FerNey: A Case Study on the Viability of an E-Jeepney Rapid Transit (ERT) in the City of San Fernando, Pampanga

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Abstract: - Transportation is the key component for the efficient movement of goods and people. A sound transportation system satisfies the community's demand, offering accessibility, reliability, convenience, comfort, and safety. This study titled "FerNey: A Case Study on the Viability of an E-Jeepney Rapid Transit (ERT) in the City of San Fernando, Pampanga" mainly focused on assessing the city's viability to integrating ERT into its system. The researchers aimed to analyze the current condition of the city's transportation system and determine the factors that contributed to traffic congestion. The study used a mixed-method approach to analyze both qualitative and quantitative data. This approach allowed the researchers to gather comprehensive data that could not be obtained using each method alone. Qualitative factors assessed the number of lanes and PUJs, typical road sections, transport, traffic management plan, and traffic monitoring in the CSFP. Meanwhile, quantitative factors were the AADT and boarding-alighting of commuters. The researchers gathered data from the CPDCO, CPOSCO, DPWH, and LTFRB. Furthermore, the researchers thoroughly observed the boarding and alighting along Manila North Road (McArthur Highway). The research instrument used to obtain this data was the survey form from the DOTr. The researchers found that traffic congestion is brought about by increasing private vehicle ownership, poor road conditions and transportation systems, and incompetent internal system. The city needs more relevant and timely data that will aid in understanding the current condition of its system. Hence, the researchers maximized the data gathered in boarding and alighting to draft the possible stationing of Project FerNey. This endeavor was in its preliminary stage. Future researchers are encouraged to gather more data that are updated and realistic to better assess the viability of FerNey in CSFP in terms of road properties and financial capability. Also, it is recommended to consider the analysis and design of the station that will cater to all types of commuters.

Key Words: — *Mode of Transportation, Rapid Transit, Traffic Congestion.*

I. INTRODUCTION

Transportation enables people to connect with everyday activities by moving goods and people efficiently (Transportation | Definition & Facts | Britannica, n.d.).

It established civilization and helped transfer people and goods from one place to another. A sound transit system satisfies the community's demand, offering accessibility, reliability, convenience, comfort, and safety. It benefits commuters and their necessities and directly impacts the country's economy. In fact, for developed countries, the transportation sector propped up about 6% to 12% of their Gross Domestic Product (GDP) (Rodrigue, 2020). However, how have these countries sustained their transportation system to attain stability?

Transportation is an essential component that sustains relationships and growth between socioeconomic systems (Rodrigue, 2020). Sustainable transportation satisfies the needs of the public regarding efficient and effective mobility.

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Singapore leads the highest customer satisfaction with public transportation with the help of Mass Rapid Transit (MRT) and buses (Wong, 2018). MRT in Singapore has 122 stations with a 203km total length, and the government plans to extend the railway to 360km by 2030. This train uses electric multiple units with six MRT lines. They also use "Ez-link" as a transport ticket that costs 1.50 Singapore Dollars (SGD) to 2.50 SGD, making Singapore rank first in the affordability of public transportation (MRT Metro - Singapore Metro, Map, Schedule and Price, n.d.; Patel & Padhya, n.d.). Singapore also has a bus system; it is barrier-free and wheelchair accessible.

Another country with a quality transportation system is Columbia called TransMilenio or Bus Rapid Transit (BRT) in Bogota, Colombia, which was acknowledged as the largest BRT in the World (TransMilenio Bus Rapid Transit System, n.d.). The system of TransMilenio comprises high-capacity buses, dedicated bus lanes, and elevated bus stations. They also implemented restrictions within the city, including peak-hour car restrictions, car-free days, and public space improvements. They made the system serviceable in many aspects, like reduced air pollution, increased employment, fewer road accidents, and improved traffic flow.

The availability of accessible and reliable modes of transport is beneficial to commuters. It reduces travel time, avoids delays and accidents, and makes traveling safer and more comfortable. To achieve this, developments within road transport arose. Different modes like buses, BRT, LRT, and MRT were established. Bus stops are also notable and might be recognized as World's Best Bus Stops. There are different types of buses around Singapore, such as Trunk and Feeder Buses; these buses travel from one neighborhood to another and from MRT to bus interchange, respectively (Public Buses in Singapore - ALL ABOUT CITY - SINGAPORE, n.d.; Garfield, 2017). They also have bus trips depending on time, place, and purpose.

On the 2020 traffic index report of Numbeo, the Philippines has the worst traffic among its six neighboring countries in South East Asia and ranks ninth-worst worldwide. (Mercurio, 2021). New research also found that it is the eighth worst city in the world for the number of hours spent in traffic among cities. According to Britannica, Manila has a 43% congestion level, and 98 hours annually are lost due to traffic (Transportation | Definition & Facts | Britannica, n.d.). This problem has led to a solution for integrating the Bus carousel of the city since the BRT System has benefited many countries. It has an exclusive bus lane called EDSA Busway that separates from the usual road traffic along the EDSA. Currently, 15 bus stops are designated, and 550 buses are authorized to operate around the loop. The inner lane of the busway has contravened technical barriers that result in a possible upgrade of the busway infrastructure to a gold standard of BRT.

Another effectuated program to develop transportation systems is the Public Utility Vehicle Modernization Program (PUVMP). This program is set to phase out 15-year-old jeepneys and switch to E-jeepneys or modernized jeepneys. The new jeepneys are environmentally friendly since most are electrically powered, unlike the traditional jeepneys that use diesel. Furthermore, they have a higher capacity than traditional jeepneys. PUVMP utilizes Omnibus Franchise Guidelines for releasing franchises for public vehicles. This Guideline requires the Local Government Units (LGUs) to create a Local Public Transport Route Plan (LPTRP), which consists of a five-year plan to provide safety, efficiency, environmentally friendly, and adequacy to the public transportation system. Therefore, this study focuses on the viability of E-Jeepney Rapid Transit (ERT) in the City of San Fernando, Pampanga, where the Fernandino Jeepney (FerNey) will be the modernized Public Utility Vehicle (PUV) used. In addition, ERT has been prompted through this modernization program. ERT integrates the BRT system and the PUVMP, enabling electric jeepney vehicles to have stationing, scheduling, and right-of-way on less broad roads, unlike on highly urbanized roads. ERT aims to cater faster, more accessible, safe, and more comfortable service and to lessen Green House Gases (GHG) and other air pollution brought by the transportation sector.

II. METHODOLOGY

The researchers used a mixed-method approach to analyze both qualitative and quantitative data. The mixed method approach allows the researchers to gather comprehensive data by integrating two approaches. It provides detailed information that cannot be obtained using each method alone (Mixed Methods Study, n.d.). Qualitative factors were the assessment of the number of lanes and PUJs, typical road sections, transportation, and traffic management plan, and traffic monitoring in the CSFP was identified to determine the quality of the transportation system. On the other hand, the quantitative factors were the AADT and boarding-alighting of the commuter along the McArthur Highway. Together, these factors were considered to develop an enhanced transport mode for Project FerNey's viability.

The study approached an exploratory sequential design where the qualitative data were gathered and analyzed. Quantitative data then assessed the results. The final results determined the

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interpretation of the study regarding the enhanced mode of transport for the viability of Project FerNey. The qualitative data came from the DPWH, CPDCO, and CPOSCO. On the other hand, the quantitative data were the detailed observation of the commuter trip patterns and the data gathered from DPWH and CPMS.

The study required data from the departments and LGUs of the CSFP. The researchers visited respective offices in the city and gathered the necessary data. The data from typical roadway sections were gathered in DPWH, the number of PUJs was gathered in LTFRB, the LPTRP, and the transport and traffic management plan of the city were gathered in CPDCO, and the traffic monitoring was gathered in CPOSCO. Also, researchers gathered data from the website of the DPWH for the number of lanes and AADT along the McArthur Highway. The researchers used the templates of DOTr for the boarding-alighting of commuters to gather data from boarding-alighting. The researchers visited the good office of the DPWH, LTFRB, CPDCO, and CPOSCO to distribute the letter of intent to gather data regarding the typical roadway section, number of PUJs, LPTRP, and traffic monitoring, respectively.

The data regarding the number of lanes and AADT of the McArthur Highway were available on the DPWH website.

This study identified both quantitative and qualitative data, a mixed-method approach. The researchers initially gathered data from the CPDCO, CPOSCO, DPWH, and LTFRB. The obtained data were analyzed to understand better the current condition of the transportation system in CSFP.

The CPDCO provided the draft of the LPTRP and the transport and traffic management plan. The draft contained a systematized route plan for traditional jeepneys alone. Due to the unavailability of field professionals, an update or revision has yet to be done to the draft making it unreliable. The transport and traffic management plan was a proposed project for the city in collaboration with the San Fernando City Project Team (San Fernando CPT). The City of San Fernando sees itself to be a "Habitat of Human Excellence," "Global Gateway," "Gateway to North Philippines, Regional Center of Central Luzon," and "Champion of Good Urban Governance." In achieving this, the city's traffic and transport system must meet the standard of environmentally sustainable transport. The project was able to propose a transport and traffic management plan for the city but ended up pending due to different factors of consideration. After a thorough analysis of these data, the researchers found out that they were outdated and that no recent data was available to showcase the current condition of the

city's transport system. As a result, issues concerning the transportation system were not addressed properly.

The CPOSCO provided the data regarding the traffic monitoring scale. It indicated the day-to-day traffic condition of CSFP by using the light to heavy-traffic scale. These data were made available and written in the logbook. After browsing the logbook, the researchers found the data predictable and unrealistic. It can be seen in the records that even during the busy holiday season, their data showed light traffic all day. The researchers also tried to obtain information about their office's present and future plans to address issues regarding the transportation system. However, they failed to provide it because they only acted out of necessity.

The DPWH provided the typical roadway section of Manila North Road. It showcases the road elements of the specified road. The researchers hoped to obtain data regarding geometric and pavement design analysis of the road, but the department needed help to produce it. This caused the researchers to fail to analyze the road properties necessary for assessing the adaptability of the Manila North Road to modification and changes.

The LTFRB provided the researchers with the recent number of lanes and registered PUJs along the Manila North Road. The data showed that the number of lanes ranges from 4 to 8, capable of adapting a rapid transit. Aside from the number of PUJs, the researchers also wanted to determine the number of registered operators and modernized jeepneys to assess the level of sustainability of the mode of transport for the viability of Project FerNey.

After gathering the qualitative data, the researchers conducted a detailed observation of the boarding and alighting. The DOTr survey forms were used to determine the boarding and alighting of the commuters traveling from San Fernando to SM Telabastagan and vice versa. The observation was done during peak hours, 6 AM to 8 AM and 5 PM to 7 PM. During these hours, a huge number of commuters travel simultaneously because these are the time of the day when people, especially students, and workers, are going in and out of their respective schools and offices.

III. RESULTS

The researchers were able to gather data from different departments that have connections with the transportation sector of the city, specifically the CPDCO, CPOSCO, LTFRB, and DPWH. In addition, the researchers conducted a detailed observation of the Boarding and Alighting. The data gathered

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helped the researchers better understand the City of San Fernando, Pampanga's transportation system and enabled them to propose an enhanced mode of transport that will aid in reducing the traffic congestion within the city.

The CPDCO provided the researchers with the transportation and traffic management plan and the draft of the LPTRP. These data were used to examine the current condition of the transportation system to present an enhanced system. The researchers needed these data to perceive the situation and determine what must be done.

Fig.1. Local Public Transport Route Plan and Traffic and Transport Management Plan of the City of San Fernando, Pampanga. Prepared by the CPDCO

The CPOSCO provided information regarding traffic data. Also, they discussed information that was beneficial to the study. The researchers included their staff as respondents to analyze the flow of traffic and the factors that affect the movement of vehicles.

Table.1. Light-Moderate-Heavy Traffic Monitoring Scale of CPOSCO

Type	Classification
Light Traffic	• Pedestrian lanes are always available. • Vehicles can go at speeds of up to 20 kph. • Vehicles are much farther apart.
Moderate Traffic	• Typically, pedestrian lanes are consistently available. • Vehicles can only travel at a maximum speed of 15 to 20 kph. • The distance between the vehicles is 2 meters.
Heavy Traffic	• Pedestrian lanes are not always readily available. • Vehicles can only travel at a speed of 5 to 10 kph. • There is not enough room between vehicles.

The LTFRB provided the number of PUJs and registered operators. The researchers used these data to analyze the availability of PUJs and determine the reason for the insufficient supply of modes of transport.

Table.2. Number of PUJs along McArthur Highway

Route	No. of Units
San Fernando (Downtown) - San Isidro via San Agustin	60
San Agustin - San Fernando (Downtown)	50
Angeles City - San Fernando (Downtown)	833
Total:	943

The DPWH provided the researchers with the typical roadway section. These data included the different properties of the road, dimensions, pedestrians, bike lanes, and road signs. In addition, the researcher obtained data about AADT, the number of lanes, and the volume capacity ratio that was available online. These data were used to examine road conditions.
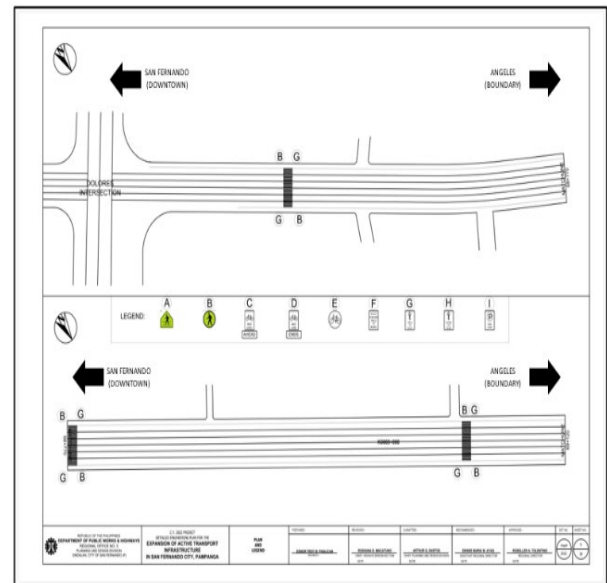

Fig.2. Typical Roadway Section near Dolores Intersection

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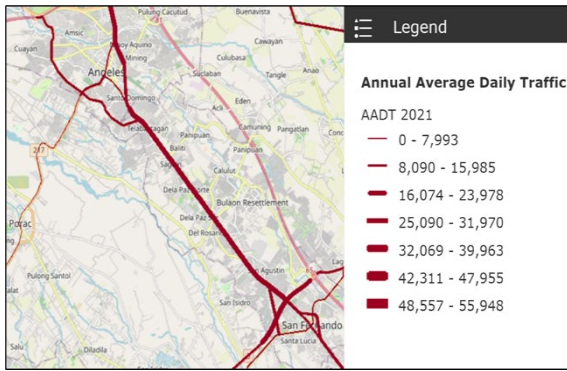
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Fig.3. AADT of CSFP along the McArthur Highway, also known as Manila North Road.

Table.3. AADT of McArthur Highway or also known as Manila North Road

Region	Region III
District Engineering Office	Pampanga 1st District Engineering Office
Road Name	Manila North Rd
Road Section	S01162LZ
Year	AADT
2021	41,475
2020	40,948
2019	46,972
2018	19,595
2017	15,864
2016	16,070
2015	15,396

$$\text{Growth rate} = (\frac{present}{past})^{\frac{1}{n}} - 1$$
$$\text{Growth rate} = (\frac{41,475}{15,396})^{\frac{1}{7}} - 1$$
$$\text{Growth rate} = 0.1520800116 \approx 15.208\%$$

The table above presents the AADT for each year from 2015 to 2021. Using the growth rate formula, it can calculate the percentage change in AADT and project future values by using the past and present values of AADT. The percentage of the growth rate was said to be 15.208% using the standard growth rate formula.

The past has a value of 15,396 and a growth rate of 15.208% to calculate the future AADT. The value of n varies on the year of the projected AADT.

$$\text{Present} = \text{past} \, (growth \ rate \ + \ 1)^n$$
$$\text{Present} = \ 15,396 \, (15.208\% \ + \ 1)^n$$

Table.3. Projected AADT of McArthur Highway

Year	n	AADT
2030	15	128,721
2040	25	530,242
2050	35	2,184,240

This value was used to anticipate the growth rate for the next ten years. Based on the calculation, the AADT for the following years was expected to increase continuously.

Table.4. AADT 2021 of Manila North Road considering Large Bus, Truck, and Trailers

LRP+ Displacement	Large Bus	Rigid Truck (2 axles)	Rigid Truck (3+ axles)	Truck Semi-Trailer (3 & 4 axles)	Truck Semi-Trailer (5+ axles)
K0076+100	184	10	288	404	75
K0068+0	87	4	223	567	81
K0069+0	250	15	369	395	52

The table shows the AADT 2021 in Manila North Road with their corresponding number of Large Bus, Rigid Truck (2 axles), Rigid Truck (3+ axles), Truck Semi-Trailer (3 & 4 axles), and Truck Semi-Trailer (5+ axles) gathered in the DPWH. According to the department, the Dolores intersection to the boundary of Angeles is between K0068 to K0081. The data contains K0076+100, K0068+0, and K0069+0.
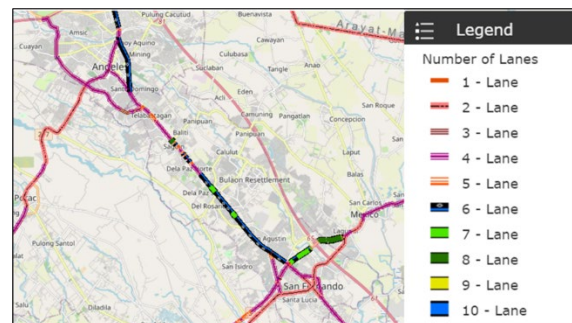

Fig.4. Number of Lanes along the Manila North Road.

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Table.5. Number of Lanes along the McArthur Highway

Region	Region III				
District Engineering Office	Pampanga 1st District Engineering Office				
Road Name	Manila North Rd				
Road Section	S01162LZ				
Directional Flow	Two-Way				
Section	Segment Length (m)	Slab Thickness	Number of Lanes	Surface Type	Pavement Type
1	192	230	4	Asphalt	Asphalt Mix on Asphalt Pvmt
2	121	230	6	Asphalt	Asphalt Mix on Asphalt Pvmt
3	644	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
4	128	300	6	Concrete	Joint Plain Conc Pvmt, + Dowel
5	149	300	6	Concrete	Joint Plain Conc Pvmt, + Dowel
6	74	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
7	1021	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
8	641	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
9	513	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
10	149	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
11	171	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
12	120	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
13	344	200	7	Asphalt	Asphalt Mix on Asphalt Pvmt
14	1182	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
15	153	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
16	150	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
17	150	200	7	Asphalt	Asphalt Mix on Asphalt Pvmt
18	257	200	7	Asphalt	Asphalt Mix on Asphalt Pvmt
19	645	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
20	235	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
21	438	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
22	280	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
23	163	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
24	188	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
25	33	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
26	43	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
27	175	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
28	100	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
29	106	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
30	112	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
31	200	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
32	264	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
33	132	200	6	Asphalt	Asphalt Mix on Asphalt Pvmt
34	94	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
35	229	200	8	Asphalt	Asphalt Mix on Asphalt Pvmt
36	87	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
37	620	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
38	569	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
39	50	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
40	75	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
41	470	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
42	473	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
43	167	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
44	33	200	5	Asphalt	Asphalt Mix on Asphalt Pvmt
45	355	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt
46	258	200	4	Asphalt	Asphalt Mix on Asphalt Pvmt

The table above presents the geometric design of the Manila North Road. The DPWH handed this data to the researchers upon request. The road was divided into numerous sections that vary in segment length. The standard slab thickness used in any section or length was 200mm. The number of lanes ranges from 4 to 8. Most of the surface type was asphalt, and the pavement type was more asphalt mixed on asphalt pavement.

Table.6. San Fernando to SM Telabastagan Number of Boarding and Alighting

San Fernando to SM Telabastagan Boarding	
Location	Qty
Jumbo Jenra - Dolores	1182
Avida Residence	53

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Location	Qty
(Opposite of Jollibee - Sindalan), (Eun Ae Korean Restaurant)	41
(LBC - Sindalan), (Eastwest- Sindalan), (7-Eleven - Sindalan), (Metrobank SF- Sindalan)	25
Caltex Baliti	23
Sampaloc - Dolores	22
(Brgy. Lara), (Baliti)	21
Opposite of OLFU	20
(Tastes from the Greens Sindalan 2), (Brgy. of Dela Paz Norte)	20
(3C Glass and Aluminum Supply), (Milk Fridge), (Brgy. Maimpis)	18
Sindalan Elementary School	18
(San Agustin Parish), (TGP the Generics Pharmacy), (St. Agustin Village)	17
(Primus Medicus), (Mother Teresa of Calcutta), (Metrobank SF - McArthur Highway (Maimpis))	17
(Caltex Sindalan), (McDonald's Sindalan), (Perpetual Heights Sindalan)	17
(Mang Inasal - SACOP), (Chowking - SACOP), (Jollibee - SACOP)	15
Brgy. Saguin	14
(San Isidro Village), (EZ Rocks)	12
Unioil -St. Francis Village	11
(San Miguel Corporation Entry Road), (Ferdinand R. Pring Rent A van Services), (Delbros)	10
(Thai Odyssey), (Opposite of Pilar Village)	10

San Fernando to SM Telabastagan Alighting	
Location	Qty
SM Telabastagan Terminal	519
Opposite of OLFU	127
Sindalan Elementary School	122
(Mang Inasal - SACOP), (Chowking - SACOP), (Jollibee - SACOP)	111
Avida ReSidence	102
(Brgy. Lara), (Baliti)	50
(Tastes from the Greens Sindalan 2), (Brgy. of Dela Paz Norte)	47
(Thai Odyssey), (Opposite of Pilar Village)	45
(3C Glass and Aluminum Supply), (Milk Fridge), (Brgy. Maimpis)	41
Sacred Heart Parish Church - Telabastagan	31
(Marlboro), (Holy Angel Village), (Hampton Orchards), (Yellow Jeep Terminal)	30
Opposite of Our Lady of Mt. Carmel	29
Brgy. Saguin	26
Caltex Baliti	23
(Starbucks Sindalan), (BIR Complex)	22

Location	Qty
(Opposite of Fortune Square), (Coca-Cola San Fernando Plant)	22
(San Miguel Corporation Entry Road), (Ferdinand R. Pring Rent A van Services), (Delbros)	20
Savemore Telabastagan	19
New Era University	17
(San Agustin Parish), (TGP the Generics Pharmacy), (St. Agustin Village)	15

Table.7. SM Telabastagan to San Fernando Number of Boarding and Alighting

SM Telabastagan to San Fernando Boarding	
Location	Qty
(SM Telabastagan Terminal), (Rotonda Angeles-Telebastagan)	942
(BPI Sindalan Branch), (BPI ATM), (Goldilocks), (Sindalan Elementary School), (DelishCheese Dough Sindalan), (Sindalan 1)	78
(Jollibee - Sindalan), (Eun Ae- Sindalan 2)	64
(Pilar Village), (Opposite of Thai Odyssey), (Northwood Hardware)	59
Caltex - Baliti	57
OLFU	44
(Matet Carienderia), (Chain Glass Enterprises), (Brgy. Dela Paz Norte), (Opposite of Tastes from the Greens - Sindalan 2)	35
(Eggs N Brekky), (CSFP Intersection), (St. Theresa Dialysis Center), (LBC Express Incorporated)	31
(Brgy. San Agustin), (TGP the Generics Pharmacy - San Agustin), (Milktealicious), (Opposite of San Agustin Church)	27
(Universal Robina Corporation), (Brgy. Del Rosario), (Japan Surplus)	26
(Savers Appliances), (Puregold Jr. - Dolores) (Ortiz Skin Clinic), (Opposite of Our Lady of Sorrows Parish Church), (Tawiran)	26
(PTT Gas Station), (Esquivel's Unlimited Grill), (Brgy. Saguin), (Brgy. Saguin 1), (Pasbul)	23
(Jumbo Jenra - Sindalan), (Susie's Cuisine- Sindalan), (Opposite of SeaOil - Sindalan)	22
(DHL Express Service Point -M Lhuillier), (Opposite of TGP), (Opposite of UPS Delbros International Express), (Opposite San Miguel Corporation), (Alphamed), (Hotel Mara), (Purok 4 San Isidro), (Saviour Bank Dolores)	19
(Jollibee - Near St. Jude), (Jollibee- Dolores), (St. Jude)	19
(Marlboro), (Holy Angel Village), (Hampton Orchards), (Biotop Philippines)	17
Our Lady of Mt. Carmel Hospital)	15

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(Brgy. Maimpis), (Maimpis 1 and 2), (Goji Coffe House), (Opposite of Milk Fridge)	15
(San Isidro Integrated School), (Opposite of Brgy. Quebiawan)	15
Northwoods	14

SM Telabastagan to San Fernando Alighting	
Location	Qty
(Eggs N Brekky), (CSFP Intersection), (St. Theresa Dialysis Center), (LBC Express Incorporated)	152
McDonald's Dolores Junction/Intersection	108
(Savers Appliances), (Puregold Jr. - Dolores) (Ortiz Skin Clinic), (Opposite of Our Lady of Sorrows Parish Church), (Tawiran)	90
(Jollibee - Sindalan), (Eun Ae- Sindalan 2)	85
(Morning Sun Hardware), (Opposite of Baliti Road), (Baliti 1 and 2), (Brgy. Lara), (D' Klassic Junjubs Bbq Restaurant-Baliti)	66
(Universal Robina Corporation), (Brgy. Del Rosario), (Japan Surplus)	56
(BPI Sindalan Branch), (BPI ATM), (Goldilocks), (Sindalan Elementary School), (DelishCheese Dough Sindalan), (Sindalan 1)	44
(Matet Carienderia), (Chain Glass Enterprises), (Brgy. Dela Paz Norte), (Opposite of Tastes from the Greens - Sindalan 2)	41
(SM Pampanga Terminal), (Corazon's Delicacies)	37
(Jumbo Jenra - Sindalan), (Susie's Cuisine- Sindalan), (Opposite of SeaOil - Sindalan)	35
OLFU	31
(Addessa - Sindalan), (Rufina Building), (Opposite of BDO - Sindalan), (BuyMaXx), (Aquino), (Opposite of Honda)	30
Caltex - Baliti	27
Northwoods	24
(Brgy. San Agustin), (TGP the Generics Pharmacy - San Agustin), (Milktealicious), (Opposite of San Agustin Church)	24
(Caltex San Agustin), (Lazatin)	24
Brgy. San Isidro	22
(San Isidro Integrated School), (Opposite of Brgy. Quebiawan)	22
WalterMart	22
(Bendix Hotel), (Imperial Appliance Plaza), (Microtel)	22

The tables above present the top 20 landmarks with the most boarding and alighting. The researchers conducted a detailed observation in boarding-alighting. In two weeks, the researchers traveled from Jumbo Jenra Dolores to SM Telabastagan on the first week, then from SM Telabastagan to Eggs and Brekky (near the intersection) on the second week.

The survey was conducted using the DOTr forms, specifically the License Plate and Occupancy Count (Passenger Load) Survey and the Boarding and Alighting Survey.

The forms include route name, public transport mode, direction, survey date, time, license plate number, passenger seating capacity, number of passengers, major station (landmark), boarding, and alighting. The schedule was made by considering the peak hours, which are 6:25, 6:55, 7:25, 7:55, and 8:25 in the morning and 4:25, 4:55, 5:25, 5:55, and 6:25 in the afternoon. According to CPOSCO, the specific times mentioned above are the time of the day when traffic is expected due to a large volume of passengers traveling simultaneously.

Table.8. Top 10 with the Highest Number of Boarding and Alighting from San Fernando to SM Telabastagan

Location	Boarding	Alighting
Jumbo Jenra – Dolores	1182	0
(Mang Inasal - SACOP), (Chowking - SACOP), (Jollibee - SACOP)	15	111
(3C Glass and Aluminum Supply), (Milk Fridge), (Brgy. Maimpis)	18	41
Avida Recidence	53	102
Sindalan Elementary School	18	122
Opposite of OLFU	20	127
(Tastes from the Greens Sindalan 2), (Brgy. of Dela Paz Norte)	20	47
(Brgy. Lara), (Baliti)	21	50
Caltex Baliti	23	23
SM Telabastagan Terminal	0	519

Table 8 shows the top 10 landmarks from CSFP to SM Telabastagan, with the greatest number of boarding and alighting.

Table.9. Top 10 with the Highest Number of Boarding and Alighting from SM Telabastagan to San Fernando

Location	Boarding	Alighting
(SM Telabastagan Terminal), (Rotonda Angeles-Telebastagan)	942	0
Caltex - Baliti	57	27
(Matet Carienderia), (Chain Glass Enterprises), (Brgy. Dela Paz Norte), (Opposite of Tastes from the Greens - Sindalan 2)	35	41
OLFU	44	31

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(Jumbo Jenra - Sindalan), (Susie's Cuisine- Sindalan), (Opposite of SeaOil - Sindalan)	22	35
(Jollibee - Sindalan), (Eun Ae- Sindalan 2)	64	85
(BPI Sindalan Branch), (BPI ATM), (Goldilocks), (Sindalan Elementary School), (DelishCheese Dough Sindalan), (Sindalan 1)	78	44
(Universal Robina Corporation), (Brgy. Del Rosario), (Japan Surplus)	26	56
(Brgy. San Agustin), (TGP the Generics Pharmacy - San Agustin), (Milktealicious), (Opposite of San Agustin Church)	27	24
(Savers Appliances), (Puregold Jr. - Dolores) (Ortiz Skin Clinic), (Opposite of Our Lady of Sorrows Parish Church), (Tawiran)	26	90
(Eggs N Brekky), (CSFP Intersection), (St. Theresa Dialysis Center), (LBC Express Incorporated)	31	152

Table 9 shows the top 11 landmarks from SM Telabastagan to CSFP, with the greatest number of boarding and alighting.

IV. DISCUSSION

The purpose of the study was to analyze the viability of FerNey, an ERT in San Fernando, Pampanga, by proposing an enhanced mode of transport. The study's respondents were the CPDCO, CPOSCO, LTFRB, and DPWH.

The researchers analyzed the data gathered and then examined the current condition of the transportation system in the City of San Fernando, Pampanga. The departments concerning the city's transportation sector were able to provide data but needed to improve in some way.

The CPDCO handed the draft of the LPTRP and the San Fernando transport and traffic management plan to the researchers. After a thorough analysis, the researchers discovered that the data obtained needed updating. The draft of the LPTRP was made a long time ago. Hence, it only integrated the traditional jeepneys rather than the modernized ones making the draft unreliable. Furthermore, the transport and traffic management plan was made last 2015. The city has to update its data better to understand the current transportation system

condition and formulate plans suitable for the time being. Lastly, according to the head of CPDCO, they needed more professionals to take charge of revising the said data, for instance, a transport planner to amend the draft and the existing management plan.

The CPOSCO provided the researchers with data regarding the traffic monitoring scale. This shows the monitoring of traffic in the city daily. The data indicate when there is light, moderate, and heavy traffic. The department can provide real-time traffic conditions but needs to have plans for unexpected traffic problems.

The researchers obtained the number of PUJs from the LTFRB. This was used to assess the availability and sustainability of the mode of transport in the city. It was shown that there was a sufficient number of PUJs and operators to cater to greater demand. However, in reality, there had always been a shortage in the supply, and the incompatibility of the data and not up-to-date data caused the situation.

The DPWH provided the researchers with the typical Manila North Road roadway section. The researchers were trying to obtain data regarding the road's geometric design and pavement analysis and design of the road, but the department still needs to issue it. This will help in analyzing the road's properties to assess the city's suitability to adapt to rapid transit. On the other hand, the researchers gathered data regarding the number of lanes and AADT readily available on the DPWH website.

The researchers also detailedly observed the boarding and alighting of commuters along McArthur Highway. This helped determine the locations which held a great volume of passengers and which were not. Consequently, it aided the drafting of the possible stations of Project FerNey. Since the DOTr does not have a specified way of proper stationing, the researchers used the major pick-up and drop-off points to mark the major stations. The researchers considered locating the stations a distance away from the busy area.

Furthermore, the spacing of the stations is approximately 1290 meters. The researchers also considered the commuters' willingness to walk to the stations. On the other hand, alternative modes of transport are encouraged for places not accessible within the stations. For instance, the trunk and feeder system was encouraged to take charge of the places.

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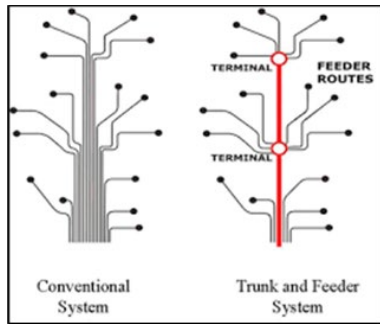
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Fig.5. The Conventional System and Trunk and Feeder System.
CITY OF TSHWANE IRPTN / BRT SYSTEM OVERVIEW (2012)

Table.10. Different Modes of Transport

Transportation Modes	Boarding-Alighting	High Capacity	Reduction of Congestion	Environmentally Friendly
Private Vehicles	✗	✗	✗	✗
Public Utility Vehicles	✗	✗	✓	✗
Provincial Buses	✗	✓	✓	✗
Active Transportation	✗	✗	✓	✓
Bus Rapid Transit	✓	✓	✓	✓
FerNey (E-Jeepney Rapid Transit)	✓	✓	✓	✓

Table 10 shows the different list of modes of transport together with the boarding-alighting, their passenger capacity, their ability to reduce congestion, and impact on the environment. It was shown that both the Bus Rapid Transit and FerNey passed the identified standards, but because buses are huge enough to be used within the CSFP, FerNey was much more suitable and relevant.

Table.11. Major pick-up and drop-off points from Jumbo Jenra Dolores to SM Telabastagan

Major pick-up and drop-off points from Jumbo Jenra Dolores to SM Telabastagan	
Station	Location
1	Jumbo Jenra - Dolores
2	Unioil -St. Francis Village
3	Opposite of Makimura Ramen Bar
4	Opposite of Coca-Cola Femsa
5	Pepsi-Cola Products Philippines, INC
6	Watsons Sindalan
7	Greenfields
8	Wilson's Instant Tree Bank
9	Union Galvasteel Corp - Baliti
10	Opposite of Motolite Delivery
11	SM Telabastagan Terminal

Table 11 shows the summary of the possible point stations of Project FerNey from Jumbo Jenra Dolores to SM Telabastagan due to the detailed observation done in boarding and alighting.

Table.12. Major pick-up and drop-off points from SM Telabastagan to Jumbo Jenra Dolores

Major pick-up and drop-off points from SM Telabastagan to Jumbo Jenra Dolores	
Station	Location
1	SM Telabastagan Terminal
2	Holy Angel Village Phase 1
3	Enoc Telabastagan
4	Our Lady of Mt. Carmel College
5	Black Scoop Café
6	Jumbo Jenra - Sindalan
7	Isla LPG
8	Pilar Village
9	Opposite M.Lhuillier Express
10	Villa Corazon
11	Eggs N Brekky

Table.13. Major Points for Project FerNey Stations

Major Points for Project FerNey Stations	
Point	Location
A	Jumbo Jenra - Dolores
B	Unioil -St. Francis Village
C	Opposite of Makimura Ramen Bar
D	Opposite of Coca-Cola Femsa
E	Pepsi-Cola Products Philippines, INC
F	Watsons Sindalan
G	Greenfields

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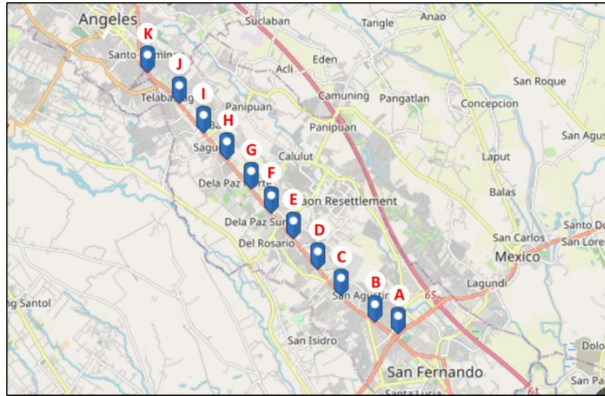| H	Wilson's Instant Tree Bank
I	Union Galvasteel Corp - Baliti
J	Opposite of Motolite Delivery
K	SM Telabastagan Terminal

Fig.6. Major Points for Project FerNey Stations

Table 13 shows the major points of the proposed stationing of Project FerNey. The researchers obtained this data from the major pick-up and drop-off points from Jumbo Jenra Dolores to SM Telabastagan and vice versa. The points were drawn from the centermost section of the road coinciding with the two opposite road directions with a station spacing ranging from 1200 m to 1600 m. The uniformity of station spacing was not strictly observed because the researchers considered locating the points a distance away from the busy area to avoid commotion and overcrowding.

For the travel time of FerNey, a proposed ERT integrating BRT system and E-jeepney, it has the same average speed as BRTs. According to Gaurav V. Jain et al. (2022), the average speed of BRT is 23.77 km/h. The approximate length of Manila North Road is 13km. To project the estimated time travel of FerNey, the researchers used the given information to the speed formula to compute the travel time of FerNey.

$$speed = \frac{distance}{time}$$

$$time = \frac{distance}{speed}$$

$$time = \frac{13,000\ m}{23,770\ m/hr}$$

$$time = 0.547\ hr \times \frac{60\ mins}{1\ hr} = 32.82\ mins\ \approx 33\ mins$$

Based on the computed value, the estimated travel time of FerNey is 33 minutes from the starting point to the last point.

One of the qualifications for rapid transit is having a designated pick-up and drop-off point with a limited time to board and alight passengers. FerNey allot a minute for passengers boarding and alighting. Consequently, the estimated travel time of FerNey will be 44 minutes in total since there will be 11 proposed stations, and a maximum of one minute is expected for boarding and alighting.

Lastly, according to the National Association of City Transportation Officials of their Bus Rapid Transit Service Design Guidelines (2007), the BRT has a minimum of five to fifteen minutes of headway. With this, Project FerNey will have a 5 minutes interval in Points A and K for each PUJ that will operate, especially during peak hours.

V. SUMMARY OF FINDINGS

The study aims to identify the factors that contributed to the traffic congestion in the city. Furthermore, to assess the viability of Project FerNey, an ERT, in the City of San Fernando, Pampanga. The researchers used the five indicators of a good traffic system which are accessibility, mobility, quality of life, operational efficiency, and system condition and performance (Celso et al., 2022) to identify the current condition of the transportation system in the city. The researchers were able to examine the transportation system of CSFP with the use of the data gathered. The factors that contributed to the poor quality of the transportation system were known to be the lack of a dependable mode of transport that would cater to a greater capacity, road condition errors, and inconsistency with the road properties, and lastly, incompetent departments due to lack of suitable professionals, unavailability of futuristic plans and management, and lack of specialized department that will focus on enhancing the transportation sector. As a result, traffic congestion in CSFP has reached an alarming extent.

The study was limited to assessing the city's adaptability towards Project FerNey. The financial aspect of the project was not considered because the focus of the study was to determine the factors that degraded the performance of the transportation system and then propose ways to enhance the current condition viable for the city. Consequently, the researchers proposed Project FerNey, an ERT, to upgrade the quality of the transportation system into an efficient and sustainable one.

Several studies on transportation have shown that traffic congestion is brought about by poor transportation management and road conditions. To address the issue, the government is implementing policies to support the developments within the

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transportation sector. Several countries have adopted different alternative modes of transport, such as active transport, mass transit rail, train, car sharing, BRT, and others which aided in reducing traffic congestion.

The PUVMP was a long-standing transformational plan of the government. Its emergence was brought about by the worsening traffic congestion in the Philippines (Andalecio et al., 2020). However, implementing the program was a huge challenge for the government due to different factors concerning the jeepney owners/drivers/operators, the commuters, the environment, and the economy. The Ten Pillars of the PUVMP were outlined along with the program to ease the worries of everyone. These pillars contain all the necessary steps and processes to guide all the participants participating in the modernization program.

The BRT system, a subdiscipline of ITS, was a widespread program adopted by many countries to address issues regarding the transportation system. This initiative aimed to cater to a greater capacity while providing safe, convenient, accessible, reliable, and comfortable travel. Studies have shown that the BRT successfully alleviated the problem not only of traffic congestion but also environmental and economic issues.

The researchers utilized the PUVMP and BRT system to emerge Project FerNey, an E-jeepney Rapid Transit, in CSFP. San Fernando City is a vital component of Pampanga. It is mainly along JASA and McArthur Highway, connecting to cities and municipalities like Angeles City or Clark. The city is considered to be the Christmas capital of the Philippines. Numerous developments also bound it as a result, the number of locals and tourists traveling in and out of the city is continuously increasing thus increasing travel demand. FerNey aimed to cater to this increasing travel demand by maximizing the use of the modernized jeepneys that started to roll out months ago. Since it is a rapid transit, it is expected to be exclusive, has systematized routes, and is efficient.

The detailed observation done by the researchers for boarding and alighting helped determine the major pick-up and drop-off points that aided in drafting the possible stations for Project FerNey. The stations were based on the result of the detailed observation done by the researchers which showed the locations that garnered the highest number of boarding and alighting.

VI. Conclusion

The researchers have concluded that the transportation sector is crucial to the success of a nation. An efficient mode of transport caters to the need of the public, the environment, and the economy. The efficiency of the transportation system depends on the efficacy of the transportation management. Rapid transit is one of the best ways to achieve a sustainable transportation system because it is faster and timelier. Generally, it is important to have a reliable transportation system because it directly affects the progress of a country.

The City of San Fernando is growing. The infrastructure continuously develops, attracting tourists to travel in and out of the city. These instances increase travel demand, yet the transportation system must be more modern and systematic. The researchers have found that traffic congestion in CSFP was brought about by increasing private vehicle ownership. Since the transportation system in the city is not dependable, many people have chosen to purchase motorcycles and cars to make their travel faster and more convenient. Second, poor road conditions and transportation systems. Based on the data gathered, road properties are inconsistent, resulting in road malfunctions. Also, the unsystematic transportation sector due to weak implementation of policies. Lastly, incompetent internal system. The researchers have concluded that, aside from these observable factors, there is a huge problem within the departments. For instance, the unavailability of field professionals in offices governing the transportation sector leads to poor management. The incapability of the people working from within the system demonstrates the substandard quality of the transportation system.

The detailed observation done for the boarding-alighting of commuters showed the places which cater to a great volume of passengers. These data were used to draw the major station of Project FerNey. Point A was at the Jumbo Jenra Dolores, while point K was at SM Telabastagan. The stations will be placed at the center-most part of the road. The basic feature of the station was expected to be accompanied by a pedestrian for the safety of the commuters when passing through the road.
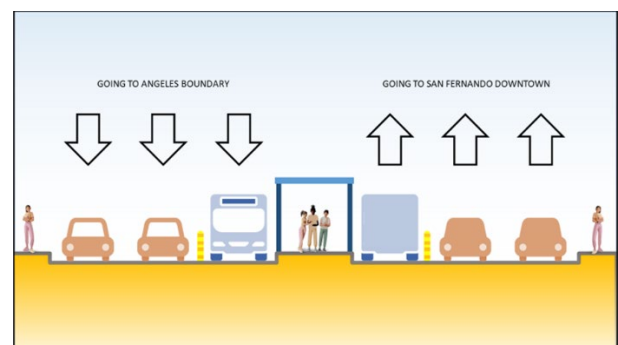

Fig.7. Project FerNey

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The picture shown above presents the proposed representation of Project FerNey. There will be an exclusive lane for the Fernandino Jeepney and the stations determined in the above discussion. The CSFP had undergone numerous developments and modifications on its road and system, yet the problem regarding congestion just worsened over time. Plans were also held pending due to piled-up issues. Project FerNey aimed to upgrade the government and its people's initiative in addressing traffic problems. This should aid in reducing traffic congestion for a long time.

It is recommended that the city should expand some of the roads in the Manila North Road to equalize the number of lanes. The ideal number of lanes is eight; four lanes for public use, two lanes for FerNey, one for the stations, and one for sidewalks. The four lanes intended for public use will serve the private vehicles and traditional jeepneys that still meet the standards for the PUVMP. The three lanes intended for FerNey and the common station will suffice the space for Project FerNey. The remaining lane is dedicated to sidewalks which will be divided into two, placed at the outermost lane of the road on both sides.

The stations are located on the innermost lane of the road, as recommended. Point A (Jumbo Jenra Dolores – Terminal) and Point K (SM Telabastagan – Terminal) will be located inside the establishment to allot a larger space since starting and final stations has the most prominent boarding and alighting.

For the parking space of the FerNey, it is recommended to be located between Northwalk 1 and Green City for Point A, and a parking space between Savemore Telabastagan and Sacred Heart Parish Church for Point K.
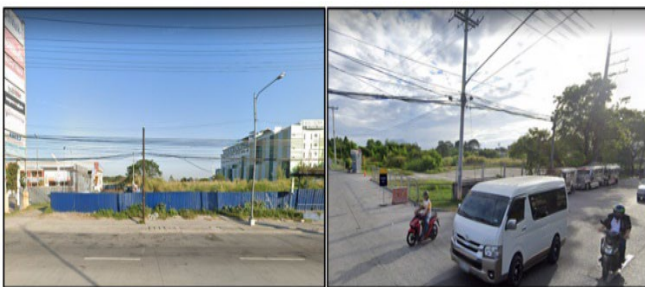

Fig.8. Recommended Parking Space

The implementing policies for Project FerNey should be strictly observed and followed. It is encouraged that the transportation sector will dedicate an office to supervise FerNey. Considering that Project FerNey is a systematized public transportation system, detailed scheduling of the traffic lights shall be anticipated along Manila North Road to avoid delays and problems during the roll-out of FerNey.

The condition of the transportation system varies over time. The problems and solutions done before may not be applied to the present. Project FerNey integrated the Intelligent Transportation System (ITS) to improve the system. ITS can be utilized to enhance and provide suitable solutions to current and future problems concerning the transportation sector.

VII. RECOMMENDATIONS

The researchers recommend conducting a commuter experience survey that will focus on assessing the commuter trip experience of different passengers using traditional and modernized jeepneys. The survey will specifically answer questions about the safety, reliability, accessibility, travel time, and comfort of both jeepneys. This will add up to the credibility of the result. The study aims to suffice the need of the public, especially commuters, for a systematic transportation system, so it is better if they will take part in the study's data. Furthermore, future researchers should consider conducting structured interviews with different government officials in the transportation sector. This will aid in obtaining information that will contribute to a more in-depth analysis of the city's transportation system.

The researchers were able to propose stationing of the ERT due to their detailed observation of the boarding and alighting. The study's proponents recommend designing stations that will cater even to vulnerable passengers like the PWDs, the elderly, children, pregnant, and others. This will make the study beneficial to all commuters, making it more reliable and efficient.

Traffic rules and regulations should not obstruct public transportation such as Rapid Transit, and it is recommended that future researchers plan elevated routes for Project FerNey in the CSFP, especially to the Manila North Road or McArthur Highway.

One of the requirements of the government for the LGU is to submit an LPTRP in line with the implementation of the PUVMP. This will include the five-year plan of the local government promoting and delivering an adequate, safe, dependable, efficient, and environmentally friendly transportation system. The researchers recommend having a

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thorough analysis of the LPTRP of the city if there is any, to assess the current condition of the transportation system in the city. If it so happens that the local government fails to produce an LPTRP, it is recommended that future researchers will develop the route plan.

Future researchers should evaluate the financial aspect of the project. They should consider the city's capability for funding, and if they are willing to allot a budget for the project just in case there is none. The financial discussion will determine the ability of the city to adopt and implement the said project fully.

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