

# Assessment of Jeepney's Components, Systems and Separate Technical Units for the Development of Standards

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**Abstract:** This established database of manufacturers and their design specification, determined the condition and design of the vehicle based on the perception and preference of jeepney drivers and passengers, and compared the parts of the jeepney vehicle using Philippine National Standards and international standards. The study revealed that most 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 jeepney vehicle. Most of the jeepney drivers and passengers want to improve, change and standardize the parts of the jeepney vehicle. The parts of jeepney vehicles have similar specifications compared to the 4 out of 5 mandatory PNS and 22 out 32 UNECE Regulations applicable for jeepney vehicle. It is concluded that the jeepney vehicle can be standardized in terms of design, safety and environmental concerns.

**Key Words:** jeepney, ergonomics, safety, environmental factors

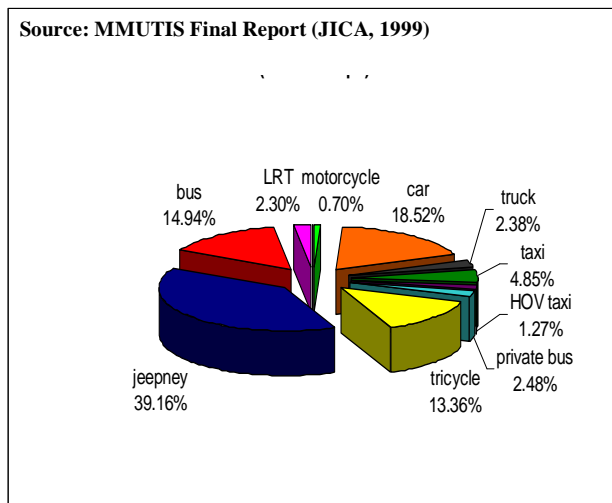
## 1. INTRODUCTION

The most popular means of transportation in the Philippines is the jeepney. In fact, jeepneys are one of the insignias of Philippine culture. They were originally built from US military jeeps left over from World War II and famous for their colorful decoration and crowded seating. They are commonly used for public transportation.

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, 1995:29 and Ebata, et al., 1996).

Figure 1-1 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%. Table 1-1 shows the total number of jeepneys in the National Capital Region and nationwide in 2007. Also, it shows the type of fuel used by jeepneys.

**Table 1. Number of Jeepneys and by Fuel Type**



Number of Jeepney		
Source of Data	NCR	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

**Figure 1. Transportation Demand by Mode in Metro Manila, 1996**

In 2007, the jeepneys were first officially classified as utility vehicle under customized local road vehicle (CLR V). Class CLR V 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. This classification (PNS 2060:2007) in the Philippine National Standard was promulgated by Sub-Committee 28 under TC 44 of the Bureau of Product Standards (BPS) of the Department of Trade and Industry (DTI).

### 1.1 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 (CLR V), 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.

### 1.2 Objectives

This study aims to characterize and evaluate the jeepney vehicle based on ergonomics, safety and environmental factors. Specifically, the study attempts to:

1. Establish database of manufacturers or assemblers and their design specifications in constructing jeepney vehicle;
2. Determine the condition and design of the vehicle based on the perception and preference of jeepney drivers and passengers; and,

3. Compare the design specifications of components, systems and separate technical units of the jeepney vehicle with Philippine National Standards (PNS), LTO regulations, DENR Standards and selected international standards.

### **1.3 Significance of the Study**

This study will generate baseline information that will help government agencies such as DOTC, LTO, DTI-BPS in their standardization activities on CLRVs. 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.

### **1.4 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. Also, the study is limited on perception and preference of the jeepney drivers and passengers only. The ergonomics, safety and environmental aspects of the vehicle will be considered in this study. Existing standards such PNS and UNECE will be used for the assessment of vehicle systems/ components and separate technical units.

## **2. REVIEW OF RELATED LITERATURE**

### **2.1 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. Jeepneys symbolize the history of the Philippines in the 21<sup>st</sup> century. They also stand as evidence to Filipino mechanical genius. The "jeepneys" 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.

### **2.2 Jeepney Profile**

In 1981, R. B. Ocampo described how the Philippine jeepney was locally remodeled 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?".

### **2.3 Public Transport Operation**

The jeepney had been the predominant mode of public transport in Metropolitan Manila, accounting for 55% of the daily person trips, followed by buses at 15% (Ebata, et al, 1996:1). 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, 1994).

In 1997, A Bus and Jeepney Operators 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 similar to the one built in JUMSUT which is intended to contribute to transportation planning, research and education in the Philippines. A total of 49 jeepney operations and 18 jeepney cooperatives participated in the survey. Included in the survey are jeepney operators with a minimum fleet size of 5 units. For public transport modes, the jeepney has a significant share of total demand. This mode comprised 51% of the total demand or 77% of public transport demand alone. However, a distinct 40% of “business” trips were notably made by cars (JUMSUT I).

Jeepney is dominating the trips in Metro Manila accounting for 39% of the trips. The work-trip commuting demand was significant enough to encourage jeepney services to serve the affluent commuter moving from the suburb to the urban or vice versa. Jeepneys are used not only by the very poor but by middle and upper income groups. Jeepneys are privately owned and operated, with the fleet mostly owned by individual operators who lease them to drivers. In addition, the vehicles are assembled locally. The dominance of jeepneys have 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.

### **2.4 Emission standard**

Jeepney manufacturing companies use second-hand Japanese engines, reconditioned or overhauled and fitted to the newly assembled PUJ body. The common perception 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, Tagell and Ogden 1986a; Kirby, Sayeg and Fehon 1986b).

Diesel-fed jeepneys used for public transport contribute to 15% of the particulate matter (PM) emissions and 11% to carbon dioxide (CO<sub>2</sub>) emissions in Metro Manila according to the IES Philippines Study (Manila Observatory, 2005).

### **2.5 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.

## **2.6 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

## **3. JEEPNEY INDUSTRY, DRIVERS AND PASSENGER SURVEY**

### **3.1 Survey Method**

#### **3.1.1 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.

#### **3.1.2 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.

#### **3.1.3 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.

### 3.1.4 Standards and Regulations Checklist

The five (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. Also, the LTO regulations on dimensions and weight as well as the DENR standard for emissions were used in the study. The international standards specifically the 32 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 general construction were also used as check list to compare and evaluate the parts of jeepney vehicle.

### 3.2 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, at present, most companies produce 2 jeepney units per month. Table 2 shows the 18 jeepney models and their capacity. The jeepney models have 20, 22, 24 and 26 passenger capacities excluding driver.

**Table 2. Jeepney Model and Capacity**

<b>Company</b>	<b>Jeepney Model</b>	<b>Capacity</b>
Morales Motors Corporation	Morales Jeepney	24
LCS Motors Corporation	LGS Jeepney, SANLOR Jeepney	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 companies practice with regard to mode of payment for sales are usually on cash and installment 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 for conventional jeepney and PhP 980, 000.00 to PhP 1, 500, 000.00 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 OFWs, private individuals, local residents, walk-in clients from Bulacan, Manila, Pangasinan, Visayas and other provinces.

### **3.3 Jeepney Industries' Specifications and Comparison with Local and International Standards and Regulations**

#### **3.3.1 Jeepney Dimensions and Weight**

The conventional and jumbo jeepneys comply with the 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.

#### **3.3.2 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.

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. 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.

The drivers perceived that the floor – ceiling height and ground – floor height is adequate for them while passengers experienced of head bump during entrance/ exit and during the ride of passengers. This indicates that the height of the service doors and floor – ceiling height is not sufficient for the passengers. In addition, passengers experienced 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 is not adequate for the passengers.

#### **3.3.3 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.

If a hip breadth of 357 mm based from the anthropometric dimensions of jeepney passengers will be considered as a seat space, only 5 jeepney models including jumbo jeepney passed the seat space requirement and 13 jeepney models failed on the seat space requirement. Based on LTO regulations on seat space of 350 mm, 8 jeepney models passed the seat space regulations including the jumbo jeepney and 10 jeepney models failed on the said regulations.

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.

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.

### **3.3.4 Jeepney's Engine**

Most of the jeepney companies use 4BC2 surplus or reconditioned/ overhauled second-hand Japanese engine. Based on the interview with Isuzu Philippines personnel, brand new 4JB1 and 4HF1 isuzu engines are compliant with the Euro 1 emission standards and EURO 2 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.

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 DENR.

### **3.3.5 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.

### **3.3.6 Jeepney's Braking System and Audible Warning Devices**

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).

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 noise reduction system.

### **3.3.7 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. Also, the jumbo and conventional jeepneys have similar specifications with regards to the requirement of the pneumatic tires - specifications (PNS 25: 1994).

The tires of jumbo and conventional jeepneys have similar specifications with respect to the sizes and dimensions of the regulation concerning pneumatic tires (UNECE 30).

### **3.3.8 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.

### **3.3.9 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.

For the road vehicles – safety belts and restraint systems (PNS 130: 2004), 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 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. 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 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.

### **3.3.10 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.

For the regulation with respect to the general construction (UNECE 52), the jumbo and conventional jeepneys have similar specifications with regard to the protection against fire risk, engine compartment, fuel holes, fuel tanks, electrical and wiring, batteries, and material used. For the exit and doors requirements, both jumbo and conventional jeepney's configurations are similar with the requirements. However, conventional jeepney does not have similar specifications particularly on the dimension of the service door. With respect to seat, both jumbo and conventional jeepneys have similar requirement with the seat cushions.

But on the seat dimensions and seat spacing regulations, only jumbo jeepney is similar to the requirements. For the handrails and handholds, both jumbo and conventional jeepney's specifications are similar to the requirements of the regulation.

### **3.4 Jeepney Driver's Perception and Preference on the Jeepney Vehicle**

For the comfort ability of jeepney, more than 50% of drivers responded that they are comfortable with the seat, access, gauges and ride quality of the existing jeepney vehicle. In relation to the alighting practices, when the passenger is getting off, 75% of the driver preferred passengers shout and 25% preferred the use of buzzer to stop the vehicle. Almost 93% of the drivers are comfortable with the existing fare collection method. And when it rains, 56% responded that they stop and roll down the window cover. For the parts of jeepney to be improved or changed, significant percentages of responses of the jeepney drivers are pertaining to the width and length of the vehicle. These can be done through the manufacturers or assemblers of the jeepney. With respect to the issue of standardization of jeepney, 75% of the drivers are in favor that the jeepney vehicle should be standardized.

### **3.5 Jeepney Passenger's Perception and Preference on the Jeepney Vehicle**

Most of the passengers (55%) perceived that the seating space designed by the manufacturer is not enough for the passengers. 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. Based on the interview, most of the passengers are annoyed with the wind, the noise/ sound inside the jeepney and the smoke coming from the exhaust. Most of the passengers preferred to shout to stop the jeepney vehicle when they are alighting. Sixty five percent (65%) of the passengers observed that the jeepney drivers do not stop and do not roll down the window cover when it rain and only 35% responded that the driver are doing it. 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. 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. For the parts of jeepney vehicle that are desired to be improved or changed, most of the responses are seat, engine and all parts of the vehicle. For standardization of jeepney, 58 % of the passengers wish that the jeepney be standardized.

## **4. CONCLUSIONS**

### **4.1 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 signaling 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.

#### **4.2 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 agreed 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. Most of the passengers are annoyed with the noise and smoke of the jeepney. They perceived that most serious problems of jeepney vehicle are driver behavior, 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.

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

The jeepneys comply 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 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(PNS 25: 1994) and rubber inner tubes (PNS 34: 2006), batteries (PNS 06: 2002), and safety belt and restraint system (PNS 130: 2004). However, the safety belt of jeepney is provided at the driver's seat only. On the safety glass specifications (PNS 130: 2004), 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 22 regulations out of 32 UNECE regulations applicable to the jeepney. These are regulations on the light and light signaling devices, door, seat, braking system, audible warning device, pneumatic tires, fuel system, speedometer equipment, mirrors, safety glazing materials, steering equipment and general construction.

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

## 5. RECOMMENDATIONS

1. Based on the jeepney industry and jeepney drivers and passengers' survey, the recommended dimensions for conventional jeepneys are shown in Table 3.

**Table 3. Recommended Dimensions for Conventional Jeepneys**

Dimensions and Weight		26-Seater	24-Seater	22-Seater
Overall Length (mm)		7, 100	6, 900	6, 750
Overall Height (mm)		2, 100	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	1550
Ground – Floor Height (mm)		850	850	850
Front Door (mm)		W (mm)	850	850
		H (mm)	1, 000	1, 000
Back Door (mm)		W (mm)	850	850
		H (mm)	1, 350	1, 350
Seat	Front	W (mm)	400	400
		L (mm)	720	720
	Rear	W (mm)	400	400
		L (mm)	4, 320	3, 960
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. The recommended components, systems and separate technical units for the conventional jeepney are shown in succeeding tables.

**Table 4. Recommended Engine Steering, Fuel System and Battery, Braking System, Audible Warning Device, Wheels and Tires for Conventional Jeepneys**

Engine	Brand new 4JB1 with turbocharger
Steering	Power assisted re-circulating ball and nut with steering lock
Fuel	Diesel
Tank Capacity	60 liters
Battery (Volts)	2 sets- 12V
Braking System	Service brake, Parking brake
Audible Warning Devices	main horn
Steel Rim Size	5.5F x 15
Tire Size	7.00 - 15 - 12 PR
# of Tires	5 including spare tire
# of Studs	6

**Table 5. Recommended Light and Light Signaling Devices for Jeepneys**

Main-beam headlamps	2	white
Front-fog lamps	2	yellow, amber
Reversing lamps	2	white
Rear direction-indicators	2	amber
Stop-lamps	2	red
Rear registration plate illuminating device	1	white
Parking lamps	2	Front-white Rear-red
Side-marker lamps	6	red
Emergency stop signal	2	red
Convenience lights	6	amber

**Table 6. Recommended Exterior, Convenience Items and Safety for Jeepneys**

<b>Exterior &amp; convenience items</b>	<b>Safety</b>
Front Bumper	Driver and Passenger's Seat Belt (front seat)
Front Grille/ Bumper Guard	Passenger Grab Rail
Front Grab Rail	Front Step board
Rear Grab Rail	Rear Step board
Plastic cover	Mirrors

- 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.
- It is recommended to explore more research on types of jeepney vehicle particularly those used in rural areas.
- 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.
- 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.
- 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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