

EVALUATION OF HYBRID ELECTRIC ROAD TRAIN (HERT) AS AN ALTERNATIVE MODE OF TRANSPORTATION IN METRO MANILA

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ABSTRACT

EDSA has been one of the busiest roads in the Philippines and essential component of the spatial structure of the Metro Manila. The decent growth of the areas around the avenue adds a great volume of traffic which cause traffic congestion and at the same time pollution. HERT is a 40 meter long vehicle, powered by an eco-friendly electric generator batteries with a totality of 240 passenger capacity. The purpose of the research is to define components and features of HERT and determine the willingness to pay of commuter's through their own preferences. The results show that most of the commuters in Metro Manila, even with a minimum wage are willing to pay and patronize the system in spite of, the fare price being greater or equal amount of MRT-3's fare price. HERT components and features diminished about half of the pollutant released by regular buses. Thus, HERT has the potential to serve as an alternative mode of mass transportation system not only in Metro Manila but to other major and minor roads in the Philippines.

Keywords: Electric Road Train, Mass Transportation, Willingness to pay, Eco-friendly

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1. INTRODUCTION

Metro Manila is one of the regions in the Philippines suffering from the many problems of excessive street traffic, especially in the road of Epifanio de los Santos Avenue (EDSA). Serious transportation problems as well as traffic problems are being experienced by the commuters every day. In addition, the commuters are also exposed to different types of pollutions particularly noise and air pollution. The growing population, increasing number of vehicles contribute to traffic congestion. On the other hand, environmental pollutions are due to the increasing number of privately owned vehicles and public transport vehicles like busses traversing the road at the same time. These problems bring socio-economic impacts as well as health related problems to the people particularly the commuters. In this aspect, the Department of Science and Technology (DOST) through its Metal Industry Research and Development Center (MIRDC) introduced the HERT as an alternative mode of transportation system.

The main objective of this study is to evaluate and assess the Hybrid Electric Road Train as an alternative mode of transportation system in Metro Manila Specifically along EDSA. It aims to define components and features of the HERT System in terms of traffic and environmental impacts, evaluate HERT System thru commuter's preference, and determine the willingness to pay of the commuters to HERT System.

The research can be utilized by Government Agencies and private entities to know the potentials of this new mass transportation system not only in EDSA but also to other major or minor roads. In addition, the research will develop public awareness on new innovations regarding Filipino-made eco-friendly transport systems which promote health, safety, accessibility and improved mobility.

2. LITERATURE REVIEW

Hybrid Electric Vehicle (HEV) is powered by a combination of a combustion engine and an electric motor. This design potentially achieves almost twice the fuel-mileage compared to conventional vehicles and reducing tailpipe emissions substantially [1]. Williams [2] validated that Hybrid cars produce fewer gas emissions than conventional cars. On average, compact hybrid cars produce 10% fewer smog-producing emissions than their conventional

counterparts. The demand for gasoline especially by light-duty vehicles, continues to increase with economic growth and development. Fossil fuel driven vehicles are not only creating financial strain due to fluctuating gas prices but are also polluting the environment and posing health risks to the community [3]. This exponential increase in fuel cost not only influences the expenditure on transportation, producing financial strain on vehicle owners, but also has a cascading effect on the prices of all other commodities and services, creating economic stress and financial uncertainties especially in the market [4]. Vehicles that run on oil and gas are a heavy burden on the environment, releasing chemicals, pollutants, and other wastes. Automobile manufacturers are using hybrid vehicles to tackle this problem, as they release fewer and cleaner wastes, resulting in smaller pollution levels [5]. Hybrid vehicles are also more fuel-efficient, boasting mileages that are twenty to thirty percent greater than traditional vehicles, thus allowing us conserve more of those resources [6].

3. METHODOLOGY

This study was conducted in order to assess the newest innovation of DOST - MIRDC which is HERT as an alternative mode of mass transportation system along EDSA. The researchers utilized two data gathering techniques. The Survey questionnaires for the commuters and Interview question for the government agency (DOST-MIRDC). The components and features of DOST HERT, commuter's perception and current condition of EDSA were considered in the study. Two categories of respondents were surveyed, the commuters along each train station along EDSA and the people who experienced to riding the HERT. Cluster Random Sampling Technique was used in the sample selection. Additional informations were gathered through conducting interviews and collecting data/ documents from DOST-MIRDC. Data gathered from DOST-MIRDC consists of raw data survey tallies from past demo rides and essential characteristics of Hybrid Train. The total number of respondents is divided into 2 categories, 200 respondents were randomly selected for the commuter's along EDSA and another 200 respondents for the participants who experienced to ride the Hybrid Train. In order to evaluate and analyze the acquired data, Likert-type scale and descriptive statistics were utilized.

3.1 Feature and Components of HERT System

The HERT is one of the new innovations developed as an alternative mass transport system, to help ease traffic congestion in Metro Manila. The road train can serve 650,000 commuters when fully implemented [7]. It is composed of five interconnected fully air-conditioned coaches which can accommodate 240 commuters per ride. It can run at a maximum speed of 60 kph powered by a hybrid engine that runs on diesel fuel and electric battery. It uses wide doors for faster loading and unloading and have designated stops. It utilizes regenerative braking which is an energy recovery mechanism that slows down the vehicle by converting its kinetic energy into a form which can be used immediately or stored in its batteries.



Fig.1. DOST Hybrid Electric Road Train

Based from the study done by Asian Development Bank (ADB), the Road Train Type II, almost reached the passenger capacity of the MRT-3 and 11 times (11X) the ridership capacity of mixed traffic and 2.4 times (2.4X) the ridership capacity of buses. The cost of Road Train application compared to MRT-3 is approximately 12 times (12X) cheaper saving millions of pesos. In addition, the cost for support infrastructure for the Road Train would be around 10% of the cost of fabrication of Road Train sets. The creation of the Road train as a new mass transport industry, including parts and components locally available will help in maximizing the revenue potential of existing major and feeder routes up to ten times. The cost of operation is lower as compared to buses in terms of fuel and labor, as well as the maintenance cost. The capital cost for similar ridership capacity is substantially lower than that of using buses. The hybrid road train must have a dedicated lane and requires minimal support infrastructure.

Basically half reduction in pollution since its emission is also halved because its engine is smaller compared to five regular buses.

3.2 DOST HERT Demo Ride Survey Results

Table 1 shows the results conducted by DOST with 3940 respondents pertaining to the exterior aesthetics, interior aesthetics and for the riding experience in the HERT during the event of National Science and Technology Week held on 24 to 28 of July 2015 at SMX Convention Center, Mall of Asia.

PERCENT RATINGS SUMMARY									
	5	4	3	2	1	Mean	SD	CV	Remarks
Exterior Aesthetics	%	%	%	%	%				
Color	68.0	25.8	5.5	0.6	0.3	4.90	0.644	0.132	Excellent
Design	59.1	30.6	7.7	1.0	0.3	4.49	0.710	0.158	Very Satisfactory
Interior Aesthetics									
Color	64.5	27.2	7.1	0.6	0.4	4.55	0.685	0.151	Excellent
Cleanliness	68.5	24.6	4.9	0.9	0.5	4.61	0.671	0.146	Excellent
Space Optimization	41.6	34.7	17.0	4.3	1.1	4.13	0.926	0.224	Very Satisfactory
Riding Experience									
Safety	62.6	26.9	7.4	1.6	0.7	4.50	0.759	0.169	Excellent
Comfort	51.9	31.2	12.6	2.3	0.8	4.31	0.845	0.196	Very Satisfactory
Temperature	50.3	29.5	14.9	3.1	1.2	4.26	0.911	0.214	Very Satisfactory
Smoothness	50.6	31.4	12.5	2.9	0.9	4.30	0.866	0.201	Very Satisfactory

Table 1. HERT Demo Ride Survey Result

The survey consists of 5 ranges of criticism and 5 being the most appealing from the passengers' perspective. Based on the survey results, for exterior aesthetics, the commuters rated the color as excellent and the exterior design as very satisfactory with a mean of 4.49, standard deviation of 0.710 Hence, the exterior aesthetics of the HERT are attractive and appealing to the commuters.

Interior Aesthetics includes the color, cleanliness, and the space optimization for the passenger ridership. The results show that the color and cleanliness were rated by commuters as excellent. For the space optimization, it needs to determine if the design of the bus has an efficient division of area used for the passenger capacity. The HERT has a 60 person/coach based on the estimation of DOST and it was rated as very satisfactory with the mean of 4.13 and standard deviation of 0.926.

For the riding experience, it includes the safety, comfort, temperature and smoothness. Before riding the HERT, commuters were asked to observe the HERT and then evaluate the HERT after riding. This is to let commuters fully and accurately analyze the simulation of HERT while moving towards specific courses or routes.

The results revealed that most of the commuters rated HERT's safety as excellent. For comfort, it was rated by the commuters as very satisfactory with a mean of 4.31, and standard deviation of 0.845. Thus the respondents are comfortable while riding the road train. The interior temperature of the HERT is evaluated based on the air conditioning system. Most of the commuters rated temperature inside HERT as very satisfactory with a mean of 4.26 and standard deviation of 0.9111. For the smoothness or the flow of travel, this survey analyzes the engine proficiency and improvements along with its durability. Commuters rated the smoothness as very satisfactory even at maximum passenger capacity with a mean of 4.30 and standard deviation of 0.8655. Thus, commuters are very satisfied on HERT in terms of riding experience.

3.3 Perception of Commuters

This survey conducted to know the perception of commuters about the problems they experienced when commuting along EDSA, the modal shift behavior if HERT implemented along EDSA, and willingness to pay to patronize the HERT with 400 respondents.

Based on the result of the survey, the majority of the commuters identified that the three main problems they experienced along EDSA are traffic congestion, air pollution and riding difficulties. Most of the respondents perceived that the trains provide a vital role to mass transportation. The most often used mode of transport along EDSA is the MRT-3. The result complements with the observation that trains provide a vital role along EDSA and as such is the most often used mass transport system and then followed by the buses. Majority of the commuter's along EDSA were aware of the DOST's HERT and it will be considered alternative mode mass transportation in the in Metro Manila.

75% respondents agreed that the transportation problems can be reduced if the HERT System is applied along EDSA. The result shows that the respondents perceived that HERT will help to solve transportation problems along EDSA. 91% of the respondents said that they are willing to patronize the DOST Hybrid Electric Road Train if it is implemented along EDSA. It shows that the commuters are ready to try alternative modes of mass transport that can promote safety, health, convenience and efficient transportation.

Table 2: Willingness to pay of the commuters to HERT

	Commuter's along EDSA	Experience the Road Train
Mean	2.05	2.00
Standard Deviation	0.94	1.09
Coefficient of Variation	0.459	0.5464

64.5% of the respondents who agreed to patronize the HERT system are willing to pay an amount greater than or equal to the fare price of MRT-3. In addition, the average of the sample population agreed that they are willing to pay as indicated by a mean of 2.05 & 2.00 and a standard deviation of 0.94 & 1.09 and a coefficient of variation of 0.459 & 0.546 for commuters along EDSA and those who experienced the road train respectively. Furthermore, the coefficient of variation less than 1 indicates that there is a low variation of answers among the respondents and most of them were agree. The result shows that even though the majority of the respondents receive a minimum wage, they are still willing to pay in order to have an efficient mode of transportation.

4. CONCLUSION

The DOST Hybrid Electric Road Train is locally made and is equipped with diesel-electric engine. It will increase ridership capacity of roads in EDSA and will reduce pollution emission to half as compared to regular buses. Dedicated lanes are also needed for the Hybrid Train system that will increase the ridership capacity of one regular road lane. The cost advantage of the Road Train is also evident compared to other proposed elevated rail-based transport system in Metro Manila with similar passenger capacity.

Based on the survey to respondents that experienced the HERT, the study revealed that the commuters are very satisfactorily satisfied with the HERT System from its aesthetics, safety, comfort and smoothness. The commuters are willing to patronize this new mode of transport when implemented in order to address the three main problems they experience which are traffic congestion, pollution and riding difficulties. In addition, the survey conducted on the commuters along EDSA affirmed with the same result. The commuters perceived that the transportation problems will be reduced when this kind of transport system is implemented.

Based on the results of the study, it is concluded that even though most the commuters along EDSA are receiving minimum wage compensation, the commuters are still willing to pay a fare of greater than or equal to that of the fare price of the MRT-3 for this new mode of transportation.

In general, the study concluded that the DOST Hybrid Electric Road Train has a good potential to serve as alternative mode of mass transportation system in Metro Manila.

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