International Journal of u- and e- Service, Science and Technology
Vol.8, No.1 (2015), pp.91-104
http://dx.doi.org/10.14257/ijunesst.2015.8.1.09

The Influence of Megatren System on Ridership in Metro Manila

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Abstract

The inauguration of the Metro Rail Transit (MRT-2) or Megatren in line 2 with a total length of about 13.8 km and run from Santolan, Pasig City to Recto in Manila marked the comeback of the train as an important passenger mode of transport in the Philippines. Since then high speed train (HST) services have been introduced in ASEAN countries and are planned in many more, and the train has once more become the dominant mode of transport on many routes. This review summarizes the efficiency of the expanded rail network system which is quite modern through the application of technology and scientific principles by means of modern ways of transportation engineering for managing the facilities of MRT-2 system. The study further concludes that MRT-2 is less cost-efficient than private transportation, the benefits of MRT-2 such as aesthetics, providing transit for the poor, potential economic development spillovers, and reducing congestion and pollution—must all be considered in the cost-benefit analysis of MRT-2.

Keywords: *Highway engineering, railway transit, road engineering, transportation engineering*

1. Introduction

More commuters are alarmed by traffic jams and slow moving vehicles due to some collision and accident on roads particularly the non-stop increasing volume of passengers in Metro Manila. Public transport was nearing its saturation point but was still barely able to meet demand. Hanging on the back end of moving jeepney-this always indicate how badly at traffic situation has become. Monorail and trains was built for the corresponding highway transportation difficulties in the country such LRT line 1, reference, the first monorail in the Philippines. However, the total number of vehicles and travelers as well as commuter rises continually and the development of transportation become complicated for government agencies such as road widened installation of traffic lights, route planning and others.

In the most of developed countries, there were efficient urban rail network before the rapid urbanization, on the other hand, in developing countries, lacking of infrastructure has supported the rapid motorization in the city such as Manila and Quezon City. One of the most important and well known problems in Manila along C.M. Recto is traffic congestion. Without any efficient demand management policy for transport, many attempts to solve the problem focused on road-based transportations, such as building more roads or increasing road capacity, which is inefficient in the long-term development of the city. The Department of Transportation and Communication (DOTC) statistical summary 2011 indicated that there are 5.6 million out of country's 26.8 million registered cars are in Metro Manila [1,12]. Before 1986, the public

ISSN: 2005-4246 IJUNESST
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transports were jeepney, taxi and bus transit which were insufficient and inefficient to serve commuters. Until the government agencies (LRTA) plan for expansion alternative [1,12].

The MRT-2 or Megatren like predecessors in LRT line 1 and MRT-3 is electrically driven using solid state propulsion. Technology powered by electric motors of 1500 volts [2]. This enables train to travel anywhere from 40 kilometers per hour to 80 kilometer per hour top speed, from Santolan to Cubao, one can reach his destination in about 15 minutes. Previously the travel time was one hour to more than two hours through jeepney or bus.

Because of its bigger size and more powerful engines, should be classified not within the "light railway" category but as "medium size railway". Each train is mounted with two air conditioning units and can transport 1,000 passengers per trip which is 25 percent bigger than the MRT-3 metro star and twice that of the LRT 1[2, 11].

If the Megatren can transport at least 200,000 passengers a day, if can break even in its operational costs. If passenger volume is higher than this end and the MRT 2 is able to earn substantially from non-rail income, it could be able to raise the needed revenue to partly pay off the loan it has contracted from foreign official development assistance (ODA) loans. Like MRT-3, MRT-2 can also produce negative externalities such as traffic congestion, noise pollution effects, safety and visual clutter effects for residents who reside too close to a railway station and line, hence, may negatively affect property values [3].

The twentieth century witnessed a dramatic increase in private vehicle ownership such as cars and trucks. Due to this dramatic increase, most in Metro Manila have struggled with traffic and parking congestion problems especially in city centers. Traffic congestion leads to negative effects such as increased travel time for motorists and their passengers, increased levels of pollution (noise and air) and increased tardiness, stress, frustration and to potentially cause road-traffic accidents. In addition, increasing time spent in congested traffic results in exposure to air pollution. However, traffic congestion could be reduced through the improvement of public transportation such as by constructing MRT-2. This is because MRT-2 can provide the quickest means of transport in the most congested travel corridors, convenient and be able to carry up large number of passengers.

In Metro Manila for instance, road-traffic accidents have cost 1-2 per cent of their gross domestic product (GDP) each year [2]. Moreover, most of the road-traffic accidents victims are often young adults whose families rely on their earnings. The Philippine National Police Commission on Road Traffic Injury Prevention as cited by [3] estimated that more than 3000 people were killed and 977 people were injured in road-traffic accidents in 1998. These figures continue to rise with the increasing number of vehicles on the roads. In Metro Manila for instance, 24 per cent of children deaths are caused by road-traffic accidents. The phenomenon of road-traffic accidents could be reduced by constructing MRT-2 as the systems are much safer than cars.

Furthermore, the construction of MRT has potentially played a significant role in stimulating transit-oriented development (TODs). In more developed countries such as the UK and US, their rail transit systems have created compact and mixed-use urban villages around stations [4]. As a result, residents around these areas tend to own fewer cars and drive less than if they were to live in more automobile independent neighborhoods.

This study focuses on the analysis and management of the administration regarding on the status of the on-going operation of Megatren. This includes the purpose and

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development of Megatren system. It also involves the reduction of congested traffic and up grading the trend in terms of ridership.

Researcher concerned for effectivity measures concerning to daily uncontrolled increased of commuters definitely during peak hours.

2. Technological Evolution of Metro Rail Transit 2

The Megatren system was built at a cost of P31 billion in soft loans mainly from the Japan Bank for International Cooperation (JBIC). This is a very concessional loan, with 2 percent interest for three packages, and payable for 30 years with a 10-year grace period.

The Asia Europe MRT Consortium, led by the Marubeni Corporation, has delivered 18 new four (4) car trains. Compared with the previous light rail projects, LRT 2 was more difficult to build because of highly technical problems [5].

Several international companies participated in the project, which consists of four (4) contract packages. Package 1 is the depot in Santolan, Pasig where the 18 trains are stabled, and where the employees, quarters, and offices are based. Package 2 consists of the substructures, mainly the railways foundations including the columns and pilings that support the guide ways. Package 3 forms the superstructure composed of the girders, or beams that support the train rails, the viaduct, and the train stations. Package 4 includes the electro-mechanical systems, the rolling stocks, the track works, including the network of cables and poles that transmit power to the trains [3, 7].

A special method called the pre-casting segmental method (PSM), was used in building the viaduct or the long stretch of suspension bridges resting on the concrete towers. The method is of European technology and is widely used worldwide. In the Philippines, the Megatren Line 2 project pioneered the use of the PSM technology or the pre-casting of the girders into smaller segments so that each span connected between two columns is weighing not more than 58 tons.

The Megatren is the latest of its kind in the world today. It is a fully automatic (*i.e.*, driver-less) system which is at par in terms of facilities and technology with those in other parts of the world.

It is equipped with a CCTV system that enables the railway operator to monitor activities of passengers and employees at the stations and inside the trains. Moreover, the LRT 2 is commuter friendly and has facilities especially designed for the elderly and the differently-abled [8.10]. It has Braille tactiles along the lanes and elevators which enable blind passengers to be guided on their way to the trains. The coaches are also more spacious than those of the earlier systems. These enable passengers with disabilities and those onboard wheelchairs to be able to board and alight from Megatren without any problem. Elevators are installed in the stations also for the use of the elderly and disabled passengers.

Another key feature of the Megatren is its automatic vending machines which enable the passengers to buy their tickets without queuing at the ticket booths. This allows for faster mobility of people and added convenience to commuters [6,9]. Line 2 has a total length of about 13.8 km and when fully operational, will run from Santolan, Pasig City to Recto in Manila. Phase 1 of the line has started operating from its Santolan Station in Pasig, heading in a northwest direction towards Katipunan, and finally, in a southwesterly direction along Aurora Boulevard, to Cubao.

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2.1. History of MRT-2

During the construction of the first line of the Manila Light Rail Transit System in the early 1980s, Electrowatt Engineering Services of Zürich designed a comprehensive plan for metro service in Metro Manila. The plan—still used as the basis for planning new metro lines—consisted of a 150-kilometer (93 mi) network of rapid transit lines spanning all major corridors within 20 years, [1,4] including a line on Epifanio de los Santos Avenue, the region's busiest road corridor.

The MRT-2 (informally LRT-2) project officially began in 1996, twelve years after the opening of the LRT Line 1, with the granting of the soft loans for the line's construction. However, construction barely commenced, with the project stalled as the Philippine government conducted several investigations into alleged irregularities with the project's contract. The consortium of local and foreign companies, led by Marubeni Corporation, formed the Asia-Europe MRT Consortium (AEMC) which won the contract and restarted the project in 2000 after getting cleared from the allegations [7.9].

The AEMC was subsequently given the approval to commence construction by the DOTC and LRTA. The LRTA would have ownership of the system and assume all administrative functions, such as the regulation of fares and operations as well as the responsibility over construction and maintenance of the system and the procurement of spare parts for trains.

Construction started on March 1996 after the LRTA signed the first three packages of the agreement with Sumitomo Corporation delivering Package 1 in which covers the construction of the depot and its facilities, while the Hanjin-Itochu Joint Venture delivered packages 2 and 3 in which covers the substructure and the superstructure plus the stations respectively. The final package which was the package 4 agreement was signed after several delays with Asia-Europe MRT Consortium which was composed of Marubeni Corporation, Balfour Beatty, Toshiba, Daewoo Heavy Industries, and a local company which was D.M. Consuji Incorporated (DMCI) in which includes the communications and fares systems, vehicles, and track works [8.12].

During construction, the LRTA oversaw all the design, construction, equipping, testing, commissioning and technical supervision of the project activities.

On April 5, 2003, the initial section, from Santolan to Araneta Center-Cubao was inaugurated by President Gloria Macapagal-Arroyo, with all remaining stations opening on April 5, 2004 except for Recto which opened on October 29, 2004. However, ridership was initially moderate yet still far below expectations, since the passenger volume in this line is not yet fully achieved.

To address passenger complaints on earlier train lines, the LRTA made sure during the construction phase that the stations are PWD friendly by putting up escalators and elevators for easier access, as well as making passenger fares at par with the other existing lines.

2.2. MRT-2 Stations

As shown in Figure 1, line 2 has a total length of about 13.8 km and run from Santolan, Pasig City to Recto in Manila.

The Line 2 has a total of eleven (11) stations. These are Recto, Legarda, Pureza, V. Mapa, J. Ruiz, Gilmore, Betty Go, Cubao, Anonas, Katipunan and Santolan. Three of these stations are major Terminal / Transfer type stations, namely at Recto (west -end terminal and transfer to Line 1), Cubao (transfer to Line 3) and Santolan (east-end

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terminal) [1, 11]. Ten (10) stations are elevated and one (1) station (Katipunan) is underground.

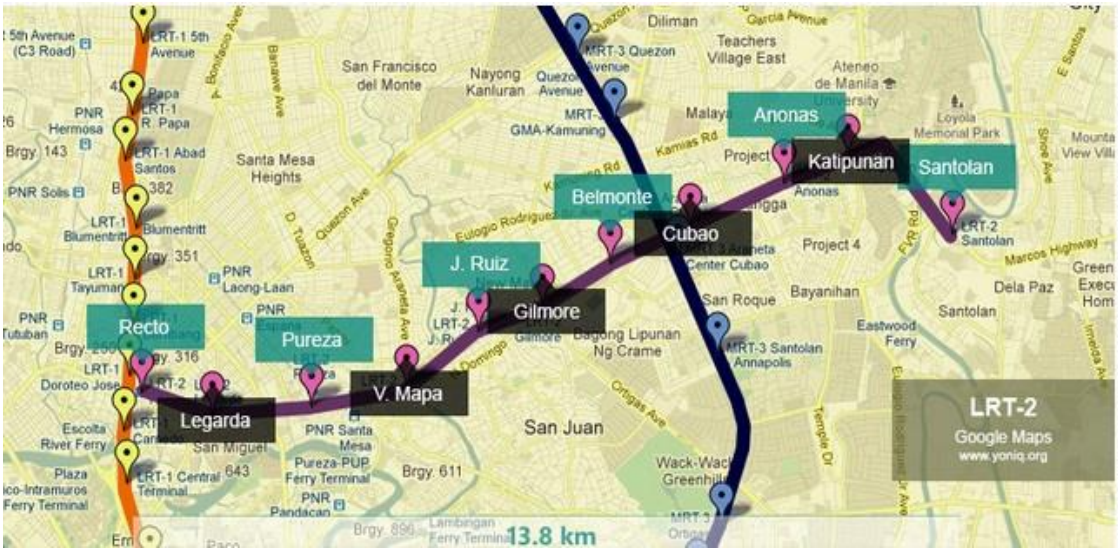

Figure 1. MRT-2 Stations

2.3. MRT-2 Trains

As shown in Figure 2, MRT-2 runs full metro cars-18 four -car trains which have a capacity of 1,628 passengers per train, which is more than the normal capacity of LRT-1 and MRT-3 rolling stocks.

The MRT-2 runs heavy rail vehicles made in South Korea by Hyundai Rotem in a four-car configuration. The trains came in together with the fourth package during the system's construction.

Each train is 92.6 meters long and consists of four motorized cars. Gangways at the short ends of the cars allow passengers to move through the whole train [3, 7]. One train has the capacity of 232 passengers seating in longitudinal bench type fiberglass reinforced plastic and 1,396 standing passengers, *i.e.* total of 1,628 passengers per train set shown in Figure 3.

Figure 2. The Megatren or MRT-2 Trains

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The track gauge is 1,435 mm. The height of the platform from top of rail is 1,100 mm. The car body width is 3.2 m with window, which is 6 mm tinted safety glass double sliding type per car.

The train's maximum speed is 80 km/hr. and travel time between the end terminals at Santolan and Recto will be approximately 25 minutes. Each train has 20 doors per slide to facilitate quick and convenient boarding and alighting. The passenger's seats are positioned along the sidewalls, and there are dedicated seats for the elderly and disabled.

The trains have 2 units of roof mounted air-conditioning system per car. Announcement of the next station will be done automatically over the PA system, which can also transmit music for entertainment in the passenger's compartment. The trains are electrically driven using the solid state propulsion compartment. Braking energy will be regenerated to the over power line, thereby reducing the energy consumption significantly [4, 11 ,13]. A signaling system will ensure full safety during operation. The train will be operated automatically by an ATO system (Automatic Train Operation). A train attendant will supervise each train.

Figure 3. Inside an MRT-2 Train

2.4. Stations Layout and Accessibility

MRT-2 stations have a standard layout, with a concourse level and a platform level shown in Figure 3. The concourse is usually below the platform except for the underground station, with stairs, escalators and elevators leading down to the platform level. The levels are separated by fare gates [5, 10].

The concourse contains ticket booths. Some stations, such as Araneta Center-Cubao, are connected at concourse level to nearby buildings, such as shopping malls, for easier accessibility.

Stations either have island platforms, such as Santolan, or side platforms, such as Gilmore and Recto. Part of the platform at the front of the train is cordoned off for the use of pregnant women, children, elderly and disabled passengers. At side-platform stations passengers need to enter the concourse area to enter the other platforms, while

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passengers can easily switch sides at stations with island platforms. Stations have toilets at the concourse level.

All stations are barrier-free inside and outside the station, and trains have spaces for passengers using wheelchairs.

Figure 3. MRT-2 Platform

Inside the concourse of all stations is at least one stall or stand where people can buy food or drinks. Stalls vary by station, and some have fast food stalls. The number of stalls also varies by station, and stations tend to have a wide variety, especially in stations such as Recto and V. Mapa.

Stations such as Recto and Santolan are connected to or are near shopping malls and/or other large shopping areas, where commuters are offered more shopping varieties.

In cooperation with the Philippine Daily Inquirer, passengers are offered a copy of the Inquirer Libre, a free, tabloid-size, Tagalog version of the Inquirer, which is available from 6 a.m. at all MRT-2 stations [2, 11].

2.5. MRT-2 Depot

The MRT-2 maintains an at-grade depot in Santolan, Pasig City, near Santolan station. It serves as the headquarters for light and heavy maintenance of the MRT-2, as well as the operations of the system in general which includes the operation of the driverless trains. It is connected to the main MRT-2 network by a spur line [2, 12].

The depot is capable of storing multiple electric multiple units, with the option to expand to include more vehicles as demand arises. They are parked on several sets of tracks, which converge onto the spur route and later on to the main network

Figure 4. MRT- 2 Depot

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2.6. MRT-2 Safety and Security

The MRT-2 has always presented itself as a safe system to travel in, which was affirmed in a 2004 World Bank paper prepared by Halcrow describing the overall state of metro rail transit operations in Manila as being good [4].

With an estimated daily ridership of 200,000 passengers, the MRT-2 operates significantly below its designed capacity of between 570,000 and 580,000 passengers per day. Operating under capacity since 2004, [5,8] government officials have admitted that system extensions are overdue, although in the absence of major investment in the system's expansion, MRT-2 management has resorted to experimenting with and/or implementing other solutions to maximize the use of the system, including having bus feeder lines [6].

For safety and security reasons, persons who are visibly intoxicated, insane and/or under the influence of controlled substance, persons carrying flammable materials and/or explosives, persons carrying bulky objects or items over 1.5 metres (5 ft) tall and/or wide, and persons bringing pets and/or other animals are prohibited from entering the MRT-2. Products in tin cans are also prohibited on board the MRT-2, citing the possibility of home-made bombs being concealed inside the cans [7,9].

In response to the Rizal Day bombings and the September 11th attacks, security has been stepped up on board the MRT-2. The Philippine National Police has a special police force on the MRT-2, [8,12,14] and security police provided by private companies can be found in all MRT-2 stations. All MRT-2 stations have a head guard. Some stations may also have a deployed K9 bomb-sniffing dog. The MRT-2 also employs the use of closed-circuit television inside all stations to monitor suspicious activities and to assure safety and security aboard the line. Passengers are also advised to look out for thieves, who can take advantage of the crowding aboard MRT-2 trains. Wanted posters are posted at all MRT-2 stations to help commuters identify known thieves.

3. Research Design and Instrumentation

3.1. Research Design

The study used the interviews, inferential and descriptive methods of research with questionnaires as the main data-gathering instrument. The subjects of the study were passengers of jeepneys and buses, commuters of MRT, MRT staff and government agencies such as the Department of Public and Highways that has been involved in railway transport strategies. The target population had to be within the catchment of MRT station. A reconnaissance survey was first conducted in June 20, 2013, the period when questionnaires and interview schedules were also formulated, units of observation and analysis identified and sampling procedures designed.

3.2. Instrumentation

Direct field observation and recording by the researcher was done by the use of a filed notebook, base map and a camera. To verify all the information provided, the researcher made field observations. Some of the issues that were observed directly include the MRT lines and also the conditions of the existing coaches and engines.

The researcher conducted personal interview of a selected sample respondents using standard structured questionnaires. This gave the researcher the socio-economic background of the study area. Questionnaires also captured that were informative about

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the modes affecting Metro Manila commuter rail system in the Metro Manila, the problems of potential train users in facing the MRT transport system.

4. Findings

4.1. Reasons for Commuting with MRT-2

As shown in Figure 5, it seems that the main reason why the respondents ride in MRT-2 is that the transportation through the line is much faster compare to the public utility vehicles.

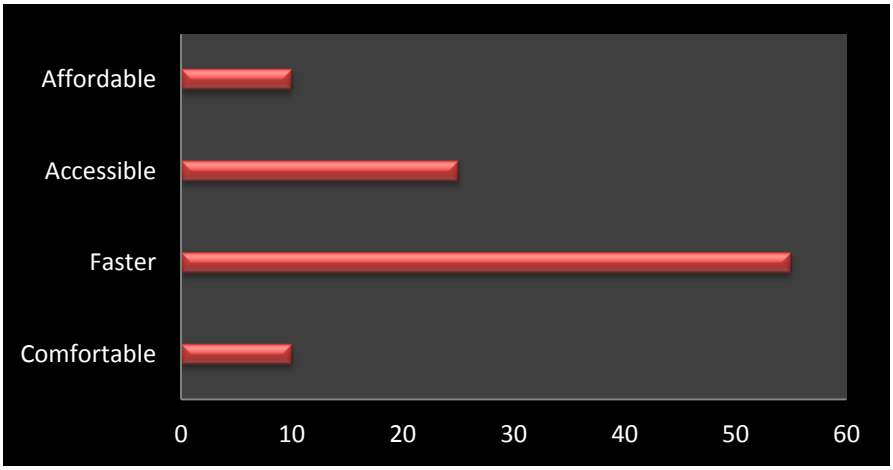

Figure 5. Reasons for Commuting MRT

It consumed less time for the desired destinations such as commuters can avoid traffic jams and obstacles below the ground.

4.2. Feedback in the Construction of MRT-2

As shown in Figure 6, 67% respondents choose "yes" that the construction of MRT-2 reduces traffic congestion. But according to some respondents it is actually does not stop the continuous increasing volume of vehicles in the cities. Traffic depends on the discipline of the drivers. Another factor that affects the flow of vehicles on the ground is that construction of column inserted on highways makes the road narrow where the volume capacity of the vehicles is reduced.

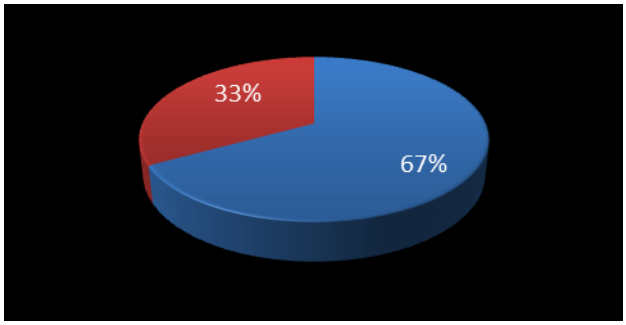

Figure 6. Feedback in the Construction of MRT-2

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4.3. Approval Rating of MRT-2 Facilities and Safety Measure

As shown in Table 1, the MRT-2 capacity and air condition got the highest score with an approval rating of 31.33% and the least score is "extensive use of escalators". Some part of the station does not operate escalators like in Katipunan station which has the lower volume of ridership.

Table 1. Approval Rating of MRT-2 in Category A

Categories A	Grade Total	Percentage (%)	Approval Rating (%)
1. Give enough facilities to meet the demands of riding public.	119/150	79.33	29.33
2. Train capacity and air condition.	122/150	81.33	31.33
3. Extensive use of escalators.	92/150	61.33	11.33
4. Convenience of the fare collection	106/145	73.10	23.10
5. Accessibility of depots and stations for a large number of people.	109/140	77.86	27.86
6. Facilities to accommodate handicapped commuters.	111/140	79.28	28.28

As shown in Table 2, all choices got a passing score of public approval enhanced safety measure inside and outside the train got the highest score of 29.28% and followed by "speed up the processing of fair collections", "give clear verbal and written instructions/directions for every passengers" and the "deployment of security as an action against terrorist and illegal activities" got a 26.29%, 25.86% and 22.41%.

Table 2. Approval Rating of MRT-2 in Category B

Categories B	Grade Total	Percentage (%)	Approval Rating (%)
1. Deployment of securities in action through terrorist and other illegal activities.	105/145	72.41	22.41
2. Give clear verbal and written instruction direction for every passenger.	110/145	75.86	25.86
3. Speed up the process .of the fare collection.	103/135	76.29	26.29
4. Enhance safety measure inside and outside the train.	111/140	79.28	29.28

5. Metro Rail Transit 2 as a Mode of Transport

Reducing travel time is also an important reason for introducing MRT-2 services, although not the main reason in most cases. Before the inauguration of the MRT-2 in Philippines, it took 90 minutes to travel between Recto Avenue and Cubao on the conventional road; it was then reduced to 35 minutes following the inauguration of the MRT-2 and it is 25 minutes since 2012. The ability of the MRT-2 to cut travel time is

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determined by the average speed it achieves, which is affected mainly by the number of stops and the different speed restrictions along the route.

Therefore, MRT-2 have a very high maximum operating speed might still achieve a relatively low average speed and limited travel time savings. Shorter travel times and an increased level of service (a higher frequency and also improved travelling conditions) following the introduction of MRT-2 lead to changes in the modal share on the route and to the generation of new demand.

The modal share the MRT-2 captures depends mainly on the travel time it offers compared with other modes, but also on the cost of travel and travel conditions. Most of the demand shifted to the train mode following the introduction of MRT-2 services is from the bus and, to a lesser extent, from the car.

In summary, by definition all MRT-2 lines fulfil the purposes of increasing the route capacity and reducing travel time. Higher capacity and travel speed lead to changes in the modal share, increasing the share of the train at the expense of the bus, jeepney and the private car and diverting passengers from the conventional mode of transportation to the MRT-2. In addition, the introduction of MRT-2 services also leads to the generation of new demand on the route.

6. Impact of Metro Rail Transit 2

By changing the relative accessibility of places, the MRT-2 creates in effect a different social and economic space.

The shorter travel times offered by MRT-2 services bring closer cities connected to the MRT-2 network and increase their connectivity, the network effect of the MRT-2, which in turn is the driver for the social-economic impacts if these exist. The Megatren has strong development effects in Metro Manila at the cities and station levels. For example, cities served by the MRT-2 achieved higher population and employment growth rates than those without direct MRT-2 services. However, there are other factors prevailing in these cities that can support and affect such an impact and, therefore, it is unclear if the MRT-2 led to the increase in growth rates or if the Megatren was constructed in other cities where higher growth rates already existed: At the cities, Megatren's correlation with population and employment growth rates is clear but it seems that the Megatren has served to shift growth, not induce it and at the station level, development has varied.

In situations where existing stations were expanded to accommodate the MRT-2 services, little or no development around the station occurred, while in new stations development was dependent on other factors and mainly good transportation links to the new station.

Positive spatial and socio-economic impacts might occur at places connected to the MRT-2 network, yet in places bypassed by the MRT-2 (*i.e.*, areas in which the MRT-2s go through without stopping) negative impacts usually occur because high speed infrastructure connects only important cities, but not the space in between them leads to wider socio-economic impacts in addition to its direct impact as a mode of transport.

The evidence is mixed and there seems to be disagreement on whether overall the impacts, if they exist, are positive or negative. Still, the potential for positive economic impacts is an important factor in planning and designing MRT lines (with regard to planning, this is probably justified since it seems that it is better to be a node on MRT-2 network than to be bypassed by it.

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7. Conclusion

The research shows that the MRT-2 system's mission to this latest expansion of the Mass transit network of Metro Manila attract a considerable share of the traveling public who are currently using vehicular transport along the high-volume but slow moving transport corridor, the result would be less traffic congestion on roads, reduction in air pollution, a clean environment, considerable saving in the traveling time, great economic benefits and a higher quality of life for the passenger. The ease and convenience for large number of people to access the station produce commercial, retail, and office development opportunities that contribute to faster urban renewal.

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Dr. Ganiron Jr is a proud member of professional organizations like the Institution of Engineers-Australia and American Society of Civil Engineer. He is also very active in other professional groups like Railway Technical Society of Australasia and Australian Institute of Geoscientists where he became committee of Scientific Research. He has given invited or keynote lectures at a number of international conferences and has received the ASTM Award CA Hogentogler for 2008 in New Zealand and Outstanding Researcher for 2013 in Qassim University.

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