Journal of the Society of Automotive Engineers Malaysia
Volume 1, Issue 2, pp 103-110, May 2017
e-ISSN 2550-2239

Factors, Effects, and Preferences on Vehicle Driving Modification for the Malaysia Independent Disabled Driver

M. K. A. M. Dahuri[*1], M. N. Hussain[1], N. F. M. Yusof[1] and M. K. A. Jalil[1]

[1]Department of Solid Mechanics and Design, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

[*]*Corresponding author: mkhairulanwar7@live.utm.my*

ORIGINAL ARTICLE **Open Access**

Article History:

Received
17 Feb 2017

Received in revised form
11 Apr 2017

Accepted
20 Apr 2017

Available online
1 May 2017

Abstract – *Assistive driving was known to be the important aspect in addressing the mobility limitation, particularly for a person with disabilities. Assistive product modification for vehicle driving, ranging from hand control, secondary control, foot control, and also the wheelchair assisted vehicle developed towards addressing the driving limitation differences according to a person types of disabilities. A pilot survey was conducted to 50 Malaysia independent drivers in Kuala Lumpur. The components evaluated during the survey include, types of modification used, aspects influencing the vehicle modification decision, problem occurrence when in use, as well as to understand the preferential decision differences. The Likert scale (1 to 5) will be used as the rate score given by the responses for each question within the component in the survey. The survey was used as the approach to gather the responses from the respondent. From the survey, it was discovered that aspect such as the disability condition, safer driving, and information availability are several major factors influencing the driver to make modification for independent driving purposes. The major factors were also discovered to influence the modification origin as preferences for driving assistance. The certain least important factors such as the involved body part movement limitation and price range must not be ignored as they also contribute to the improvement for the independent disabled driving.*

Keywords: Independent drivers, person with disabilities, vehicle modifications, preferences, factors, effects

Journal homepage: www.journal.saemalaysia.org.my

1.0 INTRODUCTION

Independent driving can be described and viewed as the Activities for Daily Living (ADL) most important aspects, particularly for the person with disabilities (PWD). The ability of a person with disabilities towards using a vehicle was found to be an important aspect to address the activities for daily living (Boyce et al., 2013), community integration (Prasad et al., 2006), and also employment opportunity (Roosmalen et al., 2010).

Assistive driving using the modifications or assistive aids has led to the improvement for the person with lower body disability mobility limitations. Most countries were found to have easy access on assistive driving. This situation was proven by the availability of advanced modification introduced in several studies such as PHC-3 and TNT portable hand control (Boyce et al., 2013), Omni Haptic hand Control (Yamashita, 2014), Gesture driving (Murata & Yoshida, 2013), Joystick control (Peters & Östlund, 2005) , the flip accelerator pedal system (Jones et al., 2009), the brake accelerator pedal (Nilsson, 2002), postural support (Lawton et al., 2008), Rotational Seats (Barton & Holmes, 2013), intelligent speed adaptations (Klarborg et al., 2012; Lakkam & Koetniyom, 2015) and also wheelchairs assisted vehicles (Holmes, 2012). The suitability of a person conditions when using the modifications or driving without modifications are widely studied and recorded. Thus, the result from the usability studies has helped in making preferences and decision to be much easier besides referring to the available guidelines.

In Malaysia, the preferences and the usability effects on personal car modification for assistive driving was found to be unknown and difficult. Most of the modifications made were based on the references of modifications from other members or senior drivers. The standard of procedures available were found only focusing on the medical examination to obtain the driving license at any Ministry of Health facilities (Road Transport Department, 2012).

The aim of this study is to analyse the factors that led the person with disabilities to make modification for independent driving. This study also discusses the effects from the modifications made and the perception among users on the design and appearances of the modifications. It is hoped that the result from the study to be used as references or benchmarking for future assistive driving modification development. In addition, the result is expected to be used as references when making any decisions on modification to encounter the driving limitation, in particular to the person with disabilities.

2.0 METHODOLOGY

The pilot study was conducted within the area of Kuala Lumpur from October to December 2016. The involved respondents were gathered from Taman Cochrane People Housing Project in Cheras, Society of the Orthopaedically Handicapped Malaysia (*Persatuan Orang-orang Cacat Anggota*, POCAM) at Gurney Housing Street, and also during the Malaysia Disabled Person Career Festival at the Aloft Hotel in Kuala Lumpur Sentral. The small population study or the pilot study was used as the approach, in order to facilitate the design of actual research (Blair et al., 2014). The pilot study was conducted through quantitative approach. Under the quantitative approach, the researchers used snowball sampling in ensuring the process smoothness during the conducting survey (Browne, 2002).

The conducted study involved a total of fifty (50) Malaysia independent disabled drivers as the respondents. A set of questionnaire consisting of demographic of the respondent, factors influencing the use of selected modification, and also problems that occurred when using the installed modification were asked. The Likert scale of 1 to 5 were used to evaluate the responses given by the respondents. The data from the survey were analysed using descriptive analysis and independent samples T-test via SPSS software (Aldrich & Cunningham, 2016).

.

3.0 RESULTS AND DISCUSSION

3.1 Respondent Characteristic

The characteristic for the respondents involved in the survey are as shown in Table 1. The survey was based on the 50 respondents who drove independently and made modifications onto their vehicles. Table 1 includes the driving frequency, types of disabilities, and the types of modification made by the person with disabilities onto their vehicles. The male as displayed in the table recorded as the majority (84%) respondents in the study. As to add more, 88% of the respondents use hand control as their preferred vehicle modification as driving purposes. Furthermore, almost the entire respondents (96%) frequently use their vehicles to commute to workplace or to desired destination.

Table 1: Respondent characteristic

Demographics	N (%)
Gender	
Male	42 (84%)
Female	8 (16%)
Occupation	
Government	3 (6%)
Private	5 (10%)
Self-employed	40 (80%)
Others	2 (4%)
Qualification	
Bachelor's degree	2 (4%)
Diploma	3 (6%)
Malaysia Examination Certificate	44 (88%)
Primary school	1 (2%)
Types of Disabilities	
Upper body disabilities	0 (0%)
Lower body disabilities	41 (83%)
Hand disabilities	2 (4%)
Leg disabilities	5 (10%)
Small stature	2 (4%)
Driving Frequencies	
More than 5 days per week	48 (96%)
Less than 5 days per week	2 (4%)
Types of Modification	
Hand control	44 (88%)
Secondary hand control	1 (2%)
Foot control	5 (10%)

Figure 1 displays the images of the most common driving modification which is the push and pull control made by the Malaysia independent disabled driver.

Figure 1: Images of push and pull control known to be one of the most common modifications for the Malaysia independent driver; (a) Modification jointing, (b) Modification adjustable lock, (c) Modification position. Images are shown with the permission from POCAM

3.2 Aspect Leading the Person with Disabilities to Perform Vehicle Modification

Table 2 shows the responses on the aspect leading the person with disabilities towards making the modification to drive their vehicles. Three of the highest aspects were recorded and found to be the inability to drive a vehicle using normal control, the disability condition and the ability to drive independently. The regulation and act was found as the least aspect leading to most Malaysia disabled driver to make vehicle modifications for independent driving.

Table 2: The aspect leading the disabled person to make vehicle modification (N = 50)

The Aspect Leading to the Use of Vehicle Modification	Mean Score
Inability to drive a vehicle using the normal control	4.76
Disability condition	4.58
Safer when driving on a normal traffic road/congested highways	4.20
Information availability	4.20
Requirement by the authority	4.12
Recommendation by the physical therapist	4.02
Modification availability	3.80
Difficulties in using the public transportation	3.48
Commuting frequency to the desired destination/ workplace	3.30
To obtain the driving license	3.20
To receive the privilege of RM2.00 road tax renewal	3.04
Regulation and act	3.10

Inability to drive a vehicle as displayed in the Table 2, dominated the main aspect influencing the person with disability to make modification for independent driving. Therefore, encouragement from not only the responsible authorities, NGO's, and any related community could help in encouraging more disabled person to make modification if planning on driving a vehicle. Although regulation and act in Table 1 indicated as the least aspect, it should be noted that a modification will not be approved if not be made according to the law that has been encompassed.

3.3 Modification Usability and Reliability

Table 3 displays the responses of the modification usability and reliability when in use. It is clear that, the driving modification usages during rushing time was recorded as the main problem by the respondents. The pain occurrence and involved body part movement limitation also recorded high mean scores by the respondents. This situation shows that any types of modification that able to address the disabled person condition will be installed, and used as driving assistance. It is interesting to see that the disabled driver does not feel any focus disturbance although consistency in controlling action is highly required due to the unknown road traffic condition. However, the mean score for the driving focus factor might indicate that certain respondents have already accustomed or familiar with their modification controls.

Table 3: The modification usability problem when being used (N = 50)

Modification Usability Problem	Mean Score
Rushing time	4.04
Involved body part movement limitation	4.02
Pain occurrences on the involved body part	3.82
User-friendly	3.76
Material quality	3.66
Safety features	2.80
Modification grip and comfort	2.68
Modification position	2.54
Driving focus	2.52
Normal time	1.48

3.4 Factors Influencing the Modification Type Preferences

Table 4 shows the significant value on factors influencing the modification type preferences by using the independent samples T-test. The component which received high mean score from both aspects and usability problem was used to evaluate the significance value between local made and imported driving modification. It can be seen that some of the components from the aspects and problems resulted with <0.05 significant value.

In Table 4, information availability recorded the highest significant value of 0.001. As indicated by the local modification user respondents (4.26), the modifications made onto their vehicle were mostly influenced by the suggestions from colleagues and senior drivers. Moreover, it is almost difficult to find any up-to-date modification due to no guidelines from the authorities and also unexposed information from the fabricators. A different response received from the import modification user (3.88) as they indicated that their preferences were not just only caused by the information availability. According to the Malaysia Road Transport Department, the availability of any information or modification is not controlled by them. They also added that any enquiries relating to modification availability can directly be forwarded to any disabled vehicle modification fabricators all around Malaysia. Beginning in 2013, the Road Transport Department has removed the restriction on making modification only at their approved fabricators.

The modification availability factors as displayed in Table 4 also recorded with a high significant value of 0.038. If carefully viewed in the table, the mean score difference is small (0.09), but resulted with high significant value difference. Need to bear in mind that the total number between the local modification user (3.79) and imported modification user (3.88) are big, which is 42 to 8 respondents. If relating the demographic aspect of occupation with the category of modification user, it is clear that most local modification user respondents is self-employed and not equipped with a good level of education. According to POCAM, the majority of persons with disability in Malaysia generate their income through daily basis work (self-employed). Moreover, most job offered to the disabled person in Malaysia require a person with the minimum level of disability, which are mute and deaf.

Table 4: Vehicle modification origin preferential differences comparison

	Local (Mean Score)	Imported (Mean Score)	Significance Value
Information availability	4.26	3.88	0.010
User-friendly	3.60	3.75	0.031
Safer when driving on normal road/highway	4.24	3.88	0.037
Modification availability	3.79	3.88	0.038
Price range	3.67	3.75	0.084
Rushing time	4.43	4.25	0.130
Inability to drive a vehicle using the normal control	4.79	4.63	0.135
Disability condition	4.74	4.38	0.297
Pain occurrence on the involved body part	4.05	2.63	0.335
Recommendation by Physical Therapist	4.24	2.88	0.473
Involved body part movement limitation	4.00	4.13	0.763

Although some important factors such as pain occurrence (0.335), body part movement limitation (0.763), and inability to drive a vehicle using the normal control (0.135) displayed low significant values, they must not be ignored. These factors are necessary in making a driving modification for a disabled vehicle to be effective when being used. This situation is in line with the automotive adaptive driving control standard by the Society of Automotive Engineers (SAE) in assuring effective driving ability for a person with disabilities. The components include the product performance, manufactured quality level, and also the installed product utility (SAE, 2011).

The recommendation from the physical therapist is also another factor which must not be removed from being one of the important aspects. This aspect must not be ignored as well, although it showed low significant value (0.473). This situation can be referred to the study conducted to 33 independent drivers with chronic foot injuries (Jones et al., 2009). The study showed that 22 from 30 respondents had never been exposed to any modification availability to encounter their driving limitations. The situation has led to the unknown availability of suitable car modification to counter such driving disabilities.

In summary, several important aspects need to be considered in assuring the effective assistive driving modification product and its use. The aspects include the information availability, user friendly of the product, usage safety, and also the product availability. Certain

aspects and problems high mean scores must also be taken into measures, although resulted with low significant values.

4.0 CONCLUSIONS

In conclusion, the result from the study conducted on Malaysia independent disabled drivers has been presented. The result from the study concludes that certain major factors need to be taken as a measure to achieve effective disabled driving modifications. These include the information availability, the product user-friendly, product ability to produce safer road driving and the product availability. Besides, some aspects and problems which recorded high mean response (e.g. body part movement limitation, price range and pain occurrence) should also need to be considered. Although some of the responses given by the respondents are considered as unimportant, they still need to be used as a measure in developing more effective and reliable driving modifications. By considering on the knowledge from the study, it is believed that it can help in increasing the awareness for the independent disabled drivers. It is also hoped that the knowledge could help in improving the driving scenario, in particular to the Malaysia independent disabled driver.

ACKNOWLEDGEMENTS

The authors obliged to Universiti Teknologi Malaysia Johor for laboratory facilities and financial assistances throughout the whole research process. The authors would also like to acknowledge Road Transport Department Malaysia and POCAM who provided insight, expertise and documentation that greatly guided the research. The authors also like to express their gratitude to the Niyaz Mobility Product and Services for sharing their pearl of wisdom with us during the course of this research. Huge acknowledgement would also like to be given to the Ministry of Human Resource due to their willingness in giving permission to conduct the survey activities in their programme. This research was funded under Research University Grant (PY/2016/07387).

REFERENCES

Aldrich, O.J., & Cunningham, B.J. (2016). Using IBM SPSS Statistics: Second edition. Northridge: SAGE Publications.Barton, C., & Holmes, J. (2013). Getting in and out of a car. London: Research Institute of Consumer Affairs.

Blair, J., Czaja, F.R., & Blair, A.E. (2014). Designing surveys: A guide to decisions and procedures. United States: SAGE Publications.Boyce, M.W., Fekety, D.K., & Smither, J.A. (2013). Resource consumption and simulator driving performance using adaptive controls. *Journal of Assistive Technology*, *25*, 158-165.

Browne, K. (2005). Snowball sampling: Using social networks to research non-heterosexual women. *International Journal of Social Research Methodology*, *8*, 47-60.Jones, C., Abbassian, A., Trompeter, A., & Solan, M. (2009). Driving a modified car: A simple but unexploited adjunct in the management of patients with 18 chronic right sided foot and ankle pain. *Journal of Foot Ankle Surgery*, *16*(4), 170-173.

Holmes, J. (2012). Car controls: A guide for older and disabled people. London: Research Institute of Consumer Affairs.

Jones, C., Abbassian, A., Trompeter, A., & Solan, M. (2009). Driving a modified car: A simple but unexploited adjunct in the management of patients with chronic right sided foot and ankle pain. *Procedia Manufacturing*, *16*, 170-173.

Klarborg, B., Lahrmann, H., NielsAgerholm, Tradisauskas, N., & Harms, L. (2012). Intelligent Speed Adaptation as an assistive device for drivers with acquired brain injury: A single-case field experiment. *Journal of Accident Analysis & Prevention*, *48*, 57-62.

Lakkam, S., & Koetniyom, S. (2015). Investigation of accident scenarios between pedestrians and city buses in Thailand. *International Journal of Automotive & Mechanical Engineering*, *12*, 3076-3088.

Lawton, C., Cook, S., May, A., Clemo, K., & Brown, S. (2008). Postural support strategies of disabled drivers and the effectiveness of postural support aids. *Applied Ergonomics*, *39*, 361-369.

Monacelli, E., Dupin, F., Dumas, C., & Wagstaff, P. (2009). A review of the current situation and some future developments to aid disabled and senior drivers in France. *Alliance for Engineering in Biology and Medicine*, *30*, 234-239.

Murata, Y., & Yoshida, K. (2013). Automobile driving interface using gesture operations for disabled people. *International Journal on Advances in Intelligent System*, 6(3&4), 329-341.

Nilsson, R. (2002). Evaluation of a combined brake–accelerator pedal. *Journal of Accident Analysis & Prevention*, *34*, 175-183.

Peters, B., & Östlund, J. (2005). Joystick controlled driving for drivers with disabilities. A driving simulator experiment (VTI rapport 506A). Linköping: Swedish National Road and Transport Research Institute.

Prasad, R., Hunter, J., & Hanley, J. (2006). Driving experiences of disabled drivers. *Journal of Clinical Rehabilitation*, *20*, 445-450.

Road Transport Department (2012). Form use and medical examination standards for the disabled driving license application at Malaysia Ministry of Health facility. Putrajaya, Malaysia: Road Transport Department.

Roosmalen, L.v., Paquin, G.J., & Steinfeld, A.M. (2010). Quality of life technology: The state of personal transportation. *Journal of Physical Rehabilitation and Medical Clinics*, *21*(1), 111-125.

SAE (2011). Secondary control modifications (No. J2388_21110). Warrendale, Pennsylvania: Adaptive Devices Standards Committee, SAE International.

Yamashita, M. (2014). Assistive driving simulator with haptic manipulator using model predictive control and admittance control. *Procedia Computer Science*, *39*, 107-114. doi.org/10.1016/j.procs.2014.11.016