ICT implementation of bus public transportation towards green engineering in Indonesia

A C Sutandi1*, Y Suriansyah2 and Y K Kusliansjah2
1Civil Engineering Department, Parahyangan Catholic University, Bandung, Indonesia
2 Architecture Department, Parahyangan Catholic University, Bandung, Indonesia

*Corresponding Author Email: caroline@unpar.ac.id

Abstract. Green engineering can be applied to road infrastructure and in public transport. ICT application regarding bus operation can improve services to bus passengers. Furthermore, it encourages society to use public transport and it leads to sustainable transportation by reducing traffic congestion and pollution to the environment. The aims of this study are to evaluate the existing ICT application regarding bus operation, development of ICT application, and provide recommendations to improve services to the passenger. Case studies are ICT application in large cities in Indonesia i.e. Qlue in Jakarta, E-Wadul in Surabaya, and Pro-Denpasar in Denpasar. The results of cross-tabulation analysis indicated that implementation of ICT application on the bus is still at an early stage. Moreover, based on the level of importance and priority of passengers, the aspects of the application are response to passenger’s report, bus services, and application facility to minimize reporting errors, whereas the aspects that have to be improved is the punctuality of bus’ arrival at the bus stop and fixed bus schedule. Government and society have to work together continuously and consistently, so that ICT implementation towards green engineering could provide higher benefit to the passengers.

1. Introduction
Green engineering is about design activities that provide efficient and effective products that will not burden society and environment in the future. Application of green engineering in public transportation can be green material or Information Communication Technology (ICT) application that can increase road safety and decrease traffic congestion. ICT application in this study focuses on bus operation as public transportation, because these applications are new facilities in Indonesia that has yet to be evaluated thoroughly. Whereas ICT like bus e-ticket is a common application. But it has yet to fulfill the expectation of society, especially bus passengers. With this condition, services to passengers have to be improved and furthermore will encourage society to use public transportation [1-7]. Therefore, evaluation of implementation of ICT application is an important action to do. The aims of this study are to evaluate the performance of the existing ICT application regarding bus operation in Indonesia, development of ICT applications, and provide recommendations to improve ICT application and increase services to passengers. The case studies for this research are ICT applications for bus operation in large cities in Indonesia, such as Qlue ICT application in Jakarta, E-Waduk ICT application in Surabaya, and Pro-Denpasar ICT application in Denpasar [8-10]. 665 bus passengers were involved in this study as respondents. In order to have substantial benefit to bus
passengers, the implementation of the ICT application towards green engineering has to implicate government and society to work together continuously and consistently.

2. Material and method

2.1. ICT Implementation regarding bus in Indonesia

This study focuses on the implementation of ICT applications of bus operation in Indonesia. Although ICT is very popular around the world, its implementation in Indonesia is not yet comprehensive and integrated. One of the implementation examples of ICT application in Indonesia is in bus operation, as a part of green road engineering implementation, and it still is at the early stage. Since ICT Implementation regarding bus operation in Indonesia is very important, a study regarding the performance of ICT application is crucial to do. The result of this study can improve the services of bus passengers. Research Methodology explain the steps to fulfil the aim of this study is presented in figure 1.

![Research Methodology](image)

2.2. Field data about ICT implementation of bus operation

Case studies are ICT applications regarding bus operation in large cities in Indonesia i.e. Qlue ICT application, E-Wadul ICT application, and Pro-Denpasar ICT application. Qlue is an ICT application
that has been operating since 2014 in Jakarta, the capital city of Indonesia. This ICT application facilitates local citizen to communicate to local government regarding transportation services, including bus operation (TransJakarta bus). By using this ICT application, local government can quick check the input and then do quick respond and quick implementation to improve the bus operation services [8]. E-Wadul is the ICT application in Surabaya, East Java, Indonesia, that can be used to provide input and complain to local government regarding the infrastructure, which includes bus operation since 2016. For example: road condition, road lighting, and bus operation [9]. Pro-Denpasar is the online service to society in Denpasar, Bali, Indonesia. This application has been operating since 2013. By using Pro-Denpasar, the local citizen can do online communication to local government regarding transportation services, including bus operation. In 2016, there was a control room named Damamaya Denpasar Cyber Monitor (DDCM). Local government can also use input, suggestion, and complain from the citizen to evaluate and improve bus operation services [10]. All ICT applications can be downloaded from the internet (App Store or Play Store) using a website or mobile phone. People will use the applications more often if they have easier and simpler interface. Therefore, this study is important to evaluate how to improve the online ICT application in order to increase public services to the local citizen, especially regarding bus operation services to bus passenger.

The data of bus passenger population is obtained from terminal authorities, such as Jakarta Smart City 2016 [8]. The questionnaire regarding information communication technology is used in this study. The questionnaire consists of the demography of bus passengers, existing ICT implementation regarding bus operation based on passenger’s experience and opinion, and development of the ICT application that is needed by passengers based on their experience. A minimum number of respondents is counted using the minimum sample size equation as required based on the population’s number [11]. Minimum number of respondents in Denpasar, Surabaya, and Jakarta is presented in table 1. Respondents in this study are bus passengers that have experience using ICT applications. The minimum number of passengers as respondents is 665 passengers. This number is much more than the minimum sample size n. Therefore, the analysis and result of this study are valid. Likert scale between 1 to 5 is used to measure the level of importance and priority. 1 means it has the lowest value of importance rate and priority rate, while 5 means it has the highest value of importance rate and priority rate, based on passenger’s opinion [11]. Detail demography data of bus passengers as respondents is presented in table 2. Whereas the implementation of ICT application regarding bus public transportation based on passenger’s experience and passenger’s opinion is presented in table 3. Furthermore, the development of the ICT application to improve passenger’s services needed by all passengers is presented in table 4.

Table 1. Minimum number of bus passenger involved in Denpasar, Surabaya, and Jakarta, Indonesia.

| Average number of bus passenger per day | Minimum number of bus passengers |
|----------------------------------------|----------------------------------|
| Population size N                      | Denpasar | Surabaya | Jakarta |
| Standard error e                       | 2,048    | 31,131   | 30,866  |
| Minimum sample size n                  | 96       | 100      | 100     |
| Bus passengers as respondents in this study | 136      | 429      | 100     |
| Total number = 136 + 429 + 100 = 665  | |

Legend: Minimum sample size \( n = \frac{N}{1 + N (e)^2} \) [11]

3. Results and discussion

3.1. Analysis of ICT implementation on bus in Indonesia

Data in table 2 indicates that in general most of bus passengers are male, young person under 25 years old with high school education level with a salary between 2.6 – 5 million rupiah (180 USD – 380 USD), they ride bus to go to work for more than 24 months due to cheaper ticket price, and have used
ICT application at least 2 times, they previously ride motorcycle as a transportation mode before riding the bus. Table 3 shows that in average, the highest value of level of importance and level of priority regarding performance of ICT application, based on passenger’s opinion, are bus authority response to passenger’s report, the application’s impact to increase bus services, and facility of ICT application i.e. “cancel” and “back” to minimize reporting error. Data in table 4 shows that 76 percent of bus passengers use ICT application for 1 time, and the latest time using the application is less than 1 month. Then, based on the passenger’s experience and need, the part of ICT application that needs to be improved the arrival time of the bus at the bus stop and the schedule. This means that the bus operator needs to arrive on time at bus stop. Using data in tables 2, 3, and 4, and then cross-tabulate the analysis regarding the level of importance and priority of the implementation of ICT applications. This will result in the detail of all respondent’s demography, this data is presented in table 5.

Table 2. Demography of bus passengers as respondents.

| Respondent’s Demography Data | Number of Respondent | Quie | E-Wadul | Pro-Denpasar | Total |
|------------------------------|----------------------|------|---------|--------------|-------|
| Gender          | Male/ Female | 57/43 | 228/201 | 77/59 | 362/303 |
| Age            | < 25       | 52    | 178     | 46    | 276    |
|                | 26 – 35    | 35    | 124     | 3     | 162    |
|                | 36 – 45    | 11    | 86      | 25    | 122    |
|                | 46 – 55    | 1     | 30      | 31    | 62     |
|                | > 55       | 1     | 11      | 31    | 43     |
| Education      | Primary school | 12 | 3 | 22 | 37 |
|                | Secondary School | 9 | 13 | 35 | 57 |
|                | High School | 7 | 151 | 47 | 205 |
|                | Undergraduate | 67 | 76 | 3 | 146 |
|                | Graduate | 5 | 186 | 29 | 220 |
| Salary (in million Rupiah) | < 1 | 13 | 36 | 33 | 82 |
|                | 1 – 2.5    | 12    | 98      | 49    | 159    |
|                | 2.6 – 5    | 31    | 159     | 32    | 222    |
|                | 5.1 – 10   | 26    | 104     | 19    | 149    |
|                | > 10       | 18    | 32      | 3     | 53     |
| Bus passenger’s purpose | Work | 42 | 105 | 50 | 197 |
|                | Education  | 11    | 120     | 23    | 154    |
|                | Tourism    | 20    | 70      | 12    | 102    |
|                | Daily activity | 21 | 50 | 20 | 91 |
|                | Urgent activity | 6 | 84 | 31 | 121 |
| Frequency of riding bus per week (times) | Fist time | 40 | 117 | 29 | 186 |
|                | 1 – 2      | 47    | 153     | 46    | 246    |
|                | 3 – 4      | 4     | 77      | 40    | 121    |
|                | 5 – 6      | 2     | 23      | 16    | 41     |
|                | 7          | 7     | 59      | 5     | 71     |
| Reason of using bus | Doesn’t have any vehicle | 16 | 51 | 36 | 103 |
|                | Faster travel time | 10 | 44 | 12 | 66 |
|                | Cheaper ticket price | 42 | 186 | 50 | 278 |
|                | More comfortable trip | 20 | 79 | 37 | 136 |
|                | Safer trip  | 12    | 69      | 1     | 82     |
| Transportation mode before using bus | Walk | 5 | 5 | 25 | 35 |
|                | Private car | 21 | 111 | 8 | 140 |
|                | Private motorcycle | 38 | 185 | 32 | 255 |
|                | Paratransit/online-veh | 31 | 114 | 60 | 205 |
|                | Taxi       | 5     | 14      | 11    | 30     |
Table 3. Performance of the ICT application regarding bus public transportation based on the passenger’s opinion.

| Code | ICT Application                                                                 | Qlue | E-Wadul | Pro-Denpasar | Average |
|------|--------------------------------------------------------------------------------|------|---------|--------------|---------|
|      |                                                                                 | L_I | L_P     | L_I          | L_P     | L_I          | L_P     |
| Q1   | Notification of passenger’s report process                                      | 3.78| 3.70    | 4.00         | 3.64    | 3.85         | 3.70    | 3.88         | 3.68 |
| Q2   | Language used is formal and understandable                                      | 3.77| 3.77    | 3.78         | 3.69    | 3.93         | 3.77    | 3.83         | 3.74 |
| Q3   | Navigation is usable                                                            | 3.88| 3.79    | 3.86         | 3.74    | 3.89         | 3.83    | 3.88         | 3.79 |
| Q4   | “cancel” and “back” buttons to minimize reporting error                         | 3.97| 3.79    | 4.02         | 3.92    | 3.93         | 3.84    | 3.97         | 3.85 |
| Q5   | The reporting process is easy and simple                                         | 3.76| 3.69    | 4.00         | 3.84    | 4.13         | 4.01    | 3.94         | 3.85 |
| Q6   | The application is user-friendly for new users                                   | 3.80| 3.64    | 3.94         | 3.74    | 4.04         | 3.90    | 3.93         | 3.76 |
| Q7   | The application design is simple and easy to understand                          | 3.62| 3.71    | 3.87         | 3.66    | 3.86         | 3.75    | 3.78         | 3.71 |
| Q8   | Features to inform “error” to the user                                           | 3.82| 3.75    | 3.84         | 3.72    | 3.84         | 3.69    | 3.83         | 3.72 |
| Q9   | A “help” feature to assist the user                                             | 3.53| 3.60    | 3.88         | 3.57    | 3.88         | 3.71    | 3.76         | 3.59 |
| Q10  | The application’s impacts in increasing bus services                             | 3.94| 3.48    | 3.94         | 3.79    | 4.14         | 4.13    | 4.01         | 3.80 |

Legend: q_n = question number n, L_I is level of Importance, L_P is level of Priority

Table 4. Development of the ICT application to improve services based on the passenger’s opinion.

| Code | Development of the ICT Data | Number of passengers | Qlue | E-Wadul | Pro-Denpasar | % out of 655 respondent |
|------|-----------------------------|----------------------|------|---------|--------------|-------------------------|
|      |                             |                      | Qlue | E-Wadul | Pro-Denpasar |
| D1   | Times of using ICT application|                     | 67   | 300     | 131          | 76                      |
|      | 1 – 4                       |                      | 26   | 107     | 5            | 22                      |
|      | 4 – 7                       |                      | 4    | 17      | 0            | 2                       |
|      | 8 – 10                      |                      | 2    | 5       | 0            | 0                       |
|      | > 10                        |                      | 1    | 0       | 0            | 0                       |
| D2   | Latest time using the application (month)                                   |                      | 40   | 140     | 90           | 42                      |
|      | < 1                         |                      | 18   | 99      | 4            | 15                      |
|      | 2 – 3                       |                      | 18   | 99      | 2            | 19                      |
|      | 4 – 5                       |                      | 8    | 36      | 4            | 7                       |
|      | > 7                         |                      | 16   | 55      | 36           | 17                      |
| D3   | Complain about bus services                                               |                      | 16   | 39      | 53           | 17                      |
|      | Different bus route                                                                  | 48   | 39      | 65           | 49                      |
|      | Bus doesn’t arrive on time at bus stop                                         | 9    | 206     | 13           | 9                       |
|      | Broken bus                                                                 | 15   | 39      | 5            | 16                      |
|      | Not obeying the traffic regulation                                            | 12   | 82      | 0            | 9                       |
|      | Bus physical condition                                                       |                      | 36   | 137     | 69           | 33                      |
|      | Facility in the ICT application                                              |                      | 20   | 116     | 0            | 21                      |
|      | Bus schedule                                                                 |                      | 28   | 141     | 14           | 29                      |
|      | Bus real time location                                                        |                      | 16   | 35      | 53           | 17                      |
|      | Others                                                                      |                      | 0    | 0       | 0            | 0                       |
Table 5. Cross tabulation analysis of ICT application based on the passenger’s demography

| Data of Respondent’s Demography | Q1  | Q2  | Q3  | Q4  | Q5  | Q6  | Q7  | Q8  | Q9  | Q10 | Q11 | Q12 |
|---------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                                 | L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P| L₁P|
| **Gender**                      |     |     |     |     |     |     |     |     |     |     |     |     |
| Male                            | 3.9/| 3.9/| 3.9/| 4.0/| 4.0/| 4.0/| 3.9/| 3.9/| 3.9/| 4.0/| 4.0/| 3.8/|
| Female                          | 3.7/| 3.7/| 3.8/| 3.9/| 3.9/| 3.9/| 3.7/| 3.7/| 3.7/| 3.9/| 4.0/| 3.8/|
| Age < 25                        | 4.1/| 4.2/| 4.1/| 4.2/| 4.3/| 4.3/| 4.0/| 4.0/| 4.1/| 4.2/| 4.3/| 4.0/|
| 26 – 35                         | 3.9/| 3.7/| 3.9/| 4.0/| 3.9/| 3.9/| 3.9/| 3.9/| 4.1/| 4.1/| 4.1/| 3.8/|
| 36 – 45                         | 3.5/| 3.7/| 3.8/| 3.9/| 4.0/| 3.8/| 3.6/| 3.7/| 3.6/| 3.8/| 4.0/| 3.7/|
| 46 – 55                         | 3.6/| 3.6/| 3.7/| 3.8/| 3.7/| 3.6/| 3.7/| 3.6/| 3.9/| 3.9/| 3.7/| 3.7/|
| > 55                            | 3.7/| 3.4/| 3.5/| 3.6/| 3.9/| 3.5/| 3.4/| 3.4/| 3.3/| 4.0/| 4.1/| 3.7/|
| Education                       |     |     |     |     |     |     |     |     |     |     |     |     |
| Primary school                  | 3.4/| 3.5/| 3.4/| 3.4/| 3.6/| 3.6/| 3.3/| 3.3/| 3.3/| 3.7/| 3.7/| 3.4/|
| Secondary School                | 3.3/| 3.4/| 3.4/| 3.4/| 3.5/| 3.4/| 3.3/| 3.3/| 3.3/| 3.7/| 3.7/| 3.3/|
| High School                     | 3.7/| 3.7/| 3.7/| 3.7/| 4.3/| 4.3/| 3.3/| 3.3/| 3.3/| 4.0/| 4.0/| 3.5/|
| Diploma                         | 3.9/| 3.9/| 3.9/| 4.0/| 4.1/| 4.0/| 3.8/| 3.9/| 4.0/| 4.1/| 3.9/| 3.9/|
| Under/Graduate                  | 3.5/| 3.7/| 3.7/| 3.7/| 3.8/| 3.4/| 3.7/| 3.4/| 3.7/| 4.1/| 4.2/| 3.3/|
| Salary (million Rp)             |     |     |     |     |     |     |     |     |     |     |     |     |
| < 1                             | 3.7/| 3.8/| 3.7/| 3.8/| 3.8/| 3.9/| 3.8/| 3.7/| 3.6/| 4.0/| 3.8/| 3.8/|
| 1 – 2.5                         | 3.9/| 3.7/| 3.7/| 3.3/| 4.0/| 3.9/| 3.6/| 3.8/| 3.8/| 4.0/| 3.9/| 3.9/|
| 2.6 – 5                         | 3.6/| 3.6/| 3.6/| 3.6/| 3.9/| 3.8/| 3.5/| 3.7/| 3.9/| 3.9/| 3.8/| 3.9/|
| 5.1 – 10                        | 3.8/| 3.6/| 3.7/| 3.9/| 3.8/| 3.8/| 3.9/| 3.7/| 4.1/| 4.0/| 4.1/| 3.7/|
| > 10                            | 4.3/| 4.3/| 4.4/| 4.4/| 4.4/| 4.4/| 4.1/| 4.1/| 4.3/| 4.4/| 4.3/| 4.3/|
| Purpose                         |     |     |     |     |     |     |     |     |     |     |     |     |
| Working                         | 3.8/| 3.7/| 3.7/| 3.8/| 3.9/| 3.8/| 3.7/| 3.8/| 3.9/| 4.0/| 3.7/| 3.7/|
| Education                       | 3.7/| 3.6/| 3.6/| 3.8/| 3.8/| 3.7/| 3.6/| 3.5/| 3.9/| 3.9/| 3.9/| 3.6/|
| Tourism                         | 4.2/| 4.1/| 4.1/| 4.2/| 4.3/| 4.3/| 4.1/| 4.2/| 4.3/| 4.3/| 4.1/| 4.1/|
| Daily activity                  | 4.0/| 4.2/| 4.3/| 4.3/| 4.2/| 4.3/| 4.2/| 4.3/| 4.3/| 4.3/| 4.3/| 4.1/|
| Urgent activity                 | 3.9/| 3.6/| 3.7/| 3.7/| 4.0/| 3.9/| 3.7/| 3.6/| 3.7/| 4.1/| 4.2/| 3.6/|
| Frequency/week                  |     |     |     |     |     |     |     |     |     |     |     |     |
| First time                      | 4.0/| 4.1/| 4.2/| 4.2/| 4.3/| 4.2/| 4.1/| 3.9/| 4.0/| 4.2/| 4.3/| 4.0/|
| 1 – 9                            | 3.9/| 3.8/| 3.7/| 3.9/| 4.0/| 3.9/| 3.9/| 3.9/| 4.1/| 4.2/| 4.3/| 4.0/|
| 7 – 10                           | 3.6/| 3.7/| 3.7/| 3.8/| 3.9/| 3.7/| 3.6/| 3.7/| 3.9/| 4.0/| 4.1/| 3.6/|
| 5 – 9                            | 3.9/| 3.6/| 3.7/| 3.9/| 4.0/| 3.9/| 3.7/| 3.7/| 3.9/| 4.0/| 4.1/| 3.7/|
| Reason of using bus             |     |     |     |     |     |     |     |     |     |     |     |     |
| Have no vehicle                 | 3.9/| 3.8/| 3.8/| 3.9/| 4.0/| 3.9/| 3.8/| 3.8/| 3.8/| 4.1/| 4.1/| 3.8/|
| Faster time                      | 3.7/| 3.7/| 3.8/| 3.9/| 4.0/| 3.7/| 3.6/| 3.7/| 3.7/| 4.0/| 4.1/| 3.8/|
| Cheaper price                   | 3.9/| 3.9/| 3.9/| 3.9/| 4.0/| 4.0/| 3.9/| 3.9/| 3.9/| 4.0/| 3.9/| 3.9/|
| Comfortable trip                | 3.6/| 3.7/| 3.7/| 3.8/| 3.9/| 3.8| 3.8| 3.7| 3.7| 4.0| 4.0| 3.8|
| Safer trip                      | 4.6/| 4.4/| 4.5/| 4.5/| 4.1/| 4.4/| 4.3/| 4.3/| 4.4/| 4.5/| 4.4/| 4.4/|
| 4.3/ 4.4/ 4.5/ 4.5/ 4.1/ 4.4/ 4.3/ 4.4/ 4.3/ 4.4/ 4.5/ 4.4/
3.2. Recommendation to increase ICT implementation in Indonesia

It can be concluded in table 5 that in general, the value of level of importance and priority are quite high (>3.00), and the most important and prioritized aspect of implementation of the ICT application, based on bus passenger’s experience after cross tabulation analysis, are the bus authority’s response to passenger’s report (Q10) and the features of ICT application i.e. “cancel” and “back” to minimize reporting error (Q4). In details, the value of level of importance and level of priority based on bus passenger’s gender is similar, but the highest value (≥4.00) of level of importance and level of priority are from bus passengers with age less than 25 years old, undergraduate/graduate level of education, have salary more than 10 million rupiah (USD715), ride bus for tourism and once in a week, citing safer trip as a reason of using bus, they ride bus less than one month, and ride passenger car as transportation mode before using bus. Furthermore, the lowest value of level of importance and priority are from bus passengers older than 50 years old with primary school level of education and salary less than 1 million rupiah (USD72), they ride bus for work seven times a week, they don’t have a car and have been using bus for a long time (more than two years), they are less appreciative of the implementation of ICT application. Therefore, local government and bus authority have to pay more attention to this group of passengers. Moreover, their appreciation to the implementation of ICT application with the lowest value of level of importance and level of priority are features to inform “error” to the user (Q9) and bus services ICT information in the application (Q12) have to be considered as important aspects to be improved soon and in the future.

4. Conclusion

Green engineering in public transportation can be implemented by using ICT applications. The implementation on the bus in Indonesia is an important action to do. The result indicated that the most important and prioritized things, based on passenger’s experience, in the three large cities as the case studies, are the information regarding the arrival time at the bus stop and fixed bus schedule. Since in Indonesia public transportation bus is under the control of the government, implementation of the ICT towards green engineering has to involve government so it would substantially benefit local citizens. Moreover, they have to work together continuously and consistently. Result of this study can be a worthy input to the road authority and local government to always improve ICT implementation towards green engineering in Indonesia.
Acknowledgments

Thank you to Research and Community Services Directorate, Research and Development Strengthening Directorate General, Ministry of Research, Technology, and Higher Education, Republic of Indonesia and LPPM Unpar for supporting this paper.

References

[1] Jakarta Smart City 2016 Qlue Report Number 2016 (http://smartcity.jakarta.go.id/, accessed 1 May 2017)

[2] Ott R L and Longnecker M T 2010 An Introduction to Statistical Methods and Data Analysis 6th edition (Texas A&M University: published College Bookstore Wholesale) ISBN-13:9780495017585

[3] Government of Surabaya City 2017 E-Wadul (https://apkpure.com/e-wadul/gov.surabaya.mediacenter)

[4] Information and Communication Service, Denpasar City 2017 PRODENPASAR (https://pengaduan.denpasarkota.go.id/id/Profil)

[5] United State Environmental Protection Agency 2017 Green Engineering (https://www.epa.gov/green-engineering accessed April 2019)

[6] ACS Green Chemistry 2019 ACS Green Chemistry Institute & Reg. Advisory Board (https://www.acs.org/content/acs/en/greenchemistry/principles/12-design-principles-of-green-engineering.html accessed April 2019)

[7] Rosselot K and Allen D T 2017 Green Engineering Text Book 508 (https://www.epa.gov/sites/production/files/2015-08/documents/green-engineering-textbook_508_0.pdf accessed April 2019)

[8] Nikumbh K P and Aher P D 2017 A Review Paper - Study of Green Highway Rating Systeme Int. Research J. of Engineering and Technology (IRJET) 04(05) 2104-2108 e-ISSN: 2395 -0056 (https://www.irjet.net/archives/V4/i5/IRJET-V4I5560.pdf)

[9] Allen H 2010 Sustainable Public Transport – the Smart Green Solution EST Forum Bangkok, Thailand, August 23-25th 2010 (http://www.uncrd.or.jp/content/documents/5EST-P2-1.pdf)

[10] S K Jason Chang and Y T Hsu 2014 Smart Travel and Sustainable Mobility for Green Transport Cities New Cities Foundation (www.newcitiesfoundation.org, https://newcities.org/wp-content/uploads/2014/04/PDF-Research-Re-imagining-Urban-Mobility-Smart-Travel-and-Sustainable-Mobility-for-Green-Transport-Cities-S-K-Jason-Chang-Y-T-Hsu.pdf)

[11] Susanto T D 2019 SMART CITY: Bunga Rampai Pengetahuan, Gagasan, & Rekomendasi ITS untuk Indonesia (publisher AISINDO) ISBN : 978-602-74309-4-5, first printed, March 2019