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# Acceptance of Automated Vehicles: Case Study of Drive2theFuture Project

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**Abstract**

The transport sector has increased awareness regarding automated vehicles and their integration to reduce impacts by increasing efficiency. This paper aims to identify correlation parameters of acceptance by a pre-acceptance analysis questionnaire done by the Drive2theFuture project. To reach this, an acceptance interested questionnaire has considered determining the acceptance correlated parameters with also regression analysis and cross-cutting comparisons.
The result of the study indicates a well-balanced connection with the users' characteristics, in terms of knowledge, perception, education level, income, and privacy concerns, has a positive increase of acceptance with slight significance. Then, the correlation analysis shows acceptance is more related to education, risks, and previous knowledge of automated vehicles. So, training and interactions would increase acceptance.



*Keywords:* acceptance; automated vehicle; training; human-machine interaction; Drive2TheFuture

## 1. Introduction

European Union has a significantly raised technology-based transportation competition beyond borders; in particular, research and demonstration of automated vehicles are becoming popular around the member states. Because of this, automated vehicles and technological development have a possibility to be a key element to have less pollution, fewer accidents, and increased efficiency with having more acceptance level by providing more training for knowledge and more possibility to gain experiences while serving as automated vehicle-based transportation.

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To ensure better developments of automated vehicle technology and user/operator knowledge, an acceptance assessment study would be started from an example of the EU-funded Drive2theFuture project. Due to the acceptance, it is very critical to monitor the stakeholders' opinions and knowledge of automation and technological improvements. To target acceptance monitoring, various questionnaires and surveys are applied to make sure training is effective and well-understood to increase acceptance.

To test the hypothesis as automated vehicle technology acceptance would be improved due to training and experience in terms of attitudes and exposure, this paper focuses on the surveys/questionnaires results of the EU-funded Drive-To-The-Future project to reach enough data collection to evaluate the acceptance, in terms of changes in acceptance level due to training and existing knowledge on automation, with respect to various transport context. In particular, the study works on the acceptance of the automation concept, by regression and correlation analysis to highlight acceptance depending variables, in the transportation sector by providing pre-acceptance questionnaire responses while having a sample set from different application sites following stakeholders that are identified as vulnerable road users (such as pedestrians, cyclists, etc.), car drivers, drone pilots, drivers, passengers, authorities, train drivers, train signalers, maritime operators, and drone operators. The acceptance assessment also identifies which parameters-indicators are more crucial between all and each one of the stakeholder groups. Moreover, the study shows that, with a higher level of expectation, automated vehicles will be a key factor in the future's transportation; however, the stakeholders also highlight that the automated vehicle technology is not a preferable mode to be chosen instead of their day-to-day transport mode for current time because of the status of service efficiency in terms of travel time. On this purpose, the automation levels of transport modes are summarized in the following Table 1.

Table 1. Automation levels of transport modes (*beased on Drive2theFuture project questionnaire*)

| Transport modes | Level of automation | Ranking |
|---|---|---|
| Air | The pilot responds by himself to commands he gets from the Air Traffic Control<br>The pilot's reaction is aided by the computer on board and pilot retains complete control<br>The plane can automatically adjust to any condition with the pilot's ability to interfere at any time | 1-3 ranks.<br>1- most prefer<br>3- less prefer |
| Maritime | Extra sensors have been incorporated into the ship's bridge systems. When these sensors detect a potential disagreement, the captain and crew must react<br>The on-board frameworks are associated through a lackey to a command center<br>The control of the ship is being realized by a remote control<br>The dispatch is completely robotized, PCs and algorithms control its operation, while vision cameras around the ship | 1-4 ranks.<br>1- most prefer<br>4- less prefer |
| Rail | The train is fully controlled by operator<br>The train is controlled remotely but the operator is still at the driver's situate, he/she works the entryways and observes over the passengers' secure disembarkation<br>The train is controlled remotely. While at the station, the doors are being operated by the station's personnel. There is no conductor (driver) in the train<br>Train's control is fully automated and its operation is being monitored remotely | 1-4 ranks.<br>1- most prefer<br>4- less prefer |
| Road | The system informs/warns the driver on any potential danger. The driver decides on the necessary action. Thus, the car is always under driver's control<br>The driver expressly permits the vehicle to be in control. In this way, the car is capable as it were for a restricted number of maneuvers or driving situation<br>The driver can inquire the car to completely drive by itself beneath particular situation. The driver still expect obligation as he/she can recapture control at whatever point he/she needs<br>The car drives by itself. The driver is still there to react only in case of an unforeseen scenario, i.e. an emergency. The driver can also intervene whenever he/she wishes; but is not supposed to do so<br>No driver is present in the vehicle, which is fully automated and monitored remotely. There is not even a steering wheel in the car | 1-5 ranks.<br>1- most prefer<br>5- less prefer |

The objective is to work on the acceptance analysis on Automated Vehicle concepts and search fields in the previous projects, this study is carried out to mention an acceptance assessment and assess the correlation between acceptance and determining variables regarding a case study of Drive2theFuture project.

## 2. Literature Review

According to the study from Othman (2021), automated vehicles have an increased features that supports the sustainability and various positive effects on the transport sector by reducing impacts, pollutant, and travel time. It is important to highlight that all these developments, both in research and innovation supported by market, have a requirement to prepare a policy for automated vehicles.

After that, Becker and Axhausen (2017) indicates a preliminary survey requirement for automated vehicles. Moreover, the studies have been worked on according to the substantial impacts and benefits of automation levels (high automation, Level 4-5) that supports the vehicles autonomy increase focusing on acceptance assessment of users regarding automation in transport sector (Becker and Axhausen, 2017).

Based on study by Kaye et al. (2021), automated vehicles would be a key partner as a method to reduce the risks of collision, emission, and travel time, associated with human error, as well as various positive effects such as reduction of congestion, less pollution, and more effective energy consumption. The mobility of citizens, who have some difficulties to drive or have a movement in an urban area. User acceptance of this innovation is an important role to the uptake the new transport approach by citizens. This innovation and automation would be well-designed and introduced for efficiencies in completion of acceptance that refers to the users' characteristics, attitudes, exposure, knowledge, or the willingness to use (or have).

The study by Detjen et al. (2021) mentions automation that would have a significant impact on onboard driving tasks and human interaction. High-level automated vehicles are expected to become a game-changer in this decade. To increase the integration of automation innovations in the transport sector, the scope of human interaction with such approaches is reaching more comprehensive. This is not affecting only the vehicle user, but also other vulnerable road users, like cyclists or pedestrians, who have to have knowledge of automated vehicles. The acceptance of them is highly needed to be considered to provide more accepted and integrated technology development into the transport mode with more sustainability and efficiency. As a result of literature review, the acceptance of automated vehicles is important to increase the benefits of new technologies and innovations that would reduce the impacts of transport sector. More accepted services will be more effective; moreover, this acceptance would be assessed by an acceptance questionnaire in preliminary steps to foresee the potential barriers and solutions as recommendations.

## 3. Methodology

According to the Drive2theFuture project, a pre-acceptance questionnaire has been done to highlight respondents' knowledge, experience, and characteristics. Based on that, the data collection was taken into account by the responses to the automation pre-acceptance questionnaire. The questionnaire focuses on various automation levels (see Table 1) of road, rail, air, and maritime transport modes. The dissemination of this questionnaire was done like an online method. After data collection from this questionnaire, a statistical analysis assessment was applied.

The questionnaires consisted of different parts and subparts. The first part administered to all respondent groups consisted of six different demographic characteristics (which included Gender, Age, Country, Education, employment, and income level) and two set of questions to understand the user's exposure to AVs. The second part was specific to users of a given mode of transport and included series of questions to measure the construct: level of Acceptance, Perceived risk and Attitude towards AVs. The number of subparts(items) for the risk and acceptance varied across the different modes of transport of transportation due to the differences in their specificities and levels of Automation. However, the same ranking system was used for all modes and the question related to user attitude was similar for all modes.

In-order to capture the effects of different items which measures a particular construct, the items were aggregated to one which represented the variable and is used for further analysis. Aggregation which was done for exposure, perceived risk and attitude consisted of taking the average of the different items under each construct. In order to ensure the validity of the aggregation, an initial correlation was run to ensure the items under each construct were correlated. As the objective was to measure the acceptance of AV, the acceptance was set as the dependent variable and the Demographic characteristics, Exposure, Perceived Risk and Attitude as independent variables. Based on the variables stated, regression and correlation analysis were done in IBM SPSS and MS Excel.

## 4. Case Study of Drive2theFuture Project

The case study has highlighted to indicate the developments of the Automated Vehicles increasingly become more available in the transportation sector to support sustainable targets of the European Green Deal (2020). On this basis, the acceptance of new and innovative solutions has become more crucial to spread the use of technologies and to make them part of society. Regarding this issue, the acceptance assessment of automated vehicles was evaluated by several projects across Europe to understand the valuable points, challenges, and requirements of automated vehicle technologies in the transport sector. Based on this purpose, automated vehicle acceptance significantly increases the wideness and use of automated vehicles while having efficient, effective, and sustainable transport modes in the cities. According to the EC-funded Drive2theFuture project (Drive2theFuture, 2019), the acceptance levels of various automated transport technologies have been defined, tested, and evaluated in terms of users-drivers-operators' perspectives. Because of this, the project has been determined to be a reference study case to evaluate the user acceptance of automated vehicle technology around the city. For this reason, the reference project has been considered to highlight the acceptance level of automated vehicles around Europe to monitor the users' opinions on the automated vehicles and their acceptance in society through several questionnaires in the pilot sites of the project.

As a piece of preliminary information, Drive2theFuture aims to prepare "drivers", travelers, and vehicle operators of the future to accept and use connected, cooperative, and automated transport modes and the industry of these technologies to understand and meet their needs and wants. To achieve this, it models the behavior of different automated vehicle "drivers" & prognoses acceptance for several automated driving scenarios to assess the acceptance levels for automated vehicles by providing training -means- increased knowledge (Drive2theFuture, Grant Agreement, 2019); with respect to this main objective, the automated acceptance questionnaire has been done. Based on this, the automated vehicle acceptance questionnaire has been developed and implemented as mentioned above. The automated vehicle acceptance questionnaire aims to identify citizens' opinions, knowledge levels, concerns, social inclusion, and sustainability perspectives regarding user characteristics and various transport modes that are involving number of responses for each mode and variable. The sample of data collected with respondents from European Union member states and various non-member countries varied differently for all modes of transport. For air transport, 71.1 % of 2785 respondents were dominated by males, with many respondents in the age group 25-25 (27.5%) followed by 45-60 (23.65%) For maritime transport, a majority (72.8%) of the 2401 respondents were males with a higher share of respondents within the age group 25- 35 (25.8% followed by 45 – 60 (24.9%). The dominant income level was 10,000 to 25,000 € for all transport modes. Rail and road transport modes had 2404 and 3317 respondents with males dominating and similar results for age and income levels as above.

## 5. Results

This chapter focuses on the automated acceptance questionnaire responses to analyze them in terms of correlation and regression assessments to highlight which parameters would be more crucial for such an automated vehicle implementation for further projects. The questionnaire is a pre-acceptance assessment of automated vehicles for various transport modes that are road, rail, air, and maritime approaches.

### *5.1. Road Transport*

Road transport related acceptance questionnaire response-data has been interested considering various parameters (in terms of respondents' characteristics, experience, knowledge, travel behavior, and technology), and regression analysis, with correlation assessment, was evaluated. Furthermore, the statistical analysis for regression is modelled considering that acceptance is dependent on the variables of gender, age, country, education, employment status, income, perceive risk, attitude, and exposure. The regression analysis results, and coefficients have been summarized in the following Table 2. After that, the following table indicates the statistical analysis of the acceptance questionnaire, in terms of the acceptance regarding the variables of automated vehicle user preference, risk concerns and feel safe, automation knowledge and experience, and respondents' attitudes as summarized in the following table.

Table 2. Coefficients of the regression analysis for Road Transport.

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95,0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| Acceptance (dependent) | 0,943 | 0,139 | | 6,776 | 0,000 | 0,670 | 1,216 |
| Gender | 0,125 | 0,031 | 0,054 | 4,004 | 0,000 | 0,064 | 0,186 |
| Age | 0,031 | 0,013 | 0,034 | 2,403 | 0,016 | 0,006 | 0,057 |
| Country | -0,001 | 0,002 | -0,005 | -0,382 | 0,702 | -0,005 | 0,003 |
| Education | 0,009 | 0,012 | 0,010 | 0,748 | 0,455 | -0,014 | 0,032 |
| Employment Status | -0,007 | 0,007 | -0,012 | -0,920 | 0,357 | -0,021 | 0,007 |
| Income | -0,026 | 0,007 | -0,050 | -3,646 | 0,000 | -0,041 | -0,012 |
| Exposure | 0,009 | 0,021 | 0,006 | 0,423 | 0,672 | -0,033 | 0,050 |
| Perceived Risk | 0,006 | 0,018 | 0,005 | 0,346 | 0,729 | -0,029 | 0,042 |
| Attitude | 0,640 | 0,014 | 0,659 | 45,841 | 0,000 | 0,612 | 0,667 |
| R Square | 0,437020566399319 | | | | | | |

Furthermore, the cross-cutting analysis have been studied, with respect to case processing determination, considering an interrelation analysis between the automated vehicle acceptance level and previously mentioned variables. On this basis, it has been highlighted that respondent acceptance is more dependent on the age clusters, previous experience and knowledge; because of that, training activities and user-technology interactions have a negligible positive correlation (when increases knowledge, increases acceptance). Moreover, analysis shows that gender and attitude have a positive effect on the acceptance level of automated road vehicles. On contrary, the acceptance of automated road vehicles would be negatively affected by employment status and income levels.

The results show that there are significant positive effects of users' attitude (β=0.64) and gender (β=0.125) towards acceptance. Therefore, the acceptance of road automation is strongly dependent on people's general opinion, preferences, and attitude towards AV. The gender (male or female) is also seen to have a positive influence on the acceptance of road automation. Moreover, the income level (β=-0.026) has a slight negative impact (acceptance increasing as income level decreases), Age (β=0.031) having a slight positive influence (higher acceptance for higher ages) on road acceptance, while the other variables are consider not affecting road automation acceptance.

To have a comprehensive view of the acceptance level in relation to user characteristics (such as gender and age), the disaggregated data was analyzed. The results showed differences in automation acceptance in gender, with females (51%) choosing either high or very high and males at only 46%. This differences in gender can be explained by different perceptions and opinions between males and females. For the age groups, as expected, the acceptance level (high or very high) was highest (54%) amongst the respondents in the age group 25-35 and decreased as the age groups increased to higher ages. The acceptance level was relatively lower (47%) for age group 18- 24. At the disaggregated income level groups, the acceptance level was rather complex, with high or very-high acceptance at low-income levels and highest income and fluctuation in the middle group reflecting the poor correlation between acceptance and income.

### *5.2. Rail Transport*

Railway transport related data has been collected from the questionnaire and interested with various parameters. Moreover, the statistical analysis was done according to the mentioned variables. After that, the regression is modelled regarding the acceptance of automated vehicles in rail transport, which is dependent on the variables of gender, age, country, education, employment status, income, perceive risk, attitude, and exposure. The regression analysis results, and coefficients have been summarized in the following Table 3.

Furthermore, the cross-cutting analysis also have been done for rail transport, with respect to case processing determination, considering an interrelation analysis between the automated vehicle acceptance level and previously mentioned variables. On this basis, it has been highlighted that respondents' acceptance is more dependent on the education, attitude, previous experience, and knowledge; because of that, training activities and user-technology interactions have a positive relation when increases knowledge, increases acceptance and willingness.

Table 3. Coefficients of the regression analysis for Rail Transport.

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95,0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| Acceptance (dependent) | 1,064 | 0,118 | | 9,029 | 0,000 | 0,833 | 1,295 |
| Gender | 0,002 | 0,026 | 0,001 | 0,082 | 0,935 | -0,049 | 0,053 |
| Age | -0,020 | 0,011 | -0,027 | -1,768 | 0,077 | -0,042 | 0,002 |
| Country | -0,001 | 0,002 | -0,011 | -0,780 | 0,436 | -0,005 | 0,002 |
| Education | 0,019 | 0,010 | 0,027 | 1,804 | 0,071 | -0,002 | 0,040 |
| Employment Status | -0,019 | 0,006 | -0,045 | -3,077 | 0,002 | -0,031 | -0,007 |
| Income | 0,005 | 0,006 | 0,011 | 0,753 | 0,452 | -0,007 | 0,017 |
| Perceived Risk | 0,014 | 0,015 | 0,015 | 0,944 | 0,345 | -0,015 | 0,044 |
| Attitude | 0,589 | 0,013 | 0,721 | 44,342 | 0,000 | 0,563 | 0,616 |
| Exposure | 0,020 | 0,017 | 0,016 | 1,141 | 0,254 | -0,014 | 0,054 |
| R Square | 0,529610476876335 | | | | | | |

The results show that there are significant positive effects of users' attitude (β=0.59), and negative effects of users' age (β= -0.020) towards acceptance. Therefore, the acceptance of rail automation is strongly dependent on people's general opinion, preferences, and attitude towards automated vehicles.

The disaggregated information was examined to have a comprehensive see of the acknowledgment level in connection to user characteristics. The difference between the genders is the next: male acceptance is higher 49% while for females is 39%. The situation with an age shows as predictable, the higher level of acceptance is for young people - category 25-35 (57%) and the lowest is for an old - >60 (33%).

## *5.3. Air Transport*

After the acceptance questionnaire, air transport data has been obtained and assessed regarding several performance parameters, and statistical analysis that are summarized. Air transport automated vehicles were represented with drone technology during the questionnaire. The acceptance has significant variances on income, privacy risk, and education also regarding a policy availability as national or European levels.

After that, the analysis indicates the case processing summary, in terms of the acceptance regarding the variables of gender, age, country, education, employment status, income, perceive risk, attitude, and exposure that are summarized as Gender*Acceptance, Age*Acceptance, Attitude*Acceptance, and Exposure*Acceptance. These cross-assessment show that exposure and attitudes are significantly positive for the rail automation acceptance level.

In the end, the statistical analysis for regression is modelled considering that acceptance is dependent on the variables of gender, age, country, education, employment status, income, perceive risk, attitude, and exposure. The regression analysis results, and coefficients have been summarized in the following table (see Table 4).

Furthermore, the cross-assessment analysis was proceeded. The results highlight that interrelation between the acceptance of automated air vehicles has a negative correlation between age, education level and employment status; on contrary, it would be affected positively by attitude.

The results show that there are significant positive effects on users' attitudes (β=0.632) toward acceptance. Therefore, analyzing the obtained data, level of adoption of air automation is highly dependent on the impact (β=0.05), gender that has a similar trend of acceptance in the different levels for both females and males (β=0.032) and perceived risk (β=0.025). But all other indicators, such as age (β=-0.005), education (β=-0.025), and employment status (β=-0.007) have a slightly negative influence, and do not significantly affect the acceptance of air automation, or are not affecting maritime automation acceptance (country, income).

The investigation was conducted at the disaggregated level to explore completely the impact of user characteristics on acknowledgment. Level of acceptance between males and females is not much different – for females 32 % and for males 38%. Results for the groups of age have a slight difference. The highest level is for the group of 36-45 (40%) and the lowest is for the group of >60 (26%).

Table 4. Coefficients of the regression analysis for Air Transport.

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95,0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| Acceptance (dependent) | 0,776 | 0,122 | | 6,370 | 0,000 | 0,537 | 1,014 |
| Gender | 0,032 | 0,029 | 0,016 | 1,098 | 0,272 | -0,025 | 0,090 |
| Age | -0,005 | 0,013 | -0,006 | -0,376 | 0,707 | -0,030 | 0,020 |
| Country | 0,006 | 0,002 | 0,050 | 3,420 | 0,001 | 0,003 | 0,010 |
| Education | -0,025 | 0,011 | -0,032 | -2,181 | 0,029 | -0,047 | -0,003 |
| Employment Status | -0,007 | 0,007 | -0,015 | -1,025 | 0,305 | -0,021 | 0,006 |
| Income | 0,003 | 0,007 | 0,006 | 0,405 | 0,685 | -0,010 | 0,016 |
| Perceived Risk | 0,025 | 0,016 | 0,023 | 1,536 | 0,125 | -0,007 | 0,057 |
| Attitude | 0,632 | 0,014 | 0,674 | 44,290 | 0,000 | 0,604 | 0,660 |
| Exposure | 0,050 | 0,020 | 0,036 | 2,533 | 0,011 | 0,011 | 0,088 |
| R Square | 0,448656614768655 | | | | | | |

## *5.4. Maritime Transport*

The automated vehicle acceptance questionnaire indicates also maritime transport to provide the data that has been interested with various parameters, and statistical analysis was considered.

In the end, the statistical analysis for regression is modelled considering that acceptance is dependent on the variables of gender, age, country, education, employment status, income, perceive risk, attitude, and exposure. The regression analysis results, and coefficients have been summarized in the following table (see Table 5).

Table 5. Coefficients of the regression analysis for Maritime Transport.

| | Unstandardized Coefficients | | Standardized Coefficients | | | 95,0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| Acceptance (dependent) | 1,008 | 0,117 | | 8,604 | 0,000 | 0,778 | 1,238 |
| Gender | 0,063 | 0,027 | 0,032 | 2,311 | 0,021 | 0,010 | 0,116 |
| Age | -0,039 | 0,012 | -0,047 | -3,276 | 0,001 | -0,063 | -0,016 |
| Country | 0,004 | 0,002 | 0,035 | 2,589 | 0,010 | 0,001 | 0,008 |
| Education | -0,009 | 0,011 | -0,012 | -0,883 | 0,378 | -0,030 | 0,011 |
| Employment Status | -0,011 | 0,006 | -0,024 | -1,760 | 0,079 | -0,024 | 0,001 |
| Income | -0,001 | 0,006 | -0,003 | -0,206 | 0,837 | -0,014 | 0,011 |
| Exposure | 0,002 | 0,018 | 0,001 | 0,090 | 0,928 | -0,034 | 0,037 |
| Perceived Risk | -0,039 | 0,015 | -0,036 | -2,518 | 0,012 | -0,069 | -0,009 |
| Attitude | 0,708 | 0,014 | 0,744 | 51,132 | 0,000 | 0,681 | 0,736 |
| R Square | 0,586112323655148 | | | | | | |

Furthermore, the cross-assessment analysis has been studied, with respect to case processing determination, considering an interrelation analysis between the automated vehicle acceptance level and previously mentioned variables. The statistical analysis shows that automated maritime vehicles have a negative correlation with age, education level, and employment status; however, it would be positively affected by attitude.

On this purpose, the analysis indicates that automated ships are mainly concerned with the automation level (higher automation, less acceptance) and age clusters (elder citizens have less acceptance). Moreover, the country is also effective to increase acceptance level (more policy availability, more acceptance).

The results show that there are significant positive effects of users' attitude ($\beta$=0.708) towards acceptance. Therefore, the acceptance of maritime automation is strongly dependent on individual's general opinion, preferences and attitude towards AV. The gender type (with $\beta$=0.063) also shows a positive influence on the acceptance of maritime automation. However, the effects could be as a result of the dominance of males in the survey. Analysis on the effect of each gender type (male, female or other) to acceptance shows similar trends for the different levels of acceptance (very low-very high). Age and perceived risk rank equitably (with β= -0.039) and have a slight negative influence on acceptance. Therefore, as risk and age increase there is an expected decrease on automation acceptance. Other variables (country, education level, employment status and exposure) are not significantly affecting maritime automation acceptance.

The analysis was also carried out at the disaggregated level to fully under the effect of user characteristics on acceptance. It was noticed that for maritime automation there was no significant difference between males and females in accepting automation as males (39%) and females (38%) had high or very high acceptance to AV. For the age group, the acceptance level (high or very high) was highest (44.5%) amongst the respondents in the age group 25-35 and least (32%) for > 60 years, which shows higher acceptance in the more active population.

## 6. Conclusion and Recommendations

In conclusion, the analysis results indicate that the correlation between automated vehicle and acceptance would have well-balanced connection with the users' characteristics in terms of knowledge, perception, education level, income, and privacy concerns. In addition to this, cross-cutting analysis shows that age and attitude is also valuable to be considered. However, the dependency of acceptance on user characteristics varies across the different transport modes and a stronger inference cannot be drawn to generalize the effects of user characteristics on acceptance. It is obvious that for some transport modes (for example roads) particular user characteristics (for example gender) become important in accepting autonomous vehicles

The analysis shows that the age positively effects the only automated road transport vehicles; on contrary, all other modes would be affected negatively. Education level has a positive effect on automated vehicles on road and rail transport; on contrary, it negatively affects acceptance of air and maritime automated transportation. Employment status has a negative effect on acceptance of all automated transport modes. As expected, attitudes have a positive effect on the acceptance of all automated transport modes. Furthermore, income level has a positive effect on the acceptance of maritime and road transport automation; however, it would be a negative effect on the acceptance of automated rail and air transport.

The results highlight that automated vehicle acceptance is directly dependent on knowledge, better understanding, and improved human-machine interaction. After all these, the study provides regression analysis and correlation statistics with respect to user characteristics and exposure, attitudes, and perceived risks of automated vehicle service demonstration in such urban environments.

On this basis, further developments would be having a scaling-up methodology to increase the coverage of all key performance indicators; in particular, to assess environmental effects concerning less emission and consumption by providing essential training and human-machine interaction.

For the further studies, it is important to work with some analysis models such as Hierarchical Analysis to see validation and further developments.

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