

Assessment of 18-Seater Vans to Determine Seating Comfortability of Passengers for UV Express Service Vans in Philippines

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Abstract

With a high population density in Metro Manila, and having most of the workforce traveling in and out of the Metro, many transport methods are used to accommodate the commuters. The UV Express vans are one of the most common modes of transportation in the Philippines, 18-seater vans are commonly used for the UV-Express. Due to its popularity, makeshift seats are used to fit more passengers and have 4 passengers per row. This leads to comfortability problems as the passengers fit in a small space. The study was conducted to determine if the current measurements and number of passengers of the vans are suitable for public transport. The study focuses on the 18-seater vans which are the Hi-ace fifth-generation vans. Using statistical analysis such as regression, the determinants that affect the overall comfortability of the passengers were determined. The recommended improvements were proposed using relevant design tools. This can be concluded that the current measurements of the UV-Express vans are not suited to the current number of passengers since the seat width are not enough to fit four in a row and the actual measurement for leg space are below the recommended measurement for the leg space.

Keywords

UV-Express vans, 18-seater vans, seating comfortability, anthropometric measurements, transportation

1. Introduction

Urban transportation is important to maintain the daily lives of urban residents and the economic development of a country (Tao et al., 2019). Having a good transportation system is vital since it transports the workforce which is vital for the economy. The Philippines' transportation system is ranked among the worst in Southeast Asia. Metro Manila is the location of central business districts and educational institutions where employees and students travel every day. Many of these commuters reside outside Metro Manila and use various means of transportation to get through their day. Common means of transportation include buses, public utility Jeepneys, rail systems, and UV express service. UV express service is one of the most popular forms of transportation since it provides point-to-point service (Asinas et al. 2017). Due to its popularity, the number of vans in transit is insufficient to meet the demand of commuters, leading to the vans' exceeding their maximum capacity in exchange for the passengers' seating comfortability. Overcrowding occurs when something is filled beyond what is usual and comfortable (Varghese & Adhvaryu 2016). Due to the demand for the UV Express, drivers add makeshift seats to fit more passengers in one trip. Manufacturers of cars consider the ergonomics in their design. This includes the seats and dashboard displays that can affect the comfortability of the user (Abidi et al. 2013). By adding the makeshift seats, the designed ergonomics of the manufacturer are sidelined leading to a more crowded and less comfortable experience for the commuters.

There were only a few research studies about the UV Express service. Although there were existing studies about the comfortability of passengers, there was no previous study on the comfortability of passengers specifically for UV Express. This drives the author to pursue a study that will focus on the passenger's comfortability availing of UV Express services. The findings of the study will benefit society, especially the regular commuters of the UV Express vans. The results of the study can improve the current service provided by the UV Express vans and can provide contributions to general public transportation. Furthermore, the findings of the study can improve and increase the level of comfortability of commuters in the Philippines. Other transportation means that use vans were not considered

in this study. The respondents of the survey were regular commuters using the UV Express service as one of their transportation means. Since there are various vans and AUVs used, the study will focus only on 18-seater vans and not on AUVs (Tamaraw, Adventure, Crosswind, etc.).

1.1 Objectives

The study aims to achieve the following objectives: 1) Determine the seating comfortability of passengers for UV Express service vans; 2) Assess the van's current interior dimensions to determine if it is suitable for the number of passengers currently accommodated by UV Express service vans based on relevant anthropometric measurements; 3) Provide recommendations for the improvement of the UV Express passengers' comfortability in terms of seating capacity. The findings of the study will benefit society, especially the regular commuters of the UV Express vans. The results of the study can improve the current service provided by the UV Express vans and can provide contributions to general public transportation.

2. Literature Review

2.1 Metro Manila Traffic

Because of the continuous population growth in the Philippines, there is an increase in industrialization and urbanization in cities, and the demand for transportation has proportionally increased as well (Mayo & Taboada, 2020). With a population density of 20,785 (PSA, 2018). There is a massive demand for transportation in Metro Manila, which leads to traffic. According to a study by Rith et al. (2020), the traffic in Metro Manila is one of the most severe in the region. The use of road-based public transport systems such as buses and jeepneys can help ease the traffic congestion since it will reduce the number of private vehicles in Metro Manila (Fillone et al., 2005).

2.2 Metro Manila Transportation

Transportation is an important aspect of a modern city because modern society needs proper transportation to carry out commuters that need to get to work (Narboneta & Teknomo 2016). There are many transportation methods in Metro Manila, the commuter rail systems have a total span of 77 kilometers, along major roads inside Metro Manila. The bus routes are only on the main roads, while jeepneys run on primary and secondary roads. Tricycles are another transportation method, but the number of passengers is limited due to their small size (Dorado et al. 2015). Taxi services are expensive compared to other methods of transportation (Wicaksono et al. 2015). AUV express service or more known as "UV Express" offers air-conditioned vans that deliver passengers point to point (Sunio et al. 2019).

2.3 Ergonomic Factors

A study by Amer & Onyebueke (2013) that aims to provide seat comfort design, considered seat measurements such as width, height, and depth. The study also includes the seat cushion material and the occupant's anthropometry. In a study by Anjani et al. (2021), there is a significant reduction in discomfort when using a bigger seat than a smaller seat space. This can be applied to the UV Express service vans since the seating arrangement of the passenger is close to one another. In another study, rotating the body while sitting can cause discomfort (Fiorillo et al. 2019). Side-by-side seating is common for the UV Express vans and rotating the body to fit more passengers is a normal practice. This reduced seat space can cause discomfort to the passengers. A study by Li & Yu (2020), shows that a rigid seat can cause more discomfort than a well-cushioned automotive seat. A good amount of leg space can give the passenger comfort. According to a study by Fiorillo et al. (2021), legroom is a variable that affects the perception of comfort and discomfort when testing for seat comfort.

2.4 Seat Comfort and Seat Discomfort

The term "seat comfort" is used to define the short-term effect of a seat on the body while seating (Dama et al. 2015). The quality of a public transport system considers many factors, one of the main considerations is the safety and comfortability of the passengers (dell'Olio, et al. 2011) In a study by Kolich (2008), he reported four factors that affect seating comfort. The first factor is the seat factor, this pertains to the geometry, dimensions, and stiffness of the seat. The second factor is the package factors, the seat height, and the knee room of the passenger. The third factor is the social factor. The fourth factor is the individual factors, which are anthropometry and posture of the individual. Discomfort is associated with pain, tiredness, and numbness of the passenger during the ride while comfort was based on the feelings of well-being (Zhang et al. 1996).

2.5 Overcrowding

Manufacturers of cars consider the ergonomics in their design. This includes the seats and dashboard displays that can affect the comfortability of the user (Abidi et al. 2013). Overcrowding occurs when something is filled beyond what is usual and comfortable (Varghese & Adhvaryu 2016). Due to the demand for the UV Express, drivers add makeshift seats to fit more passengers in one trip. By adding the makeshift seats, the designed ergonomics of the manufacturer are sidelined leading to a more crowded and less comfortable experience for the commuters. Overcrowding leads to passengers sitting in an unusual position. Prolonged unusual sitting positions could lead to MSDs or Musculoskeletal Disorders (Ng et al., 2016). According to the study by Grimes and Legg (2004), leaning back against the chair to avoid flexion in the cervical region and sitting erect for most of the time were favored. With the current setting of the UV-Express vans, the passengers could not sit in their ideal positions due to overcrowding and making space for other passengers. Poor posture can cause various sicknesses from spinal disorders to psychological stress that can affect the individual (Ma et al., 2016). Prolonged sitting in an uncomfortable position is also associated with MSD prevalence (Muhamad et al., 2020).

3. Methods

3.1 Conceptual Framework

The framework represented the detailed path of the study shown in figure 1. This is done to visualize the step-by-step process in the study. In the first phase of the study, a survey was conducted by the researcher. The survey will be the basis for the comfortability of the respondents. The output of this phase is the survey results. In the second phase, the input is comfortability survey results. Regression analysis was used in this phase, to determine the determinant that affects the overall comfortability of the passengers. Descriptive statistics are also used, with a corresponding rubric provided. The results from the previous phases are analyzed to provide recommendations.

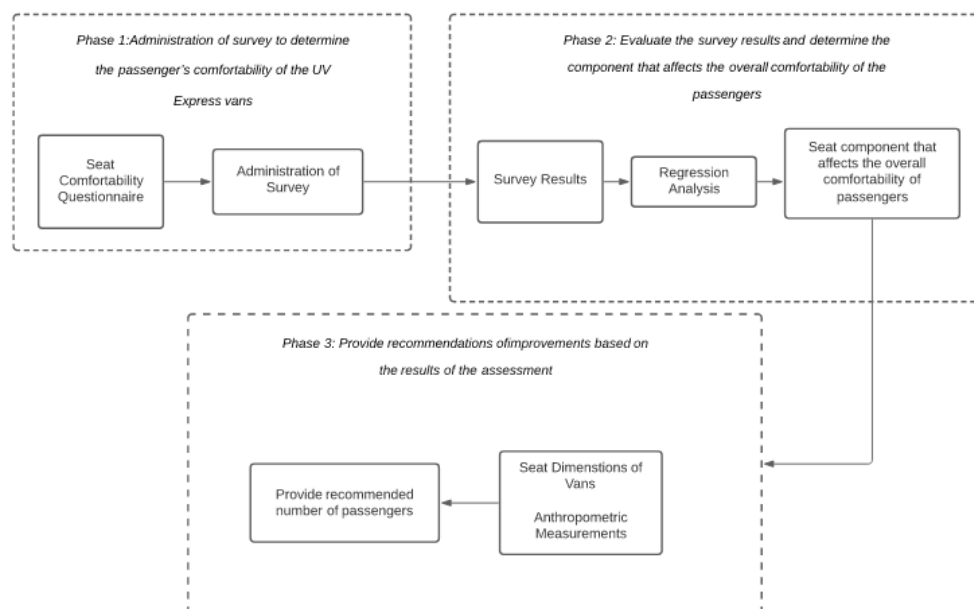


Figure 1. Conceptual Framework

3.2 Data Gathering Procedure

This study has at least 100 respondents to the survey that will fit the criteria of the study. The respondents of the study should be active commuters using the UV Express service as part of their transportation or the respondents have experienced riding 18-Seater UV Express vans. The survey questionnaire and the respondent's consent form were administered online through google forms. The respondents of the study focus on Metro Manila since it is the center of the urban economy (Ragragio, 2003). The origin is from Lawton, Manila but there is no specific destination. Lawton is considered since it is a major UV-Express terminal (Bayona et al. 2016) and routes are traversing through Lawton.

Trip-cutting is a common practice for drivers (Andres & Fernandez 2015). This means that there is no fixed time for each trip of the UV-Express vans.

3.3 Analysis and Evaluation Procedures

The comparative analysis or mismatch analysis is between the current dimensions of the UV Express vans and the standard anthropometric measurements of Filipino users. The goal of this analysis is to identify if the current dimensions of the UV Express vans can accommodate the set of standard anthropometric measurements of Filipino within the 5th and 95th percentiles. When the current dimension is greater than the standard when it comes to width, this means that the current dimension is rightfully accommodated by the population. The objective of this tool is to provide recommendations on the optimal number of passengers in the vans.

3.4 Ergonomic Tools

Anthropometric measurement was used to assess the current passenger capacity of the vans and if it is suitable for public transportation with their current dimensions. The optimal number of passengers in the current dimensions of the UV Express vans that are fitted with the Filipino anthropometry were also determined for the recommendation of this study. The data is gathered from the study of Del Prado Lu (2007).

3.5 Statistical Treatment of Data

Regression analysis was used to determine the significant determinant that affects the overall comfortability rating of the respondents. The dependent variable is the overall comfortability rating of the respondents. The independent variable is the determinants in the survey questionnaire. The questionnaire is based on the study by Park et al., (1998). The last question of the questionnaire is about their overall comfortability to determine which determinant affects their comfortability the most with the use of a statistical tool which is regression. A 5-point Likert scale was used. A score of 1 is the lowest score that is very uncomfortable and a score of 5 is the highest score which means that the respondent experienced a very comfortable experience. Table 1 shows the rubrics for the satisfaction rating.

Table 1 Rubrics for satisfaction rating

Satisfaction Level Rating	Qualitative rating
1.00 – 1.79	Very uncomfortable
1.80 – 2.59	Somewhat uncomfortable
2.60 – 3.39	Neither comfortable nor uncomfortable
3.40 – 4.19	Somewhat comfortable
4.20 – 5.00	Very comfortable

To be more specific in this study, only one van model was considered, since different models of vans have different measurements, this was asked in the questionnaire. The most frequently encountered van by the respondents is the Fifth Generation Toyota Hi-ace. The dimensions of the seat of the said model will be used in this study to determine the improvements needed and to see if the Filipino anthropometric measurements fit the measurements of the van.

4. Results and Discussion

4.1 Current Measurements of the van

Table 2 shows the current dimensions of the UV Express vans. The measurements provided are the measurements gathered from the Toyota fifth-generation Hi-ace vans. The van dimensions that were taken are the anthropometric measurements that are needed for the seating comfortability.

Table 2. Measurements of the van

Van Dimensions	Measurements
Length of the interior (wall to wall)	166.37 cm
Seat height	36.58 cm
Seat depth	48.77 cm
Seat width	35.56 cm
Backrest height	64 cm
seat-roof height	101.6 cm
ceiling-floor height	138.43 cm

4.2 Qualitative rating and satisfaction results

The determinant seat height has the least mean rating with 3.10 the qualitative score is neither comfortable nor uncomfortable. Seat-roof height of the UV Express vans is the part that the respondents are most comfortable with a mean rating of 3.75 the satisfaction level of the respondents in terms of qualitative rating is somewhat comfortable. Among all the determinants the qualitative rating does not fall below Neither comfortable nor uncomfortable. There is no qualitative rating that states that they are in any discomfort. There are also no determinants that received a very comfortable qualitative rating. Shown in table 3 is the satisfaction rating of the comfortability of the vans. This shows that there are improvements that could be made with the current setting of the vans.

Table 3. Overall comfortability rating

Determinants	Satisfaction Level	
	Mean Rating	Qualitative rating
How comfortable are you with the seat width of UV express vans	3.44	Somewhat comfortable
How comfortable are you with the seat height of UV Express vans	3.10	Neither comfortable nor uncomfortable
How comfortable are you with the seat depth of the UV Express vans	3.24	Neither comfortable nor uncomfortable
How comfortable are you with the seat-roof height of the UV Express vans	3.75	Somewhat comfortable
How comfortable are you with the ceiling-floor height of the UV express vans	3.55	Somewhat comfortable
Fitness of back (horizontal direction)	3.44	Somewhat comfortable
Fitness of back (vertical direction)	3.42	Somewhat comfortable
How comfortable are you with the Backrest height of the UV Express vans	3.29	Neither comfortable nor uncomfortable
Distance between head and headrest	3.16	Neither comfortable nor uncomfortable
Firmness of headrest	3.12	Neither comfortable nor uncomfortable
Fitness of headrest	3.27	Neither comfortable nor uncomfortable
Are you comfortable with the amount of Seat Cushion when using UV Express vans	3.22	Neither comfortable nor uncomfortable
How comfortable are you with the firmness of the cushion padding	3.33	Neither comfortable nor uncomfortable
How comfortable are you with the fitness of cushion (horizontal direction)	3.31	Neither comfortable nor uncomfortable
How comfortable are you with the fitness of the cushion (Vertical direction)	3.40	Somewhat comfortable
Overall, how would you rate your comfortability in riding an 18-seat UV van?	3.30	Neither comfortable nor uncomfortable

4.3 Regression Results

Table 4 shows the regression analysis of the passenger's overall comfortability. The dependent variable is the overall comfortability of the passengers. The following factors that were analyzed in the regression model are based on the study of Park et al, (1998) which discussed the key design parameters to be considered so that the automotive seats are comfortable for the passengers. The fitness of the cushion in the horizontal direction is the highest contributor to the comfortability model which means that the fitness of the cushion in the backrest affects the overall comfortability of the passenger. The seat width with the second-highest contributor means that with a high coefficient the narrower the seat width, the more it affects the discomfort of the passenger, followed by the amount of seat cushion. The seat roof height and the distance between the head and headrest have some contribution to the overall comfortability of the passengers. However, the following factors are not significant. The seat-roof height factor is almost statistically significant with a p-value of 0.051. The factors that have the highest coefficients that contribute to the model which are the fitness of cushion in the horizontal direction, amount of seat cushion, and seat width are the only significant since their p-values are less than 0.05. The other determinants on the other hand are not significant since their p-values are greater than 0.05. The following data was observed that there was no multicollinearity since the VIF value was less than 10. The results obtained from the regression analysis will be used for achieving the third objective of this study, which is determining the optimal number of passengers. This analysis also determines the significant factor that needs improvement for the comfortability of the passengers. The regression equation for the comfortability of the passengers is as follows:

$$\text{Comfortability} = -0.299 + 0.3555 X1 + 0.0134 X2 - 0.0718 X3 + 0.1679 X4 + 0.0370 X5 - 0.0834 X6 + 0.0573 X7 + 0.0042 X8 + 0.1149 X9 - 0.0527 X10 + 0.2252 X11 - 0.0537 X12 + 0.0604 X13 + 0.437 X14 - 0.130 X15$$

Table 3. Regression analysis of passenger's overall comfortability

S	R-sq	R-sq (adj)			
0.427040	82.06%	78.74%			
	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-0.299	0.219	-1.36	0.177	
Seat width (X1)	0.3555	0.0722	4.93	0.000	2.45
Seat height (X2)	-0.0134	0.0689	-0.19	0.847	2.37
Seat depth (X3)	-0.0718	0.0758	-0.95	0.346	2.70
Seat-roof height (X4)	0.1679	0.0846	1.98	0.051	3.54
ceiling-floor height (X5)	0.0370	0.0872	0.42	0.672	3.75
Backrest height (X6)	-0.0834	0.0656	-1.27	0.208	2.63
Fitness of back (horizontal direction) (X7)	0.0573	0.0887	0.65	0.520	4.05
Fitness of back (vertical direction) (X8)	0.0042	0.0928	0.04	0.964	4.24
Distance between head and headrest (X9)	0.1149	0.0805	1.43	0.157	3.74
Firmness of headrest (X10)	-0.0527	0.0757	-0.70	0.488	3.47
amount of Seat Cushion (X11)	0.2252	0.0971	2.32	0.023	5.12
Firmness of the cushion padding (X12)	-0.0537	0.0977	-0.55	0.584	4.06
Fitness of headrest (X13)	0.0604	0.0923	0.65	0.515	4.06
Fitness of cushion (horizontal direction) (X14)	0.437	0.114	3.84	0.000	5.72
Fitness of cushion (Vertical direction) (X15)	-0.0130	0.123	-1.06	0.294	6.93

4.4 Mismatch Analysis

The result having a negative value meant that there needs to be design improvements for the seat comfortability of the UV-Express vans. The seat height used for the data is the 5th percentile of female popliteal height. This is done to accommodate most of the population. If a higher percentile is used, a higher popliteal height could not fit other individuals with a lower popliteal height. The same gender and percentile were used for the seat depth. The large seat depth of the seats used in the airplanes caused discomfort (Goonetilleke 1998). Having a larger percentile, for example, the male 5th percentile is too much for some in the population. This means that having too much seat depth that is beyond the anthropometric measurements could cause discomfort. The establishment of a strict criterion or a having a standard for maximum seat depth is difficult due to the large variation in buttock–popliteal length of the large male and the small female (Goonetilleke & Feizhou 2001). The measurements used for the seat width is the elbow-to-elbow breadth of the Male 95th percentile, this was done to maximize the amount of the seat width in most of the population. The measurement that is used for the backrest height, seat-roof height, and ceiling- Floor height is 95th male percentile. The seat-roof height is important to have clearance, since having a low clearance can cause flexion in the neck. The ceiling-floor height is also important to have clearance so that the passengers can enter and exit the vehicle easily.

The seat height, seat depth, and the seat – roof height is above the standard based on anthropometric measurements. According to a study by Giacomini & Quattrocchi (1995), the seat-roof height impacts the comfortability of passengers entering and exiting the vehicle. The backrest height is below the standard, with a 16.25 cm difference from the recommended height for the backrest. The ceiling-floor height has the greatest difference, this means when you enter a van, you need to slouch to make your way through the van to your seats. It can cause inconvenience to passengers entering and exiting the van. Elderly people are more prone to back pains due to aging (Jones et al, 2016). Recommendations in terms of ceiling-floor height are beyond the scope of this paper. In-seat width, the researcher used the seat width of a 4 passenger-per-row setting in a UV Express. The recommended measurement shows that the Elbow-to-elbow breadth of a passenger is 49.4 cm. The gathered data in this setting has a difference of 13.84 cm, which shows that there is not enough space to accommodate 4 passengers per row.

This leads to one or two passengers slouching to give space to their fellow commuters. This practice of slouching can cause discomfort during the whole trip. This small space where the passengers are seated does not have adequate space for the passengers' personal belongings. The belongings of the passengers could also attribute to the amount of space and position the passengers could do to fit in the row of the van. Having a tight space for sitting and a small entryway from each row, it is difficult for the passengers to enter and exit their seats. Passengers carrying personal belongings is common for commuters, it is also shown that there is a delay in the boarding of the passengers when carrying personal belongings in the study by Hwangbo et al (2015). It is also shown in the mismatch analysis the amount of leg space that the UV – Express passenger has in a trip. It shows that the amount of seat space is below the recommended anthropometric measurement. With a huge difference of -15.73, it shows that some improvements should be made for the leg space. This could cause discomfort which is stated in a 2012 study by Vink et al. and the 2019 study by Liu et al., which shows that there is a significant relationship in terms of comfortability and leg space.

Table 4. Mismatch Analysis

		Anthropometric dimension based on Del Prado-Lu (2007)				Difference (cm)
Seat Dimensions	Current measurements (cm)	Corresponding anthropometric dimension	Gender	Percentile	Recommended Anthropometric measurement (cm)	
Seat height	36.58	Popliteal height	Female	5 th	36	0.58
Seat depth	48.77	Buttock popliteal length	Female	5 th	40	8.77
Seat width	35.56	Elbow to elbow breadth	Male	95 th	49.4	-13.84
Backrest height	64	Shoulder height – popliteal height – buttock popliteal length	Male	95 th	45	19
Seat-roof height	101.6	Sitting height	Male	95 th	92	46.97
Ceiling- Floor height	138.43	Stature height	Male	95 th	178	-39.57
Gap Between Seats (Leg Space)	74.17	Buttock knee-length + foot length	Male	95 th	89.9	-15.73

4.3 Discussion

Figure 2 shows the current seating setup of the UV Express vans, this setup consists of 18 passengers including in the front. It has 4 rows that have 4 passengers per row which equal 16. The first two rows of the vans are in the way of the door of the van, this leads to the first two rows of the seats having foldable seats close to the door.

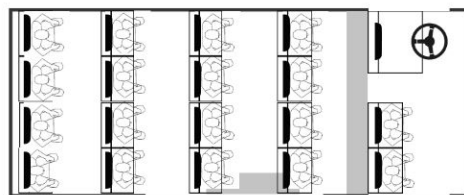


Figure 2. Current setup of UV Express Vans Figure 3 shows the format of seats in the UV Express vans with the seats marked red are the makeshift seats that the operators add and the blue are the foldable seats in the first 2 rows of the vans. These seats are foldable since it is in the way of the door of the van.

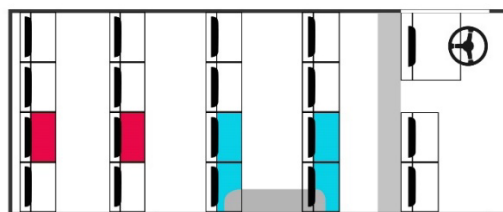


Figure 3. Seat format

Table 6 shows the number of passengers per row with the current and with the anthropometric measurements. Since the seat width is one of the main concerns of the passengers in terms of seat comfortability, in this part of the paper the current measurements in the setting of the UV Express vans are assessed. In the first row of the table, it is shown that there is only 35.56 cm per passenger is given, to fit 4 passengers in a row. This causes the passengers to compress,

neglecting the anthropometric standard seat width of each individual which is measured by the elbow-to-elbow breadth. The total amount of space that is occupied by the passengers is 142.08 cm which only gives them a small space to fit inside the interior of the van at 166.37 cm. The second row of the table shows the anthropometric standard that is suitable for the seat width of the passengers. The measurement is gathered from the table of Del Prado-Lu (2007), and the 95th male percentile is used. This row shows that the recommended amount of seat width with an anthropometric basis could not fit inside the interior of the fan and the whole length of the seat row when 4 passengers are assigned with each seat like the usual setting of the vans. The last row shows that the standard anthropometric measurement can only fit 3 passengers per row. This number of passengers per row also frees up the space for the passenger's personal belongings. This measurement also fits with the interior and the entire length of the chair. Figure 4 is the proposed recommended seat layout to satisfy the anthropometric measurements in terms of seat width. The number of passengers per row is 3, removing the makeshift seats that the operators add. Seats that are marked blue, are the foldable seats that are in the way of the door of the van. The problem with this recommendation is that the anthropometric measurement for leg space is not accommodated.

Table 5. Recommended number of passengers according to the standard Anthropometric measurement

Seat Dimensions (cm)		Number of Passengers per row	Total	Length of the seat row	Length of the interior
Amount of seat width per passenger (current UV setting)	35.56	4	142.08	160.02	166.37
Standard anthropometric measurement	49.40	4	197.6		
	49.40	3	148.2		

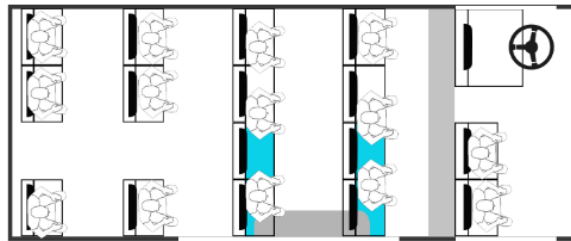


Figure 4. Recommended seating for seat width

Only having 3 rows is feasible to satisfy the recommended anthropometric measurements for the leg space. Removing one row is important based on the measurements shown in table 4. Figure 5 shows the design to satisfy the recommended anthropometric measurement, one of the main causes of dissatisfaction of the passengers from airplanes is the amount of leg space that is provided (Brundrett, 2001). Prolonged sitting in a small seat space could cause various issues in the legs. Deep vein thrombosis and pulmonary embolism could be acquired with prolonged seating in a tight seat space (Porta et al, 2019). According to a study by Stanglmeier 2012, the ratio between leg space and the anthropometry of the individual affects the experience of discomfort. Having a satisfactory amount of leg space is important for a positive perception of comfort (Kremser et al.* 2012).

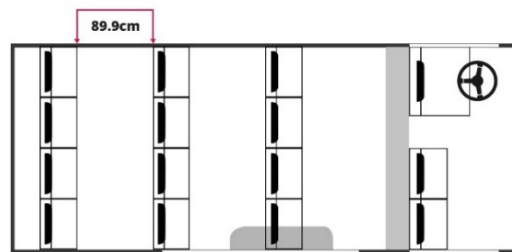


Figure 5 . Proposed design of the UV Express vans to satisfy the suggested anthropometric measurement

5. Conclusion

One of the objectives of this study is to determine the passenger's seating comfortability with the current measurements of the UV-Express 18-seater vans. This is done through the survey; it was found that the respondents are neither comfortable nor uncomfortable with the current measurements of the vans, and the respondents have a neutral feeling in terms of seating comfortability with the current setting of the vans. The second objective of the study is to determine the current dimensions of the UV-Express 18-seater vans if it is fitted with the anthropometric measurements of the Filipinos and the number of passengers currently accommodated. Mismatch analysis was used to show the difference. It can be concluded that the biggest difference in the anthropometric measurements was that of the ceiling to floor height and the seat width. The ceiling to floor height is beyond the scope of this study, and it is unnecessary since changing the body of the van will put it in a different category. The most significant finding in this portion of the study is the seat width. The elbow-to-elbow breadth of the passengers is not suitable with the current number of passengers per row, which is four. Having four passengers per row is not suitable and can cause the passengers to compress or lead to unusual seating positions to fit in that tight space.

This could lead to poor posture in seating that could lead to Musculoskeletal Disorders or MSDs. Prolonged poor posture could be linked to various orthopedic problems and joint pains, especially in the neck, shoulders, and lower back. Poor seating posture could also develop a problem with respiration and musculoskeletal structure (Swann, 2009). The last objective is to provide recommendations to improve the seating comfortability of the passengers. The seat cushion in terms of the fitness in the horizontal direction, seat cushion, and the seat width is affecting the overall comfortability of the passengers. The seat cushion and the fitness of the cushion in a horizontal direction could be improved by the UV-Express van owners by changing the seat cushion that would fit the anthropometric measurements of the Filipino passengers. The lack of space inside the van could be improved by having an optimal number of passengers inside the van. The seat width has the most significant effect on the seating comfortability of the passengers. The recommended number of passengers per row is 3, this leads to a total of 14 passengers overall including the 2 passengers in the front. This is important since the amount of seat space has a huge impact on passengers' comfortability (Miller et al., 2019). Prolonged seating in a small leg space could cause MSDs, studies that focus on leg space are from airplane seats. There are various studies in terms of leg space in airplanes since it has a long duration of travel, in the UV-Express van setting that has a shorter travel time compared to airplanes, this recommendation could be neglected. Figure 6 is the proposed design of the van to satisfy the recommended anthropometric measurements.

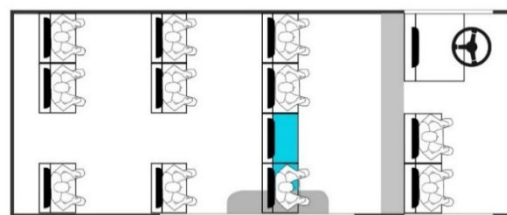


Figure 6 Van layout in accordance with the anthropometric measurements

6. Recommendation

To further improve the current study, the researcher recommends having a separate study in terms of the overall comfortability of the UV-Express vans to be able to determine the factors that affect the passengers the most in terms of comfortability of the UV Express vans. These factors should consider vibration, noise, thermal comfort, and other factors that could determine the overall comfortability of the passengers. Since many factors also can affect the comfortability of the vans. It can also be concluded that most of the determinants used in the study were not statistically significant which reflects in the value of the overall rating model using regression analysis. This means that a further study on the determinants could give a significant effect on the model and include other indicators that will have significant contributors to the results of the model. Future studies should also consider seat cushions. The materials used or if the material is breathable or if the material is dense to further expand the comfortability of the seats in terms of the seat cushion. The researcher also recommends looking into the compatibility of the currently recommended improvements if it is suited for use of the UV Express vans.

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