is significantly greater than the hypothesized value 3. One concludes that the respondents agree to this issue.

Table 4: Test values for "Economic Questions" part

No.	Items	Mean	Weight mean	t-value	P-value
1.	Establishment of a Metro helps to economic growth of the country.	3.41	68.13	3.857	0.000
2.	Establishment of a Metro is economically costly project.	4.14	82.71	9.848	0.000
3.	Establishment of a Metro increases unemployment ,especially stopping a lot of drivers on work.	3.44	68.75	3.416	0.001
4.	Establishment of a Metro helps to solve the problem of unemployment due to increased man-power during the construction and operation.	3.14	62.71	1.237	0.219
5.	Establishment of a Metro reduces transportation fare compared to the taxis.	3.59	71.88	5.875	0.000
6.	Establishment of a Metro increases commercial traffic between the vital areas.	3.28	65.63	2.522	0.013

No.	Items	Mean	Weight mean	t-value	P-value
	Total	**3.50**	**70.00**	7.873	0.000

Hypothesis NO. 4
(Technical questions is significant at 0.05 level in establishment of a Metro in Gaza City)

Table 5 shows that the mean of this issue equals 3.78 (75.51%) and Test value = 12.650. P-value = 0.000 which is smaller than the level of significance α = 0.05. The sign of the test is positive, so the mean of this field is significantly greater than the hypothesized value 3. One concludes that the respondents agree to this issue.

Table 5: Test values for "Technical Issue" questions

No.	Items	Mean	Weight mean	t-value	P-value
7.	Infrastructure in Gaza City prevent the establishment of a metro.	3.78	75.63	7.101	0.000
8.	Urban planning of Gaza City prevent the establishment of a metro.	3.57	71.46	5.277	0.000
9.	Groundwater level in Gaza City may prevent the establishment of a metro.	3.21	64.17	2.076	0.041
10.	It should increase the number of metro station to cover all vital areas.	3.98	79.58	9.859	0.000
11.	The metro should save the time to choice it as a means of transportation.	4.20	83.96	11.977	0.000
12.	Repeated Israeli shelling and air discharges is the most important negative effects on the establishment of a metro.	4.03	80.63	9.903	0.000
13.	It's difficult to develop the metro to serve new developmental areas compared to service provided by taxis.	3.42	68.33	4.164	0.000
14.	Lack of equipment is one of the obstacles in the establishment of the metro.	3.89	77.71	7.860	0.000
15.	Establishment of the metro will import modern building techniques to Gaza Strip.	3.91	78.13	9.218	0.000
	Total	**3.78**	**75.51**	12.650	0.000

Critical value of t at df "94" and significance level 0.05 equal 1.98

Hypothesis No. 5
(There is statistically significant level α = 0.05 about possibility of the establishment of a Metro in Gaza City due to age)

To test the hypothesis, one way ANOVA is used and the result is illustrated in Table 6. It shows that the p-value equals (0.950) which is greater than (0.05) and the value of F test equals (0.227) which is less than the value of critical value (2.32); that means there is no statistically significant difference atα = 0.05, about possibility of the establishment of a Metro in Gaza City due to age.

Table 6: ANOVA test due to age

Field	Sources	Sum of Squares	df	Mean Square	F value	Sig.(P-Value)
Possibility of the establishment of a Metro in Gaza City.	Between Groups	0.245	5	0.049	0.227	0.950
	Within Groups	19.389	90	0.215		
	Total	19.634	95			

Critical value of t at df "94" and significance level 0.05 equal 1.98

Hypothesis No. 6
(There is statistically significant level α = 0.05 about possibility of the establishment of a Metro in Gaza City due to level of education)

To test this hypothesis, one way ANOVA is also used and Table 7 shows the result in which the p-value equals (0.786) which is greater than (0.05) and the value of F test equals (0.242) which is less than the

value of critical value (3.09); that means there is no statistically significant difference at α = 0.05 about possibility of the establishment of a Metro in Gaza City due to level of education.

Table 7: Anova Test due to level of education

Field	Sources	Sum of Squares	df	Mean Square	F value	Sig.(P-Value)
Possibility of the establishment of a Metro in Gaza City.	Between Groups	0.102	2	0.051		
	Within Groups	19.532	93	0.210	0.242	0.786
	Total	19.634	95			

Critical value of t at df "94" and significance level 0.05 equal 1.98

Hypothesis No. 7
(There is statistically significant level α = 0.05 about possibility of the establishment of a Metro in Gaza City due to Job)

Table 8 shows that the p-value equals (0.835) which is greater than (0.05) and the value of F test equals (0.418) which is less than the value of critical value (2.32); that means there is no statistically significant difference at α = 0.05 about possibility of the establishment of a Metro in Gaza City due to Job.

Table 8: ANOVA test due to job

Field	Sources	Sum of Squares	df	Mean Square	F value	Sig. (P-Value)
Possibility of the establishment of a Metro in Gaza City.	Between Groups	0.445	5	0.089		
	Within Groups	19.189	90	0.213	0.418	0.835
	Total	19.634	95			

Critical value of t at df "94" and significance level 0.05 equal 1.98

Hypothesis No. 8
(There is statistically significant level α = 0.05 about possibility of the establishment of a Metro in Gaza City due to gender)

Table 9 shows that the p-value equals (0.609) which is greater than 0.05 and the absolute value of t test equals (0.514) which is less than the value of critical value (1.98). That means there is no statistically significant difference at α = 0.05 about possibility of the establishment of a Metro in Gaza City to gender.

Table 9: Independent samples test due to gender

Field	Gender	N	Mean	Std. Deviation	T	P-value
Possibility of the establishment of a Metro in Gaza City.	Male	58	3.64	0.427	0.514	0.609
	Female	38	3.68	0.497		

Critical value of t at df "94" and significance level 0.05 equal 1.98

V. CONCLUSIONAND RECOMMENDATIONS

A questionnaire is used to measure the opinions of people in Gaza City about investigation of the establishment of metro in Gaza City. The structured questionnaire consists of two groups; the first is demographic data, and the second involves questionnaire paragraphs that are divided into four issues such as, general questions, traffic questions, economic questions, and technical questions. Random sample is selected from target group involves various community layers (officials, stakeholders, people, private public transport companies, etc.) with size of 150. 96 questionnaire papers are received. By using Pearson correlation coefficients, and Alpha Cronbach's tests, It is proved that the questionnaire is valid, reliable, and ready for distribution for the population sample. One sample t test is used to determine if the mean of a paragraph is significantly different from a hypothesized value 3 (Middle value of Likert scale). So that all issues of the questionnaire are significant at 0.05 level in establishment of a Metro in Gaza City. One way ANOVA, and Independent Samples tests are presented and show that there is no statistically significant difference atα = 0.05, about possibility of the establishment of a Metro in Gaza City due to age, level of education, job, and gender. As a result of this study, the following recommendations are depicted:

- Effective measures in the short term to improve the public transport services as part of a comprehensive long term transport plan should be taken by Ministry of transport.
- Formation of a committee to develop an integrated strategy to start implementing the steps to create metro project that includes members of General Authority for Investment, Ministry of Public Works and the Ministry of Transport.
- Developing a feasibility study for the metro project to find out the total cost of the establishment and operation.
- Using of international companies specialist of metro projects that is enjoyment of a long and broad experience in infrastructure projects, through the development of preliminary studies, which include the general plan, capital costs and technical perceptions of the project.
- Implementation of economic feasibility studies on both technical and financial support, and make recommendations about the best way to restructure the project, in addition, choosing the authority that oversees the development, operation and maintenance of the metro network, taking into account the building, operating, and transport mechanism (BOT).

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