

ASSESSMENT OF JEEPNEY IN METRO MANILA FOR THE DEVELOPMENT OF SPECIFICATIONS AND STANDARDS

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ABSTRACT

This research established database of manufacturers and their design specification, compared the parts of the jeepney vehicle using Philippine National Standards and international standards, and determined the condition and design of the vehicle based on the perception and preference of jeepney drivers and passengers. The study revealed that most of the jeepney manufacturing firms have varied specifications with regard to the capacity, dimensions and weight of the vehicle and similar specification on the parts and equipment of the vehicle. The parts of jeepney vehicles have similar specifications compared to the 4 out of 5 mandatory PNS and 18 out 26 UNECE Regulations applicable for jeepney vehicle. Most of the jeepney drivers and passengers want to improve, change and standardize the parts of the jeepney. It is concluded that the jeepney vehicle can be standardized in terms of design, safety and environmental concerns.

Key Words: Jeepney, Design, Specifications and Standards

INTRODUCTION

Background

Jeepney is the most popular mode of transportation in the Philippines. In fact, jeepney is one of the symbols of Philippine culture. It evolved from US military jeep to public utility jeepney and it is famous for its colourful decoration and crowded seating. The popularity of this mode

is attributed to the following: (1) local availability – manufacturing technology is locally available and parts such as second-hand engines and imported chassis are readily available; (2) intermediate size or capacity – compatible to most Metro Manila road network and configuration, enabling it to easily move, stop, load and unload passengers as well as penetrate even the smallest interior areas; and (3) accessibility – providing a door-to door service at practically any time and place (Bayan, 1995 and Ebata, et al., 1996).

Other attributes of jeepney is its ability to provide relatively efficient and high levels of service, being able to cultivate stable riding habits due to their extensive network and route choice, high frequency, and seat availability, among others (Iwata, 1995).

Jeepneys, undoubtedly, have remarkably contributed in transporting the Filipino masses from and to any point of the city. In spite of urban pressures brought about by the jeepneys, the passengers remain faithful in riding the king of the road as their carrier wherever they are in the city.

Figure 1 shows the percentage of 1996 transportation demand by mode in Metro Manila. Trips made by public utility jeepney comprise 39 % of the daily person trips. It was estimated by MMUTIS that the share of public transport trips was around 70%.

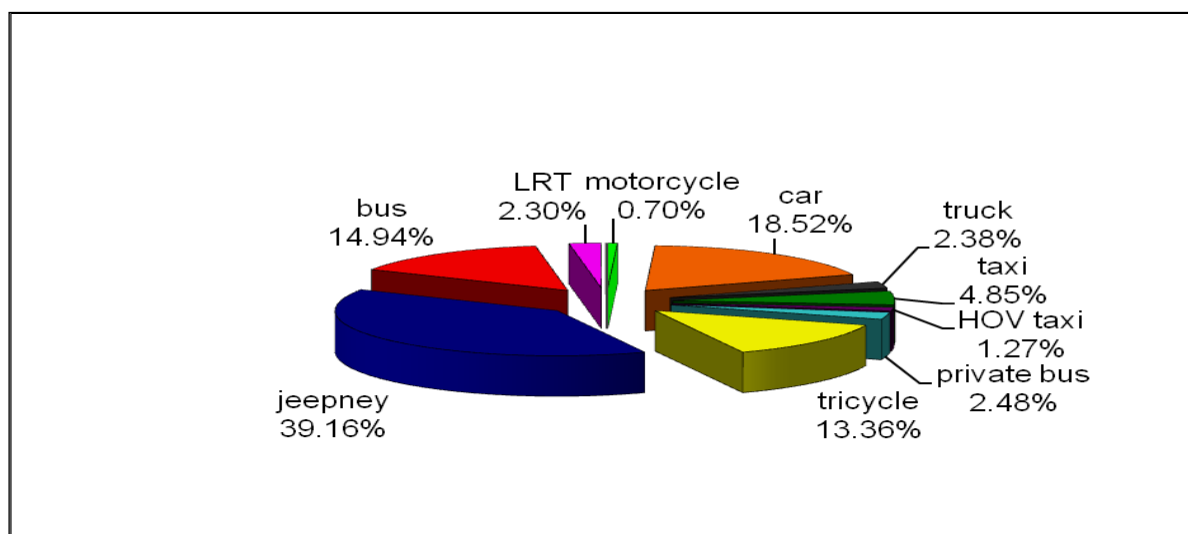


Figure 1 – Transportation demand by mode in Metro Manila, 1996

Table 1 shows the total number of jeepneys in the Metro Manila and nationwide in 2007. Also, it shows the type of fuel used by jeepneys.

Table 1 – Number of Jeepneys and by Fuel Type

Source of Data	Metro Manila	Nationwide
LTO (2007)	54, 868	201, 636
LTFRB (2007)	48, 832	213,707
By Fuel, LTO (2007)		
Gasoline	221	22, 575
Diesel	54, 647	179, 061

Jeepney plays an important role in public transportation system in the Philippines. Indeed, it is a major means of transportation and part of every Filipino day to day life. You can find jeepney in every place or town in the country. It provides low-cost transportation as well as long distance transport services that may carry goods or shipment besides to passengers. Compared to bus, jeepney offers cheaper fare and convenience to passengers to board and alight anywhere they wish for. In comparison with Asian Utility Vehicle (AUV), in addition to lower fare, jeepney has more seating capacity and has longer route. Table 2 shows the comparison of Public Transport Structure in 2006 in Mega Manila area. It shows that jeepney has many routes and operating units compared to Bus and AUV.

Table 2 – Comparison of Public Transport Structure, 2006

Modes	Number of Routes	Number of Operating Units
Jeepney	641	48,366
Bus	104	2,944
Asian Utility Vehicle (AUV)	163	2, 633

Source: Mega Manila Public Transport Study, 2007

Definitely, jeepney will remain as dominant carrier in very metropolis. It cannot easily remove in public transportation system because it provides livelihood to the drivers. Also, there is a strong existence of jeepney associations and cooperatives. There are many jeepney associations and cooperatives which are mostly grouped according to their route and they are registered and recognized by Land Transportation Franchising Regulatory Board and Office of Transport Cooperatives.

Since jeepney has no sets of standard, there many issues concerning the safety, comfort and emission of the vehicle. There are discussion on the establishment of a policy to regulate minimum capacity, size and dimension to lessen variability as well as the establishment of standards on the parts of the jeepney to promote roadworthiness, environment-friendly, comfort and safety to the public.

Statement of the Research Problem

The jeepney has remained uncomfortable with high level of emissions, and severely lacking in safety features. When a new jeepney vehicle is manufactured/ assembled and registered, it follows the Land Transportation Office (LTO) registration guidelines for rebuilt-locally assembled vehicles as well as it follows prescribed emission standards. It is generally classified and chunked into new utility vehicle.

At present, there are no national standards for assembly of customized local road vehicles (CLRv), particularly the jeepney to comply with environment and safety regulations. Because of the lack of such standard, local manufacturers or assemblers produce vehicles using sub-standard materials and backyard manufacturers proliferate whose products might be unsafe for users.

Objectives

This study aims to characterize and evaluate the jeepney vehicle in Metro Manila. Specifically, the study attempts to:

1. Establish database of manufacturers or assemblers and their design specifications in constructing jeepney vehicle;
2. Compare the parts, systems and devices of the jeepney vehicle using Philippine National Standards (PNS) and selected international standards; and,
3. Determine the condition and design of the vehicle based on the perception and preference of jeepney drivers and passengers.

Significance of the Study

This study will generate baseline information that will help government agencies such as Department of Transportation and Communication (DOTC), Land Transportation Office (LTO), Department of Trade and Industry-Bureau of Product Standards (DTI-BPS) in their standardization activities on Customized Local Road Vehicles (CLR.V). Primarily, this study will provide data on jeepney manufacturers' specifications, design preference of jeepney drivers and passengers regarding the vehicle and determine if jeepney vehicle could comply with the mandatory and voluntary PNS standards and international standards particularly the UNECE regulations. The result of the study will be utilized for the development of jeepney specifications and standards.

Scope and Limitations

This study focused on the jeepney, defined under category M2 and M3 (PNS 2060:2007) that are newly manufactured, assemble or rebuilt by the local manufacturing firms in Metro Manila and adjacent provinces. Existing standards such PNS and UNECE will be used for the assessment of vehicle systems/ components and devices. Also, the study is limited on perception and preference of the jeepney drivers and passengers only.

REVIEW OF RELATED LITERATURE

Introduction

Each Asian country has its own unique type of public transport. For example, opelet and bemo in Indonesia, minibas in Malaysia, rot song tao and silor in Thailand and jeepney in the Philippines. The common terms of public transit mode in Southeast Asian Cities similar to jeepney is shown in Table 3.

Table 3 – Common Terms of Public Transit Mode in Southeast Asian Cities

Country	Local Variant	Seating Capacity
Indonesia	Opelet	7-9
	Bemo 4-wheel	4-11
Malaysia	Minibus	16
Thailand	Rot Song Tao	14-50
	Silor	7

Source: Rimmer (1982) *The Role of Paratransit in Southeast Asian Cities*

Example of classification system of paratransit mode in developing countries is shown in Table 4. The motorized paratransit is classified as follows: Individual type (seating capacity < 4), shared type (seating capacity 5-10) and collective type (seating capacity > 11).

Table 4 - Classification System of Paratransit Mode in Developing Countries

Country	Individual	Shared type	Collective type
Bangladesh	Auto R (2-3)	Auto Tempo (6-10)	
India	T Scooter R (2)	Trekker (9)	Tempo (14)
	MCR (4)		
Indonesia	Bajaj (2-3)	Bemo 3-wheel (7)	Opelet large (17)
	Ojek (2)	Bemo 4-wheel (10)	
	Helicak (2)	Opelet (7-9)	
Malaysia		Minibus	Bus mini (16)
Nepal	Meter Tempo (2)	Tempo (6-7)	
Philippines	T (2)		Jeepney (14-18)
Thailand	Samlor (2-3)	Silor (6-8)	Pick up (14)
	Hired MC (1)		

Source: Shimazaki and Rahman (2000) *Operational Characteristics of Paratransit in Developing Countries in Asia*

Jeepneys symbolize the history of the Philippines in the 21st century. They also stand as evidence to Filipino mechanical genius. The “jeepney” is the Filipino version of the “jitney,” the taxi/minibus that travels along a fixed route, found in many countries. They were originally built by modifying leftover army surplus Willys and Ford military jeeps after WWII. The WWII military Willys MB and Ford GPW jeep over the years were rebuilt and modified, again and again, until they finally wore out all the original parts. The original jeepneys were modifications of old military vehicles. However, since the U.S. military run out of surplus jeeps to give away, today’s jeepneys are quite literally manufactured from scratch. Independently owned manufacturing companies within the Philippines now produce modern jeepneys (Bailey, 2003).

Jeepney Profile

In 1981, R. B. Ocampo described how the Philippine jeepney was locally remodelled to have larger capacities from six to fourteen passengers during those days. The report also showed the route characteristics, gross income, operating cost, and net income per driver. Also, Barwell, et al. (1985) provided a detailed description of the jeepneys, its ordinary routine and the average revenue and operating expense based on the interviews with six jeepney operators. On the other hand, D.B. Bautista (1995) identified several components that contributed to the increasing number of serious accidents in the City of Manila as well as the

locations where such transpired. One of his findings was that jeepneys ranked second in terms of proportions of accident by vehicle while trucks and buses ranked first and third, respectively.

Edata, et al. (1996) studied the jeepney supply system and structure in order to address the problems related to the goals of achieving a sustainable and stable jeepney business in Metro Manila in their paper entitled "Jeepney business in Metro Manila: What are the conditions for its sustainability?".

Public Transport Operation

The jeepney had been the predominant mode of public transport in Metro Manila. Based on the Databook on Philippine Transportation prepared by the University of the Philippines, National Center for Transportation Studies, the highest mode share of total person trips per day belongs to jeepneys, estimated at 46% in 1974, 59% in 1980, 56% in 1985 and 50% in 1989. However, the trend is decreasing due to the introduction of the other modes. In 1994, the Jeepney industry accounted for 40% of the total vehicles registered in the National Capital Region (NCR) and there were about 350,000 units plying the major and minor routes in the metropolis (Sevilla-Mendoza, 1994).

The dominance of jeepneys has resulted from generally dispersed travel demand pattern in Metro Manila. According to JICA (1995), other factors leading to dominance of jeepneys include: Abundant low-cost labor that contributes to low operating costs, the self-management system of the industry including the support of jeepney association, the availability of local technology for vehicle supply, fare levels about equal to those for buses whose service level is generally lower than that provided by jeepney.

In 1997, bus and jeepney operator's interview surveys were undertaken as part of the Metro Manila Urban Transportation Integration Study (MMUTIS). One of its main objectives was to establish an updated transportation database system which is intended to contribute to transportation planning, research and education in the Philippines. A total of 49 jeepney operators and 18 jeepney cooperatives participated in the survey. Included in the survey are jeepney operators with a minimum fleet size of 5 units.

Emissions

Jeepney companies usually use second-hand Japanese engines, reconditioned or overhauled and fitted to the newly assembled PUJ body. The common perception is that a jeepney is old, inefficient and notorious smoke belchers and older vehicles burn more fuel, which carries the risk of increasing air pollution due to exhaust gas (Kirby, et al., 1986).

Diesel-fed jeepneys used for public transport contribute to 15% of the particulate matter (PM) emissions and 11% to carbon dioxide (CO₂) emissions in Metro Manila according to the IES Philippines Study by Manila Observatory in 2005.

In 2007, based on the study conducted by UPNCTSFI, only 31 % of the 212 in-use public utility jeepneys tested passed the emission standard set by Department of Environment and Natural Resources (DENR).

Characterization of the Jeepney Vehicle

The Characterization of Jeepney Vehicle in Metro Manila study aimed to define the important aspects of the construction of jeepneys to be able to establish standards in its assembly methods. These aspects include the specifications of the jeepneys used, frame materials and construction methods, and the overall dimension of the jeepneys vehicle. In Metro Manila, jeepney factories were all over the place, making their own standards in the construction of jeepney (Colos, 2005).

Braganza, et al. (2007) conducted study entitled “Comparison of Local Jeepney Specifications and Selected Philippine National Standards for Road Vehicles”. The study aimed to develop basic standards for jeepney vehicles based on safety, materials used in construction and ergonomics. With these standards, jeepney will be able to improve the quality and comfort of jeepney and be more competitive with other means of transportation. Based on the data gathered from the two leading manufacturers, most of the safety regulations practiced by the manufacturers matched up with the Philippine National Standard.

Customized Local Road Vehicles

CLRV is defined as motor vehicles manufactured, assembled or rebuilt using new or remanufactured parts or a combination of both, driven or used upon highways for the purpose of transporting people and/or goods (PNS 2060:2007). The classifications of these vehicles are:

1. Utility Vehicle (UV) – Jeepney, Owner type Jeepney, Local Utility Vehicle (LUV), Filcab, Jumbo Jeepney
2. Motorcycle engine powered vehicle – Motorcycle with carrier, tricycle, Motorela
3. Mini bus

Current Trends of Jeepney

Few years ago, an air-conditioned jeepney was introduced as public utility vehicle in a major city to improve comfort to the passengers. Then, there is a conversion from diesel to LPG jeepney for environmental reasons/ benefits such as reduced smoke emissions, cheaper and cleaner fuel. This initiative was supported by the government to alleviate air pollution caused by jeepneys.

More recently, the e-jeep was launched in Metro Manila. The E-Jeep, dubbed as E-PHUV or the Electric Philippine Utility Vehicle aims to decrease air pollution in the Philippines with its use of electricity as its source of power instead of petroleum. With eight hours of charging, the electric jeepneys can run at a maximum speed of 60 kilometers per hour and travel up to a distance of 120 kilometers. One time charging of the battery costs about US\$3 compared to a full tank of diesel which costs US\$35. For a start, there will be around 50 electric jeepneys that will be going around the central business district. But proponents are optimistic that the project will be able to go to the mainstreams in the next three years. Fifteen (15) other cities have already expressed interest to have their own electric jeepneys. Proponents are now working on building recharging stations that will allow the electric jeepneys to charge up instead of gas up (Ong, 2008).

At this time, there are also initiatives from both government and private sector using clean development mechanism and abatement of air pollution by replacing old engines into new ones.

METHODOLOGY

Sampling Design

Popular jeepney manufacturers either large or small-scale companies in Metro Manila and adjacent provinces were selected as key informants in the jeepney industry survey. The Jeepney Industry Survey covered 12 jeepney manufacturing companies located in Rizal, Las Piñas City, Valenzuela City, Antipolo City, Imus Cavite and San Pablo City, Laguna.

The Jeepney Driver and Passenger Survey covered 220 drivers and 220 passengers in 7 cities in Metro Manila. The respondents were interviewed in jeepney terminals. The selection of jeepney terminals were based on the length of the jeepney's route.

Research Instrument

There are 3 sets of survey questionnaires used in the study. These are the jeepney manufacturing company's questionnaire which is composed of the profile of the company and the technical description of the jeepney vehicle; the jeepney driver survey questionnaire which is composed of the driver's profile, jeepney operation, perception and preference with regards to the existing design of jeepney; and the passenger survey questionnaire which is composed of the passenger's profile, trip characteristics, and perception with respect to the comfort, safety and design of the jeepney vehicle.

Data Gathering Procedure

Surveys from questionnaires and interviews were administered to jeepney manufacturers to determine and establish database of company's profile and technical input or design

specifications in constructing jeepneys. The dimensions of the frame, length, height and width were measured directly from the jeepney sample. Photographs were taken and compiled to determine and show the existing condition of the vehicle.

The drivers and passengers were interviewed about their perception and preferences with the jeepney's configuration, operational requirements and existing design of the jeepney vehicle.

Standards and Regulations Checklist

The 5 Philippine National Standards for road vehicles particularly the mandatory standards such as pneumatic tires, rubber inner tubes, safety glass, seat belt and restraint systems and lead acid starter batteries were used as a checklist in the study.

The international standards specifically the 26 UNECE regulations applicable on jeepney vehicle such as regulations on light and light signalling devices, door, seat, braking system, audible warning devices, noise emission, pneumatic tires, fuel system, speedometer equipment, mirrors and safety glazing materials, steering equipment and seat belt were also used as check list to compare and evaluate the parts of jeepney vehicle.

The UNECE regulations were used in the study because the Philippine government is planning to participate to WP 29 and accession to 1958 agreement with the issuance of Executive Order 628 on June 20, 2007 which created the committee on harmonization of vehicle standards and regulations. The advantage of international harmonization of regulations is that design specifications of vehicles do not have to be changed to meet country-specific regulations. Common specifications of vehicle parts will reduce the cost of development and production and the retail price of vehicles. It will also make approving procedures easier, make the market larger, and give the consumers a wider range of choice. Also, it gives a set of evaluation regulations to measure safety and environmental performance.

JEEPNEY INDUSTRY, DRIVER AND PASSENGER SURVEY RESULTS

Profile of Jeepney Manufacturing Companies

In terms of years of operation, 5 companies are 30 years and above, 4 companies are 15 years and above and 3 companies are less than 15 years in existence and service. In terms of production, most companies produce 2 jeepney units per month.

Table 5 shows the different jeepney models and their capacity. The 18 jeepney models have 20, 22, 24 and 26 passenger capacities excluding driver.

Table 5 - Jeepney Model and Capacity

Company	Jeepney Model	Capacity
Morales Motors Corporation	Morales Jeepney	24
LCS Motors Corporation	LGS Jeepney, SANLOR Jeepney	26,26
Benemar Motors	Marinel Jeepney, Egg type	22
Melford Credit Facilities and lending	Melford type, Egg type	22
Tolentino Motors Corporation	Tolentino Jeepney	22
David Motors & Marketing Corporation	Jumbo jeepney, Semi-deluxe jeepney, Deluxe jeepney	26,22
Rizaleño Motors	Melford type, Egg type	24
Hayag Motorwork and Machine Shop	Malagueña Jeepney	20
Milwaukee Motorworks	Milwaukee Jeepney	22
Geordan Commercial	GC Jeepney	24
FG Motors	FG Jeepney	22
Armak Motors	Armak Jeepney	22

The photos shown below are jeepney models from 12 jeepney manufacturing firms.

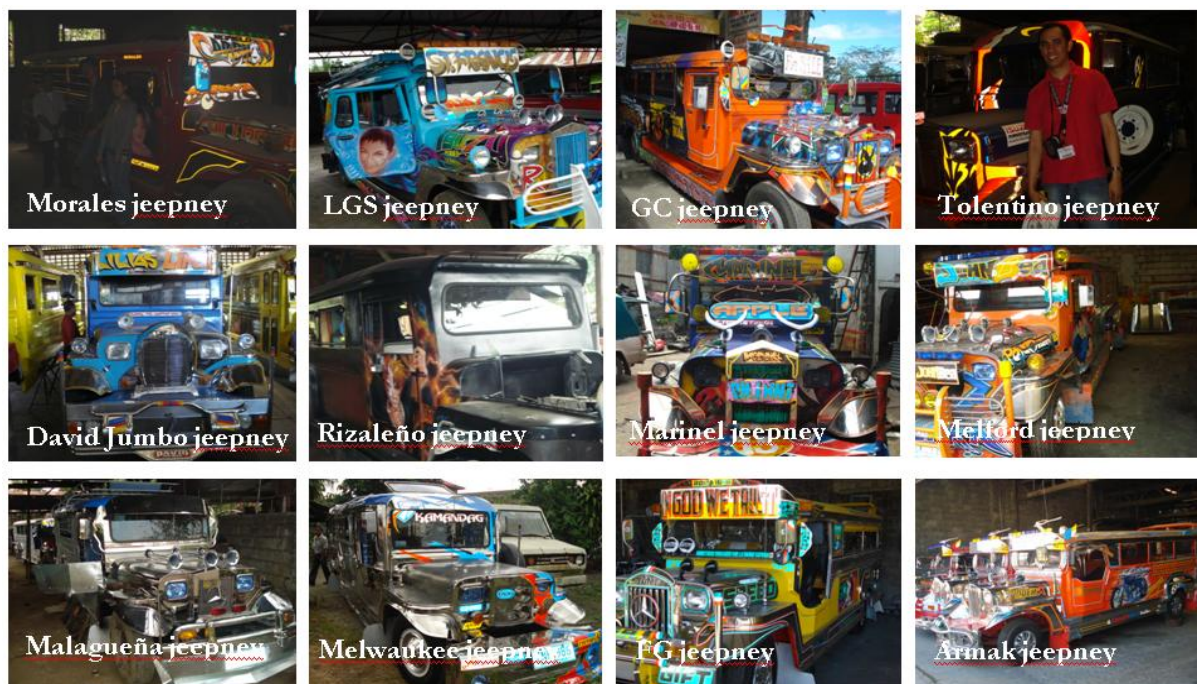


Figure 2 – Jeepney Models

The company practices with regard to mode of payment for sales are usually on cash and instalment basis. The usual number of terms is 1 to 5 years. The retail price ranges from PhP 400,000.00 to PhP 745,000.00 (US\$ 8,696.00 to US\$ 16,196.00) for conventional jeepney and PhP 980,000.00 to PhP 1, 500,000.00 (US\$ 21,304.00 to US\$ 32,609.00) for jumbo jeepney. Pick up is the most mode of turnover to the customers. The amenities provided are third party liability, registration assistance, and free accessories such as jack, tire wrench, lights, stereo, speaker and spare tire. The share of raw materials of jeepneys is estimated from 50 to 80 % brand new and 20 to 50 % surplus. Most clients of the jeepney companies

are Overseas Filipino workers, private individuals, local residents, and walk-in clients from Bulacan, Manila, Pangasinan, Visayas and other provinces.

Jeepney Industries' Specifications and Comparison with Local Standards and International Regulations

Jeepney Dimensions and Weight

The conventional and jumbo jeepneys comply with the Land Transportation Office (LTO) regulations pertaining to the overall length, overall width, overall height and gross vehicle weight. Also, the conventional and jumbo jeepneys conform to maximum mass prescribed in the PNS 1891:2006.

Figure 3 shows the total length, total width and total height of conventional jeepney.

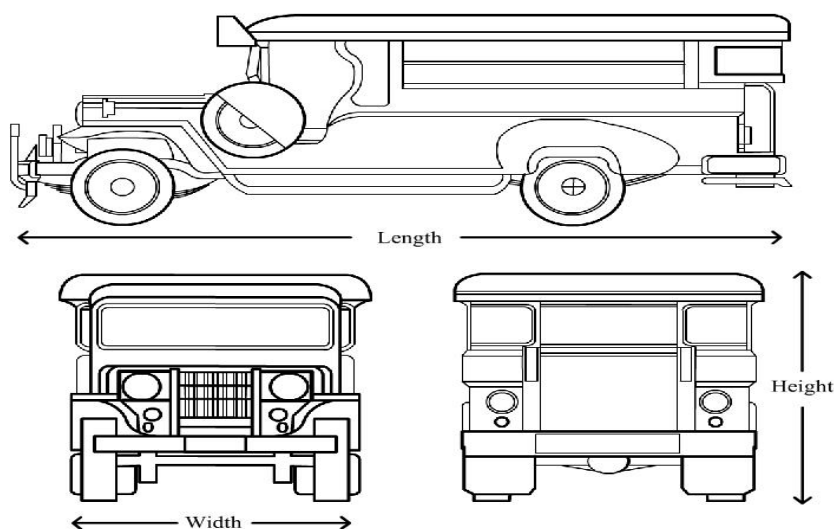


Figure 3 - Jeepney's Length, Width and Height

Table 6 – Jeepney (M2 & M3) Capacity, Dimension and Weight

Category	M2						M3	
	26		24		22		20	26
Statistics	Mean	SD	Mean	SD	Mean	SD		
Overall Length (mm)	7103	167	6895	99	6737	211	6,380	7,860
Overall Height (mm)	2313	237	2030	63	2079	152	2,110	2,550
Overall Width (mm)	1753	46	1890	58	1776	86	1,680	2,010
Gross Vehicle Weight (kg)	3800	0	3750	635	3461	344	3,200	

Table 7 – LTO Regulations and PNS on Dimensions and Weight

	Overall Length (mm)	Overall Height (mm)	Overall Width (mm)	Maximum Weight (kg)
LTO Regulations	11, 000	4,000	2, 500	3, 600 for most heavily loaded wheel 8, 000 for most heavily loaded axel
PNS 1891:2006				M2 - not exceeding 5, 000kg M3- exceeding 5, 000kg

Jeepney's Body

Most of the jeepney body panels are made up of galvanized iron, stainless steel and aluminum. It is more expensive if the body is made up of more stainless steel. Most of the materials used in the construction are sourced and manufactured locally.

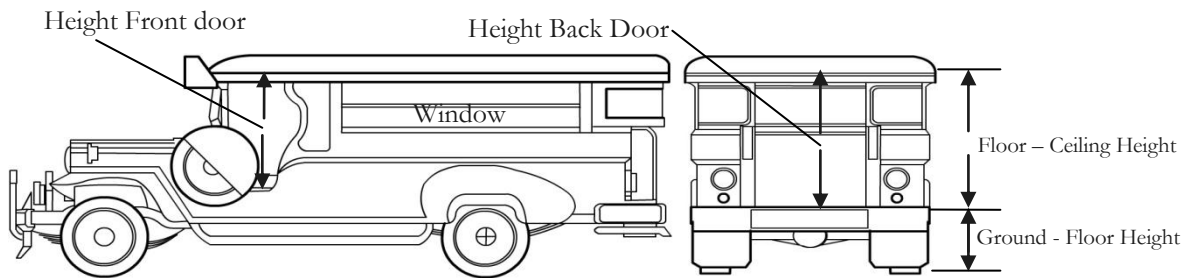


Figure 4 - Jeepney's Floor - Ceiling Height, Ground – Floor Height, Service Door and Window

Based on the jeepney drivers and passengers' survey results, most of the height of jeepney drivers and passengers are 1,524 mm – 1,651 mm. This indicates that the height of the service door of conventional jeepneys is much lower than the height of the drivers and passengers while jumbo jeepney door's height is higher than the height of the drivers and passengers. This means that the height of entrance and exit of conventional jeepney is not sufficient for the drivers and passengers.

Table 8 – Jeepney's Service Door, Floor - Ceiling Height, Ground – Floor Height and window

Category	M2						M3		
	26		24		22		20	26	
Statistics	Mean	SD	Mean	SD	Mean	SD			
Floor - Ceiling Height (mm)	1220	17	1203	25	1252	58	1,190	1,730	
Ground – Floor Height (mm)	1093	254	828	72	827	142	920	820	
Front Door (mm)	H	980	52	993	85	974	43	1120	1,840
	W	800	0	798	5	742	58	833	880
Back Door (mm)	H	1120	191	1150	131	1138	42	980	1,160
	W	833	12	810	12	792	14	800	810
Window (mm)	L	2993	514	2871	157	2552	345	2993	3,840
	H	427	23	353	26	359	58	427	530

It shows in Figure 5 the passengers' difficulty in getting in and out of the jeepney vehicle. This shows that the height and width of the service door of the conventional jeepney are not adequate for the passengers.

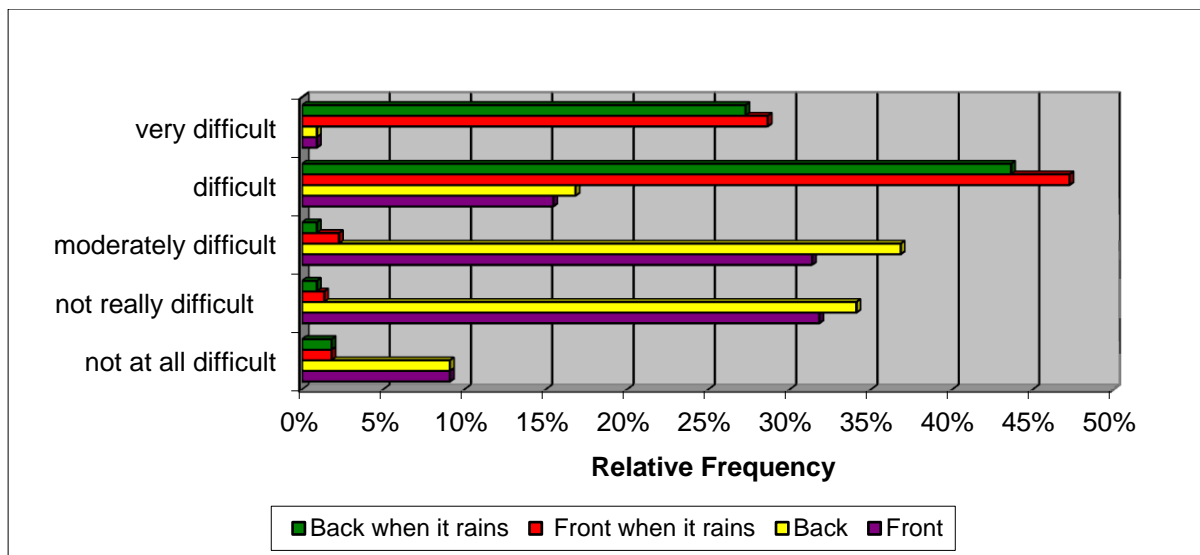


Figure 5 - Passengers Difficulty in Getting In and Out of the Jeepney

Jeepney's Seating Configuration and Specification

The seating configuration of the conventional jeepney is similar to passenger car in the front and bench type at the back while the jumbo jeepney is bus type at front and at the back. The frame of materials is made of steel and padding materials are made of foam and leatherette with complete upholstery.

Based on LTO regulations on seat space, 8 out of 18 jeepney models passed the seat space regulations including the jumbo jeepney.

Table 9 - LTO Regulations on Seat Space and Back Seat to Knee Proportion

	Seat Space (mm)	Back seat to knee proportion of passenger: (horizontal distance, mm)
LTO Regulations	350	60

Source: LTO (1997) Manual of Operation for Motor Vehicle Registration

Table 10 shows the results of anthropometric dimensions of jeepney drivers and passengers. If a hip breadth of 357 mm will be considered as a seat space, only 5 out of 18 jeepney models including jumbo jeepney passed the seat space requirement. The same results if a hip breadth of Filipino conducted by Vergara and Matias will be considered which shown in Table 11.

Table 10 – Anthropometric Dimensions of Jeepney Drivers and Passengers

Body Component	Jeepney Driver, Age 21-63 (Median)	Jeepney Passenger, age 14-80 (Median)	
		Male	Female
Shoulder Length (mm)	483	457	432
Hip Breadth (mm)	381	357	330
Torso length (mm)	533	508	483
Arm Length (mm)	559	584	533

Table 11 – Anthropometric Dimensions of Filipino

Body Component	Filipino, age 14-80 (Median)	
	Male	Female
Maximum body Breath	452	423
Hip Breadth	353	357
Elbow - Elbow Breadth	443	416
Popliteal Height	406	366
Buttock –Popliteal Length	477	454

Source: Vergara and Matias (2003) Anthropometric Data of Selected Filipinos in Metro Manila for Residential Seat Design: Pilot Study.

Table 12 shows the dimension of seat and backrest of jumbo and conventional jeepneys as well as jeepney’s seat height from the floor, back seat- front length, back seat – back seat length.

Table 12 – Jeepney’s Seat and Backrest

Category			M2						M3	
Total passenger			26		24		22		20	26
Statistics			Mean	SD	Mean	SD	Mean	SD		
Seat (mm)	Front	W	530	17	380	16	448	56	410	540
		L	693	115	523	143	581	88	780	890
	Rear	W	373	23	380	28	361	34	370	380
		L	3893	184	3813	113	3528	275	3,040	700
Backrest (mm)	Front	L	693	115	523	144	581	88	780	890
		H	700	0	520	0	647	172	620	610
	Rear	L	3893	185	3813	113	3528	275	3,040	700
		H	260	0	260	0	289	56	270	620
Seat Height from the Floor (mm)	Front		333	46	305	85	303	86	320	220
	Rear		343	23	325	44	351	49	360	280
Back Seat- Front Length (mm)			757	40	710	60	725	61	680	
Back Seat – Back Seat Length (mm)			1587	12	1575	79	1536	72	1450	780

Figure 6 shows the conventional jeepney's seating configurations as well as the length, width and legroom. The anthropometric configuration of a passenger is shown in Figure 7.

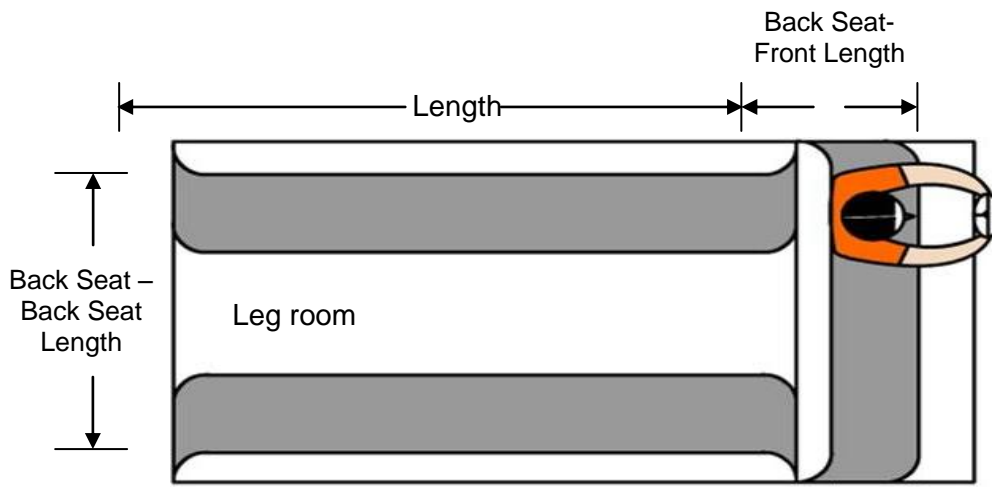


Figure 6 - Conventional Jeepney's Seating Configuration

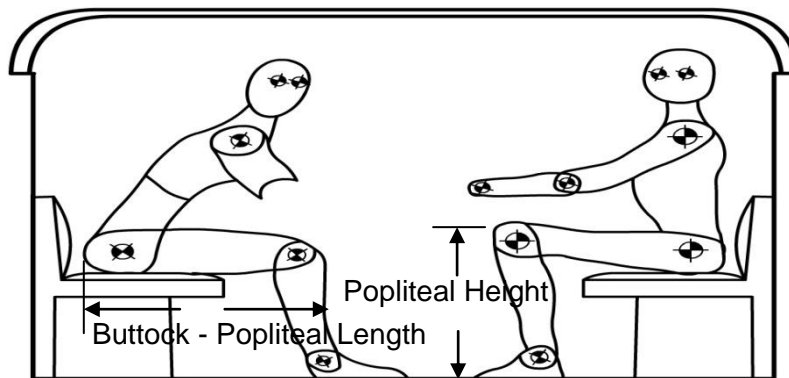


Figure 7 - Anthropometric Configuration

The heights of the seat from the floor either front or rear of all the jeepney models are lower to the popliteal height or the knee height of average Filipino which is 406 mm. For the back seat- front length and back seat – back seat length, all the jeepney models passed considering the buttock – popliteal length of 477 mm. On LTO's back seat to knee proportion of passenger requirement of 600 mm, all jeepney samples comply with the back seat- front length and all failed on the back seat – back seat length except the jumbo jeepney considering the horizontal distance and legroom of the passengers.

Figure 8 shows some photos of doors and seats of conventional and jumbo jeepneys.



Figure 8 – Jeepney's Service Door and Seat

For the door latches and door retention components regulations (UNECE 11), jumbo and conventional jeepney's specifications are similar with regards to the design, construction and fittings of the door latches and retention components requirements. On the seat, anchorages and head restraints regulations (UNECE 17), jumbo and conventional jeepney have similar specifications pertaining to the requirements of the construction and position of the seat and head restraints but are not similar with other requirements particularly on the height and width of head restraint.

Jeepney's Steering, Fuel and Electrical System

For the steering equipment (UNECE 79), both jumbo and conventional jeepneys have similar specifications with regards to the requirement pertaining to the steering system, steering control, design and energy supply of steering equipment.

For the prevention of fire risk (UNECE 34), the specifications of jumbo and conventional jeepneys are similar with the requirements for the fuel tanks and its location, filler hole, and tank cap requirements.

On the lead acid starter batteries (PNS 06: 2002), the jumbo and conventional jeepney have similar specifications particularly on the size and dimension of the batteries.

Jeepney's Braking System

For braking (UNECE 13), the specifications of jumbo and conventional jeepneys are similar with the requirements on the design, brake linings, service braking system, parking braking system, control and power supply pertaining to the braking system as well as on the replacement brake lining assemblies and drum – brake linings (UNECE 90).

Jeepney's Wheels and Tires

Photos of wheels and tires of jeepneys are shown below.



Figure 9 - Jeepney's Wheels and Tires

For the rubber inner tubes pneumatic tires - specifications (PNS 34: 2006), most of the specifications of jumbo and conventional jeepney are similar to the requirements of the standards particularly on the type, dimension, appearance and serviceability. The jumbo and conventional jeepneys have similar specifications with regards to the requirement of the

pneumatic tires - specifications particularly on dimension and markings (PNS 25: 1994). Also, the tires of jumbo and conventional jeepneys have similar specifications with respect to the sizes, dimensions and tire sidewall markings of the regulation concerning pneumatic tires (UNECE 30).

Jeepney's Light and Light - Signaling Devices

Several photos of light and light - signaling devices of conventional and jumbo jeepneys are shown in Figure 10.



Figure 10 - Jeepney's Light and Light Signaling Devices

For the regulations concerning retro-reflecting devices (UNECE 3) and head lamp cleaner (UNECE 45), both jumbo and conventional jeepneys do not have retro-reflecting device as well as headlamp cleaner. On the devices for the illumination of rear registration plates (UNECE 4), the specifications of jumbo and conventional jeepneys are similar to the construction and design of light module. The specifications are also similar with regard to the regulation concerning the direction indicators (UNECE 6); front and rear lamps, stop lamps and end-outer line marker lamps (UNECE 7); front fog lamps (UNECE 19); reversing lamps (UNECE 23); rear fog lamps (UNECE 38); parking lamps (UNECE 77); and side marker lamps (UNECE 91). For the regulation concerning the filament lamps for in-use approved lamp units (UNECE 37), jumbo and conventional jeepney's specifications are similar to the design, bulbs and caps standards. For the regulation pertaining to the vehicles with regard to the installation of light and light signaling devices (UNECE 48), the specifications of jumbo and conventional jeepneys are similar with the requirement pertaining to the installation and fitting of lamps, visibility and colors emitted by the lamps.

Jeepney's Safety, Exterior and Convenience Items

With regard to safety, exterior and convenience items, both conventional and jumbo jeepneys have the following items: driver's seat belt, passenger grab rail, front and rear step board and mirrors. Also, they have front bumper, front grille/bumper guard, front and rear grab rail and plastic window cover.

On the safety glass for road vehicles- specifications (PNS 130: 2004), the dimensions, shapes and type of glass and windscreen of jumbo and conventional jeepneys differ from the general specifications of safety glass standards.

For the approval of safety glazing materials and their installation (UNECE 43), the jumbo jeepney glazing materials and windscreen have similar specification with the regulation pertaining to the resistance to incidents while conventional jeepney's specifications are not similar with the regulations particularly on its transparency. On the devices concerning indirect vision (UNECE 46), the mirrors of jumbo and conventional jeepney are adjustable and have protective housing similar to the regulation but most of the specifications are not similar with the general requirements of the regulations.

For the road vehicles – safety belts and restraint systems (PNS 1892: 2000 and UNECE 16), jumbo and conventional jeepneys have similar configuration with respect to the installation, type of seat belt, rigid parts of seat belt, buckles, adjusting device and strap of seat belts of this regulation. The seat belt provided in the jeepney is on the driver's seat only. On the safety belt anchorages (UNECE 14), the jumbo and conventional jeepneys do not have similar specifications particularly on the minimum number of belt anchorages, location of belt anchorages and dimensions of threaded anchorage holes.

For the regulation pertaining to the speedometer equipment including its installation (UNECE 39), the jumbo and conventional jeepney's configurations are similar with the regulation particularly on the location and graduation of the speedometer equipment.

Jeepney's Chassis

For the chassis of jeepney, chassis material is made up of black iron. Nine jeepney companies out-sourced their chassis while three companies have in-house fabrication based on the survey of jeepney manufacturing firms.

Jeepney's Engine

Engine photos from sample new manufactured/ assembled jeepneys are shown in Figure 11.

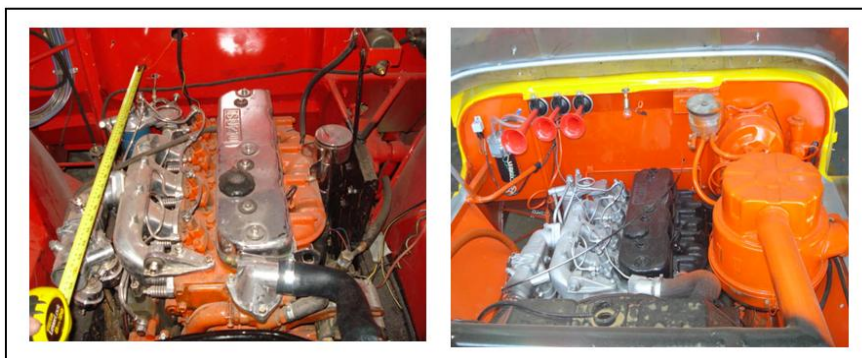


Figure 11 – Jeepney's Engine

Most of the jeepney companies use 4BC2 surplus or reconditioned/ overhauled second-hand Japanese engine which cost more or less PhP 150,000.00 (US\$ 3,260.00) and only 2 company use brand new Isuzu engine 4JB1 which cost PhP 280,000.00 (US\$ 6,087.00) and brand new Isuzu engine 4HF1 with transmission which cost PhP 386,000.00 (US\$ 8,391.00).

Based on the interview with Isuzu Philippines personnel, brand new 4JB1 and 4HF1 Isuzu engines are compliant with the Euro 1 and Euro 2 emission standards if turbocharger will be installed in the engine while surplus or reconditioned/ overhauled second-hand Japanese engine which most of the jeepney companies are using cannot comply with the emission standards set by Philippine Clean Air Act.

For jeepney's engine, only 4 out 18 jeepneys including jumbo jeepneys are compliant with the Euro 1 emission standard set by DENR and Euro 2 emission standard if turbocharger will be installed in the engine.

Turbo Charger costs PhP 70,000.00 (US\$ 1,522.00) and the difference in cost between 4BC2 surplus or reconditioned/ overhauled second-hand engine and brand new 4JB1 with turbo charger to meet Euro 2 emission standard is PhP 200,000.00 (US\$ 4,348.00).

Audible Warning Devices

For audible warning device (UNECE 28), the jumbo jeepney has similar specifications to the continuous and uniform sound regulations while the specifications of the conventional jeepney are not similar with this regulation. On the regulation for noise emissions (UNECE 51), both jumbo and conventional jeepneys do not have proper noise reduction system.

Jeepney Drivers and Passenger's Perception and Preference on the Jeepney Vehicle

More than 50% of drivers responded that they are comfortable with the seat, access, gauges and ride quality of the existing jeepney vehicle while most of the passengers (55%) perceived that the seating space designed by the manufacturer is not enough for them. With regard to the standing provision, 84% of the passengers do not want that jeepney has provisions for standing and 56% of the passengers want that jeepneys should have uniform sound of horn.

In relation to the alighting practices, when the passenger is getting off, 75% of the drivers and 85% of passengers preferred shout and 93% of the drivers are comfortable with the existing fare collection method. For the parts of jeepney to be improved or changed, significant percentages of responses of the jeepney drivers and passengers are with regards to the seat, width and length of the vehicle.

Most of the passengers perceived that driver behavior ranks number 1 as the most serious problem in jeepney. Second is the air pollution, third is vehicle construction and fourth is noise pollution as shown in Figure 12.

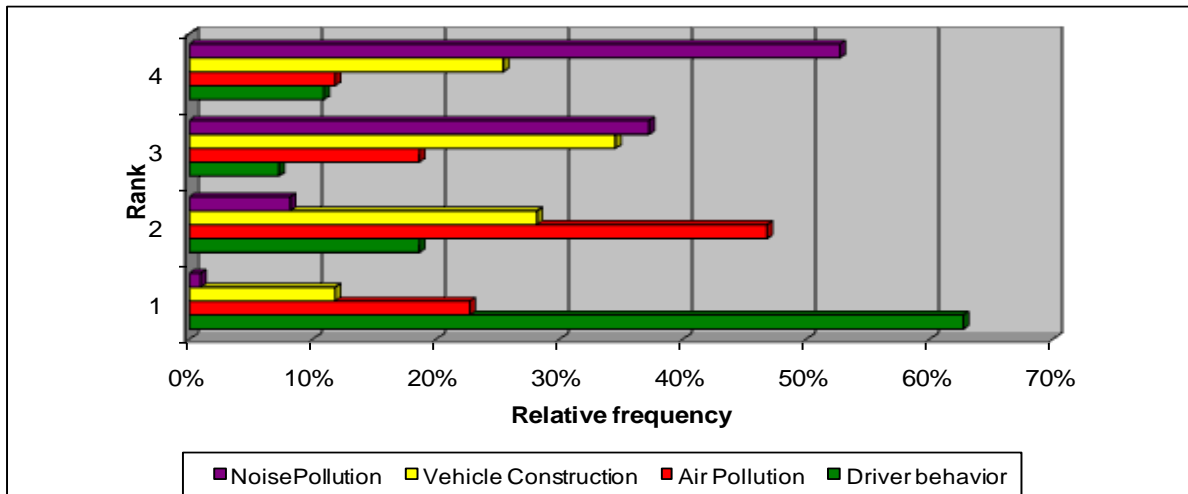


Figure 12 – Most Serious Problems of Jeepney

For willingness - to - pay for the adoption of clean technology, 63 % of the passengers are not willing to pay any single amount and 35 % of the passengers are willing to pay for 50 centavos and 1. 4 % are willing to pay for 1 peso.

With respect to the issue of standardization of jeepney, 75% of the drivers and 58 % of the passengers agree that the jeepney should be standardized as shown in Figure 13.

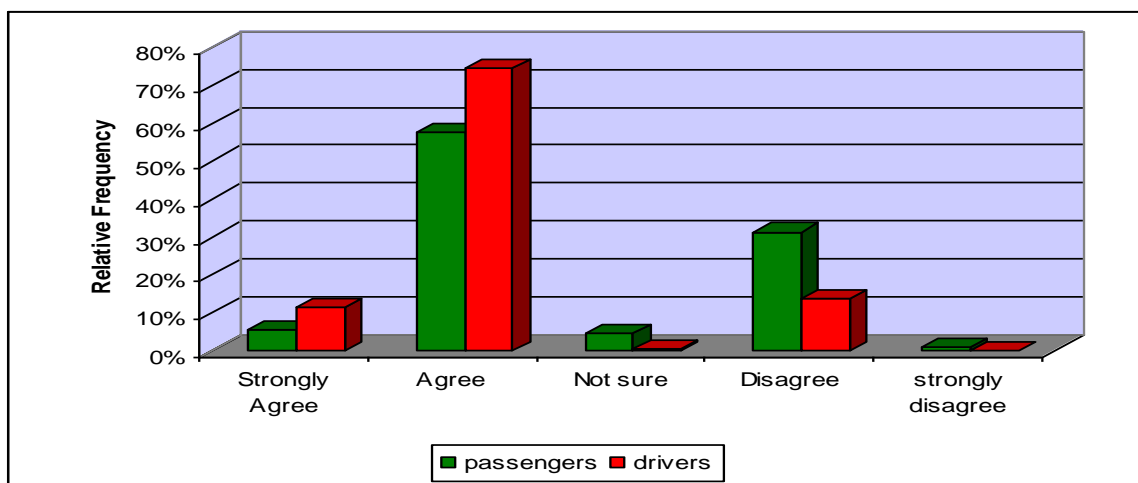


Figure 13 – Standardization of Jeepney

Adoption of Vehicle Standards

Standards on new vehicles specifically for jeepney entail an additional cost for manufacturer or result to a higher vehicle cost to meet the comfort/ safety design and emission standards. It is estimated in this study that conventional jeepney will cost PhP 745,000.00 (US\$ 16,196.00) and PhP 1, 500,000.00 (US\$ 32,609.00) for jumbo jeepney to meet the vehicle standard requirements. Certainly, the standardization of jeepney will result to higher vehicle cost but it will ensure an environment-friendly and roadworthy vehicle as well as comfort and safety to the general public.

CONCLUSIONS

Jeepney Manufacturing Firms

At present, most of the jeepney manufacturing firms have an average production of 2 units per month. Jeepney companies have varied specifications with regard to the capacity, dimensions, weight, body area, and seat and fuel system of jeepney vehicle. On the engine, steering system, electrical system, braking system and audible warning devices, most of the firms have similar specifications. Also, most of the companies have the same specification with respect to the wheels and tires, light and light - signalling devices, safety, exterior and convenience items and chassis. 10 out of 12 companies surveyed use surplus or reconditioned second-hand engine for their jeepneys and most of the parts and accessories are sourced and manufactured locally.

Anthropometric Dimensions and Perception of Jeepney Drivers and Passengers

Based on the height of jeepney drivers and passengers, the heights of service door of the jeepneys are not adequate for entrance and exit. Based on the anthropometric dimensions of jeepney passengers, only 5 out of 18 jeepney models passed with respect to the seat space requirement.

Most jeepney drivers are comfortable with regard to seat, access, gauges, ride quality and alighting practices but they wish to improve some parts of the jeepney particularly the width and length. Moreover, majority of the drivers agree with the standardization of the jeepney.

From the passengers' perspective, the jeepney is uncomfortable due to insufficient seating space and difficulty in getting in and out of the vehicle. They perceived that most serious problems of jeepney vehicle are driver behaviour, air pollution, vehicle construction and noise pollution. In addition, majority of the passengers are not willing to pay for the adoption of clean technology yet they wish to improve and standardize the jeepney vehicle.

Comparison of Design Specifications with LTO Regulations, DENR Standards, PNS and UNECE Regulations

The jeepneys complied with the LTO regulations pertaining to the dimensions and gross vehicle weight. Also, the conventional and jumbo jeepneys conform to maximum mass prescribed in the PNS 1891:2006. On the LTO seat space requirement, 8 out 18 jeepney models complied with the regulation. And on backseat to knee proportion requirements, all jeepney models passed on the back seat – front length at the front seat but all jeepney models failed on the backseat-backseat length.

On the DENR emission standards, brand new engines such 4JBI and 4HF1 complied with the Euro 1 emission standard and Euro 2 if turbocharger will be installed in the engine. 4BC2

surplus or reconditioned/ overhauled second-hand Japanese engine cannot comply with the emission standards set by Philippine Clean Air Act.

The components of jeepney vehicles have similar specifications compared to the 4 mandatory PNS particularly on the pneumatic tires and rubber inner tubes, batteries, and safety belt and restraint system. However, the safety belt of jeepney is provided at the driver's seat only. On the safety glass specifications, the jeepney specifications are not similar with respect to this standard.

For the UNECE regulations, some of the specifications of jeepney vehicle have similar specifications with respect to the 18 out of 26 UNECE regulations applicable to the jeepney. These are regulations on the light and light - signalling devices, door latches, braking system, pneumatic tires, fuel system, steering equipment, prevention of fire risks, speedometer equipment and seat belt.

Finally, based on the jeepney manufacturing firms' specifications, comparison of specifications with PNS and UNECE regulations and perception and preference of jeepney drivers and passengers, the jeepney vehicle can be standardized in terms of design, safety and environmental concerns.

RECOMMENDATIONS

1. Based on the jeepney industry and jeepney drivers and passengers' survey, the recommended dimensions for conventional jeepneys are shown in Table 13.

Table 13 – Recommended Dimensions for Conventional Jeepneys

Total Passenger			26	24	22
Overall Length (mm)			7, 150	6, 900	6, 750
Overall Height (mm)			2, 350	2, 100	2, 100
Overall Width (mm)			1, 850	1, 850	1, 850
Gross Vehicle Weight (kg)			3, 600	3, 400	3, 200
Floor - Ceiling Height (mm)			1,550	1,550	1, 550
Ground – Floor Height (mm)			850	850	850
Front Door (mm)		W (mm)	850	850	850
		H (mm)	1, 000	1, 000	1, 000
Back Door (mm)		W (mm)	850	850	850
		H (mm)	1, 350	1, 350	1, 350
Seat	Front]	W (mm)	400	400	400
		L (mm)	720	720	720
	Rear	W (mm)	400	400	400
		L (mm)	4, 320	3, 960	3, 600
Seat Height from the Floor		Front (mm)	410	410	410
		Rear (mm)	410	410	410
Seat Space			360	360	360
Back Seat- Front Length (mm)			650	650	650
Back Seat – Back Seat Length (mm)			1, 650	1, 650	1, 650

2. It is recommended that the components, systems and devices of the conventional jeepney should conform to the minimum requirements of Philippine National Standards and DENR emission standard.
3. Further awareness of the Philippine National Standards and international standards such as UNECE regulations for jeepney manufacturing companies and its stakeholders is greatly recommended in order to improve and ensure road worthiness and compliance with the emission standards. In addition, it is suggested to review existing PNS and LTO regulations for the formulation of standards appropriate for jeepneys.
4. It is recommended to explore more research on types of jeepney vehicle particularly those used in rural areas.
5. It is also suggested to undertake interviews on passengers of other modes of transport like bus or MRT to determine their perception and preferences on the jeepney vehicle.
6. Actual test/ laboratory tests of parts and equipments of the jeepney vehicle are suggested to determine if they meet the minimum requirements prescribed by the local standards or international standards. In addition, it is suggested to weigh the decorations and accessories in order to eliminate unnecessary objects/ decorations that could add weight to the vehicle and lead to increased emission.
7. Finally, study on the impact of jeepney standardization is recommended. This is to determine whether jeepney manufacturing companies can sustain and improve their operation with the implementation of the standards.

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