ANALYSIS UNSUSTAINABLE TRANSPORTATION USING THEORY OF CONSTRAINT WITH ISLAMIC PRINCIPLE COMBINING WITH QUALITY FUNCTION DEPLOYMENT METHOD

(Case Study: Sustainable Development Goals 9)

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AUTHENTICITY STATEMENT

In the name of Allah, I hereby certify that this research is based on my own work expect for citations and summaries in which of those is explicitly knowledge. If in the future this statement is proved not right and violates the legal regulation of papers and intellectual property rights, I agree Universitas Islam Indonesia to revoke my bachelor certificate.

Yogyakarta, 1st April 2019

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(Case Study: Sustainable Development Goals 9)

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DEDICATION PAGE

This undergraduate thesis I dedicate to,

My Beloved Parents, Father and Mather

Whenever I said family comes first, I really mean it

My Super Class, International Program Industrial Engineering 2014

Where I learn a lot of things

My Alma mater, Universitas Islam Indonesia

With all those chances, values, and lessons I got from lecturers, staffs, and colleagues

MOTTO

فَإِنَّ مَعَ الْعُسْرِ يُسْرًا

Verily, after every difficulty there is relief (QS Ash-Sharh 94:5)

PREFACE

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ABSTRACT

One concern faced by the UN is the unsustainability of the transportation system which causes various problems, such as high levels of emissions, climate conditions that continue to deteriorate due to global warming, the issue of the availability of reserve energy for the next generation. This study aims to develop a framework in the form of a logic tree from the Theory of Constraint (TOC) method, in order to analyse the factors that hinder sustainable transportation through literature study of previous research. The findings show the high ownership of private vehicles, public transportation facilities that are not evenly distributed, and the high demand for fossil fuel use is an issue that must be addressed immediately. Islamic principles are used as injection to guide the development process towards sustainable transportation. Based on the findings obtained related to the inability to create sustainable transportation, in this study the Quality Function Deployment (QFD) was chosen to be able to translate the demand of DI. Yogyakarta transportation system users using the QFD matrix, namely the House of Quality (HOQ) related to what improvements are desired to be implemented. The final results of this study through QFD method, obtained the Proposed Framework of Improvement Design as a response to functional targets which determined based on expert judgment and recommendations.

Keywords: Sustainable Goals Development, Sustainable Transportation, Unsustainable Transportation. Theory of Constraint, Islamic Perspective, Proposed Framework of Improvement Design, Quality Function Deployment.

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CHAPTER I

INTRODUCTION

1.1. Background

Sustainable development for the prosperity of humanity will create a better perspective for the community and lead to innovation in sustainable infrastructure through better understanding. In this century, the Sustainable Development Goals (SDGs) are expected to address sustainable development processes in both developed and developing countries in order to facilitate action at all levels. SDGs also expected that there will be contributions from various groups such as government, civil society, the private sector and the scientific community to strengthen the capacity to achieve the desired results (Recuero Virto, 2018). According to (McInnes, 2018) SDGs are designed to handle the three pillars of sustainability, namely economic development, social inclusion, and environmental sustainability. Brundtland et al. (1987) stated the concept of the SDGs based on history formed by the United Nations Commission on Environment and Development which was reported in a document titled Our Common Future (Gusmão Caiado et al., 2018). This concept states that development must be planned with the aim of "meeting the needs of the present generation without damaging the capacity of future generations to meet their own needs".

According to McInnes (2018) SDGs are developments on a socially inclusive industrial scale. SDGs also pay attention to environmental protection will be the main source of income for millions of people in every country in the world. McInnes (2018) also states that by making technological innovations, energy efficiency and a substantial reduction in the use of resources will be achieved. Infrastructure is also needed to provide Sustainable Transportation (ST) and to exploit technological progress in many other sectors, where there are agricultural production, education, transportation, and information McInnes, (2018). Giupponi and Gain (2016) mention that the SDGs were

determined through a sequences of measurable targets, and obliged at several levels a great amount of worldwide cooperation and effort in monitoring, which unfortunately is rarely possible (Gusmão Caiado et al., 2018).

According to research conducted by Chai et al., (2016) the transportation industry is currently developing in terms of technology and increasingly efficient performance. In this research it is also stated that the capability to show the efficient performances in the automotive industry will always be related to impacts that can affect the continued use of sustainable resources in practice for the next generation. SDGs are also said to have goals related to one another with the aim of developing world prosperity. In other words, every aspect of SGDs must be balanced. Industry, innovation and infrastructure in the aspects of transportation industry that mentioned in Goal 9 are closely related to the energy consumption. Apart from technology, the achievement of SDGs in Goal 9 also depends on a good understanding of the substantial subject for the development of sustainability. Therefore, in this research an analysis of sustainability of transportation system and its interaction with others related factor such as energy consumption, climate change and emission reduction have a practical meaning by considering the scarcity of natural resources and increasing energy demand.

The researcher in this thesis literature review desire to outline the lack of ST. As the issue that happening at this century of the resources of energy and level of emission, with the expectation this generation can have deep comprehensive about the sustainable development so the use of energy can be utilized for the next generation for the society in the planet. As one as the improvements of transportation technology, the application of transportation mode also improves in number in the real situation. It is referred from the growth of car ownership, government policy, raised of online shop phenomenon towards logistic transportation, community travel behavior, and built environment infrastructure aspects. In order to meet the balance of the sustainable energy resources distribution in the world, the sustainable development of the transportation must be controlled.

Islam revealed by Allah through His messenger is not only a religion for some people but also revealed for all humanity and the entire universe, as a *Huda* means

guidance. Before the technology developed and growth massively until this moment, Islam has been discussed the issue that happened related to the SDGs for the purpose of well-human being. Islam own its perspectives to maintain SDGs regarding to the Goals 9 (industry, innovation, and infrastructure). Refer to Dariah et al., (2016) Islam discussed it with the religion value orientation for the all living things without disserve one single aspect for the humanity, all the perspectives or principles that has been existed in Islam was created by the Creator Almighty without human intervention which is fragile connected to human personal interest. In order to set the prosperity for humanity the distribution of recourses and energy consumption, it has to be fair for the worldwide, evenly distribution and to avoid over transportation utilization. Sustainable development innovation and infrastructure are the core for the finding of solution to address the lack ST which can be elaborated with the Islamic value.

Greene, (2015) Transportation sector recently is absolutely depended to fossil fuels. Along with it Guang & Jin, (2018) mentioned that energy consumption is a problem that occurs and has become a global scale, meanwhile Cheng et al., (2015) mentioned there are escalations of energy demand since 1973 until 2012 by 23% to 28% based on Key World Energy Statistics. Gerike & Koszowski., (2017) stated lack of concern of sustainable urban transportation could led to the negative impacts which are high energy consumption, together with fuel scarcity Salvi & Subramanian, (2015) as the representation of unsustainable transportation. Therefore, if the issue on the lack of ST that is mentioned in this research can be addressed, it can support others SDGs, such as energy consumption which is one of the sub objectives of Goals 7 (Affordable and Clean Energy) and Goals 12 (Responsible Consumption and Production). Theory of Constraint (TOC) was chosen for this research because it is capable to explore what factors that cause lack of ST and its impact to each interaction, so that the objectives of ST can be formulated. Meanwhile, Quality Function Deployment (QFD) is implemented in this research in order to solve the issue of this research.

1.2. Problem Formulation

Based on the description has been discussed above, the problem that comes up in this literature research would be:

a. What factors can hinder the establishment of ST and the supporting factors that will give impact towards the ST, followed with Islamic perspective to handle the sustainable development of the industry, innovation, and infrastructure towards the Lack of ST?

1.3. Research Objective

Based on the research problem formulation, objective could be formulated as follows:

a. The researcher able to identify the hinder factors of the sustainable industry, innovation, and infrastructure: Transportation in order to establish proper ST
b. Able to give the recommendation for finding the solution in order to fulfil humankind prosperity related to sustainable development of the industry, innovation, and infrastructure.
c. Able to identify factors that will provide impact towards the ST
d. Able to identify the Islamic approach to handle the sustainable development of the industry, innovation, and infrastructure towards lack of ST with Islamic fundamentals.

1.4. Scopes of Research

The researcher determines the limitation of this research in order to be more focus on the problem. Here are several factors that will be the limitations of this research:

a. This research was conducted by employing the literature research that is combined with quantitative method.
b. The main objective of this research is SGDs 9th (Build resilient infrastructure,

promote sustainable industrialization and foster innovation): Sustainable Transportation.

c. The issue of this research attempts to implement the design improvement of ST in DI. Yogyakarta.
d. Data collection is derived from literature review with the related substantial topic that could be identified for the literature research purposes and from expert interview and questionnaire for the quantitative method.
e. Data processing done with:

    1. ST Indicator Guidelines based on Kumar, (2013) Toth-Szabo & Varhelyi, (2012) and Litman, (2019).
    2. The TOC methodology: Current Reality Three, Evaporating Cloud (Conflict Resolution Diagram) and Future Reality Three.
    3. QFD methodology: House of Quality matrix.

1.5. Research Benefits

This research is expected to give several benefits. The benefits derived from this research are as follows:

a. The readers of this research can get better comprehensive regarding to the sustainable industry, innovation, and infrastructure in order to address lack of ST.
b. Provide information to the readers about alternative methods that can be used in evaluating the sustainability of transportation and sustainable planning.
c. Reader can applicate this knowledge for further research to attempt ST design.

1.6. Systematical Writing

Furthermore, this thesis writing will be continued as follows:

CHAPTER II LITERATURE REVIEW

This chapter will elaborate the inductive and deductive study. Inductive study is primarily important to determine the literature study of the previous research. Deductive study is needed to be elaborated to provide basic supporting theories to develop the benchmarking assessment. The Systematic Literature Review is needed to arrange the process of previous journal review related with desire topic to assist the systematic of literature study.

CHAPTER III RESEARCH METHODOLOGY

This chapter will describe the methodology, which is applied in the study. This review consisted five steps of Thinking Process (Theory of Constraints): (1) Identify the system's constraint; (2) Decide how to exploit the system's constraint; (3) Subordinate everything else to the above decision; (4) Alleviate the system's constraint; and, (5) Prevent inertia becoming the constraints. The Quality Function Deployment (QFD) consist of: Criteria Determination (1), Capture voice of customer (2), Integration "What" and "HOW", Functional Target Decision (4)

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter will present an elaboration of all aspects of processing in the visual Current Reality Tree (CRT) which previously has been classified based on related aspects around

Sustainable Transportation with the Sustainable Transportation Indicator Guidelines, Conflict Resolution Diagram (CRD, also known as the Evaporating Cloud and Conflict Diagram), and Future Reality Tree (FRT) using the studies that has been collected based on the research. It consists of studies selection, evaluation and analysis of selected journals. The House of Quality (HOQ) also presented in this chapter in the form of integration between Sustainable Transportation basic parameter with the sub indicator.

CHAPTER V DISCUSSION

Chapter five is going to discuss the results of literature review and the analysis. It will also elaborate the recent agenda of Sustainable Transportation in SGDs.

CHAPTER VI CONCLUSION AND DISCUSSION

The final section will describe the overall conclusions from the results of study and the suggestion for the future research.

REFERENCES

APPENDICES

CHAPTER II

LITERATURE REVIEW

2.1. Literature Review

The research that is conducted by the researcher has several literature reviews, for the ST has distinctive literature approach by using Systematic Literature Review (SLR). The purpose is to straightforward the literature review process with the specific issues that have corelation with the ST, in order to provide limitations to the previous journal researches, the keywords are referred to "Sustainable Transportation", "Carbon Foot Print", "Energy Consumption", "Unsustainable Transportation", "Fossil Fuel Dependency", "Alternative Energy". Table 2.1 shows the inclusion and exclusion of the literature review.

Table 2. 1 SLR Inclusion and Exclusion

	Inclusion	**Exclusion**
Year Publication	2014-2019	Below 2014
Main Focus	What causes that influence Transportation, Energy Consumption, Alternative Energy, Carbon Footprint, and Climate Change poor of sustainability and what supporting factors should be presented to achieve Sustainable Transportation	Specific technology or detail stage explanation in order to achieve Sustainable Transportation
Source	ScienceDirect, Google Scholar, Springer	Blog, offline source and commercial article
Language	English	English
Outcome	Sustainable Transportation, Clean energy, and Climate Change Mitigation Framework or Recommendation	Total Operational Cots related with Project to conduct Sustainable Transportation

2.2. Inductive Study

The inductive study known as inductive reasoning is a literature study using previous researches that have been documented in journals, books and or proceeds. The literature review is very helpful for the researcher to get appropriate theory and methods as guidance to conduct research. The previous researches are explained as follows:

2.2.1. Theory of Constraint Previous Research

The TOC has evolved over time based on the historical evaluation of the TOC which groups its developments in 5 eras. As Şimşit et al., (2014) stated that the TOC was initially used to designate the production process and allocate resources. However, along with the technological developments and competition between competing companies that are currently increasing, the TOC can be used as a management philosophy. TOC can also be integrated with the cost accounting system. Izmailov et al., (2016) developed a TOC tool that could be used for project planning and management called Critical Chain Project Management (CCPM). This tool can be used in a one-project and multi-project structure where resources are used simultaneously in several projects.

Pacheco et al., (2018) research provided evidence that TOC and Lean have complementary approaches. From each approach, it seems that individual inequalities are largely offset by the virtues of others. This research aims to compare various models that integrate the TOC and Lean approaches. Integrated TOC and activity-based costing (ABC) can also be applied to improve decision making in Lean companies Alsmadi et al, (2013). This is because the integrated ABD and TOC provide accurate, timely and reliable tool managers that can contribute to make decisions about pricing, production line development, process improvement, and product mix. Through an analysis of the productive processes of an organization, Librelato et al., (2014) provided an integrated case between modeling using Value Stream Mapping (VSM) and the Thinking Process

of the Theory of Constraints (TP-TOC) that establishes complementary aspects between them and their benefits to the organization.

Banerjee & Mukhopadhyay., (2016) conducted research that combines TOC with the design of thought processes, opinions of people and mathematical approaches to help achieve supply chain leagility (lean and agile). This research also raises TOC application in an entirely new area of leagility adoption in supply chain. Golmohammadi, (2015) conducted research that examines the implementation of TOC rules for job-shop systems in order to make a progressive state of research on scheduling constraints. Šukalová & Ceniga, (2015) arranged framework to operate the TOC method in the praxis of Slovak industry company and applied it to the distribution system in the company.

A research that conducted by Puche et al., (2014) implemented Goldratt's TOC in order to decrease inefficiency in Supply Chain Management that is significant and mainly caused by the Bullwhip Effect. This research also carries out prove that through the Drum−Buffer−Rope (DBR) methodology, TOC with its bottleneck management strategy generates significant developments. Aguilar-Escobar et al., (2016) conducted a research that showed that the TOC could be very useful for the logistics of medical records in hospitals and gave a considerable improvement in employee productivity, cost reduction, improved services and also the number of complaints from patients.

Lowalekar & Ravi, (2017) presented the way of TOC method may facilitate the blood bank in order to increase revenues although decreasing the operating cost and it also gives an improvement toward the operational management and financial performance. Based on the Zivaljevic, (2015) research was carried out to observe roadway segment with regulated access, TOC approach can be applied in order to overcome traffic jam and enhance the land transportation system performance. Okutmuş et al., (2016) conducted a research that carry out TOC method in order to increase acquisition of a furniture firms with a purpose to provide maintained constraints by determining the constraint that avoid their targets.

Naor & Coman, (2017) conducted research that offers a way to simplify

operations present by the difficult work place of service calls that work in rotation with high agent turnover. Garza-Reyes et al., (2018) discussed main aspects of Lean application in the logistic and healthcare industries and implement the proposed Lean-TOC method based on the adaptation and simultaneous deployment of lean thinking and TOC methods and tools. Table 2.2 below shows the comparison of the previous research that were using the TOC in the process.

Table 2. 2 Previous Research with TOC

No	Research	Objective	Methodology
1	Banerjee and Mukhopadhyay (2016)	The research adopts TOC methodology and amalgamates it with design thinking process, people's opinion and mathematical approach to help achieve supply chain leagility.	The proposed framework is a seven stepped approach to achieve supply chain leagility combination analytical and mathematical procedures. Data Enveloping Analysis (DEA) is used to identify high level constraint. The new designed thinking process is used to further evaluate the constraints. Nominal Group Technique (NGT) is used to help build the current reality tree and identify detail level constraints.

No	Research	Objective	Methodology
2	Librelato et al (2014)	The purpose of this paper is to present a case of integration between the processes modeling by using the Value Stream Mapping (VSM) and the Thinking Process of the Theory of Constraints (TP-TOC) through the analysis of productive processes of an organization, indicating the complementary aspects between them and their benefits to the organization.	The paper uses a company of the Brazilian automotive industry as the administering site. The research began by identifying the organization's processes and choice of a family of products to model according to the VSM approach. The integrated view between the losses in the process (VSM) and the unwanted effects of the adding value process were analyzed by using the Current Reality Tree. After the analysis, different improvement procedures are proposed based on the lean principles. Finally, a work plan is presented based on the previous steps aiming to achieve the proposed future state.
3	Golmohammadi (2015)	The implementation of the TOC rules for job-shop systems to advance the state of research on constraint scheduling is investigated.	A number of simulation scenarios are discussed, providing insights into the master production schedule (MPS), the drum-buffer-rope (DBR) scheduling method, the role of setup times in scheduling, the impact of free products (those that do not use constraint resources) on throughput, and the effect of priority

No	Research	Objective	Methodology
			rules in resource assignment to free products.
4	Šukalováa and Cenigaa (2015)	The main goal of research is the implementation of the TOC method in the distribution system of the company.	Conflict analysis objectives through the basic tools of TOC
5	Costas et al (2014)	This paper applies Goldratt's TOC to get potential solution to reduce the operating cost and improve the income.	KAOS methodology has been used to devise the conceptual model for a multi-agent system, which is used to experiment with the well-known 'Beer Game' supply chain exercise.
6	Escobar et al (2016)	The objective of this paper was to analyze whether the TOC can be useful to the logistics of medical records in hospitals.	Case study research methodology
7	Izmailov et al (2016)	Critical Chain Project Management (CCPM) is a TOC tool used for planning and project management. It can be used both in one-project and multi-project structures where resources are being used in several projects simultaneously.	Methodology of the Theory of Constraints Critical Chain
8	Pacheco et al (2018)	The purpose of this study is to compare different models integrating the TOC and Lean approaches.	The models of reference were identified through a comprehensive literature review. A qualitative and comparative analysis was carried out by pointing out the strengths, weaknesses and gaps of models integrating the TOC and Lean based on the production system requirements.

No	Research	Objective	Methodology
9	Alsmadi et al (2014)	The purpose of this paper is to implement an integrated activity-based costing (ABC) and TOC approach to enhance decision making in a Lean company.	Based on the literature, this paper proposes an integrated ABC and TOC approach and applies it to a Lean plastic manufacturing company to improve its product-mix decision.
10	Lowalekar and Ravi (2017)	This research demonstrates the application of Thinking Process (TP) tools in the context of large blood bank in India which is struggling with the problems like excessive shortage and wastage, low product variety, high inventory levels, large error rate and poor financial performance. The root cause behind the blood bank's problems is first identified and then eliminated using a set of simple yet powerful solutions (known as injections). It is shown how the TOC based approach will help the bank in significantly improving its overall operational and financial performance. It is also shown how the TOC based solution will help the blood bank to generate higher revenues while still reducing its operating expenses.	TOC approach

No	Research	Objective	Methodology
11	Zivaljevic (2015)	The purpose of this paper is to explore use of the TOC approach in addressing traffic congestion as the main impediment to improving utility of the land transportation systems. The observed element is a motorway segment with regulated access.	As the literature addressing this topic is rare or nonexistent, this study employs exploratory design, developing tentative theory through the generation of new ideas and assumptions forming grounded picture as a base for further investigation.
12	Şimşit et al (2014)	Our search at historical background and basic concepts of TOC aims to see how this philosophy evolves through time and how the main point of TOC researches changes.	This study provides a review of the TOC evolution literature by its five eras; the optimized product technology era, the goal era, the haystack syndrome era, the it's not luck era and the critical chain era.
13	Okutmus (2015)	The purpose of the study is to provide effectively managed constraints by defining constraints that prevent their targets and thus to increase the profitability of firms.	TOC practice was carried out in a furniture firm which operates in the Mediterranean Region.
14	Naor and Coman (2017)	This study describes a typical scenario occurring inside the stressful environment of a service call center working in shifts with high agent turnover and offer ways to streamline operation through the usage of TOC methods.	TOC approach

No	Research	Objective	Methodology
15	Garza-Reyes et al (2018)	This paper proposes an alternative and/or complementary improvement approach based on the adaptation and simultaneous deployment of lean thinking and TOC methods and tools. The paper briefly reviews key aspects of the application of lean in the logistics and healthcare industries and conceptually develops the proposed lean-TOC approach.	The approach is tested, through an individual detail case study, in the EMS transport and logistic system of the Red Cross operating in the metropolitan area of Monterrey, Mexico.

2.2.2. Islamic Principle

Dariah et al., (2016) attempted to propose conceptual framework for the SGDs through Islamic principal that considers the interrelationship between human to nature, human to human, and human to Almighty God, Allah Rabbul A'alamin. Especially, for the Islamic countries which put Islamic ideology as the priority, so this research wants to fill the gap on how to integrate the Islamic principle and SGDs principle. Putting Quran and Sunnah as the sources of the principle in order to draw the welfare by means of spiritual development. Islamic principle was presented in this research as the injection in order to shape cultural attitudes and behaviors which necessary for the achievement of SGDs.

Gundogdu, (2018) performed the study that aims to fill the gap between the academic approach and the real-life practice, the study concerns about the financial issues related with the SGDs in order to reduce poverty and support prosperity for all human being which in line with United Nations goals. The practice of Islamic social investment that offered in this research are grants, concessional loans, and commercially priced loans. In order to address the hunger issues and inequality of social financial condition this research also mention the *zakat* and *sadaqah*. The researcher desires to straighten the point of view of *zakat* properly as the Quran and sunnah based on the understanding of Rasulullah and the companion which zakat is not allowed to be invested for business but immediately should be transferred directly for the poor.

Study that conducted by Abdullah, (2018) has objective to contextualize the potential role of waqf as the contemporary approach specifically related with the developmental. This study tends to present a framework of awqaf to be the bridge for the SGDs goals with the maqasid al-shariah. This study presents findings that the SDGs implementation targets are aligned with the sharia 's long-term priorities, and there is strong potential for waqf partners to establish waqf-based growth strategies in accordance with the SDGs framework. This indicate that the sustainability of the SDGs also relies on the philanthropic sector 's grant and on the constructive participation of both the private and public sectors. In which the importance of waqf is the core of the third sector of an ideal Islamic economy to support the process of the development. Table 2.3 below shows the previous researches that discuss SGDs from Islamic perspective.

Table 2. 3 Previous Research of Islamic Principle on SGDs

No	Research	Objective	Approach
1	Dariah et al., (2016)	Filling the gap on how to implement SGDs in line with Islamic ideology, especially for the Muslim countries	Literature Review
2	Gundogdu, (2018	To present the practice of Islamic social investment to attain SDGs by harnessing the collaboration of resource mobilization tools, such as grants, concessional loans, and commercially priced loans.	Literature Review
3	Abdullah, (2018)	To contextualize the potential role of waqf as the contemporary approach specifically related with the developmental by present a framework of awqaf to be the bridge for the SGDs goals with the maqasid al-shariah	Literature Review

2.2.3. Sustainable Transportation Research

Car ownership is growing very fast in China, which is indicated by the increasing ability of people to purchase cars and low-cost cars sells in the market. This is a major problem for Chinese transport policy makers as suggested by Le Vine et al., (2018). Through drawing on a unique data re-source: the 2011 wave of the China Household Finance Survey (n=8438 households) this paper provided explanations regarding to this phenomenon. In order to control the ratio number in car ownership, cities in China try to perform a trial under innovative transportation policies that in some cases exceed the number of policy choices that traditionally considered in the West. Through the utilization of the China Household Financial Survey (CHFS) that has not previously used to study car ownership patterns, this journal also displays a national-scale survey dataset advanced to monitor economic conditions in China. In this journal, the researcher reports three analysis in order to recognize factors related to: 1) car ownership in one household, 2) dual car ownership, 3) new car ownership in one household. Based on several empirical results, the researcher found that living in rural area associated with the potential of car ownership. For instance, it is reflected by poor infrastructure to support accessibility from rural area to the central business district such as long travel time and this case also could be appear in cities area. Meanwhile, in the western perspective currently rural area is always associated have the lowest car ownership but the empirical study shows that spatial effects are reversed to the typical findings.

Lee et al., (2017) in their research showed that reduced transportation sustainability is also caused by the rise of online shopping in the current era. Online shopping was initially considered as a solution to make it easier for people to shop, but with online shopping people are increasingly shopping online and don't need shopping trips. This is due to the ease of the online shopping system that is available and can be enjoyed by everyone. Online shopping, which was once a special activity has now developed into a driving activity that affects the retail market. This was clearly shown in this study. Strengthened by the results of research that shows shoppers often shop in all shopping systems both physically and online. Likewise, with shoppers who are

categorized as shopaholics continue to use all shopping system with increasing intensity, instead of choosing online shopping as an alternative to reduce physical shopping activities. This proves that the growth of online shopping is an impact of the pace of shopping trips, which can have significant consequences on vehicle congestion and emissions as a reflection of energy consumption stemming from the lack of ST.

Ding et al., (2017) in their paper focused on the relationship between the built environment and travel behavior. This paper designs the relationship between the built environment and travel mode behavior by making a limited effort to consider the intermediary nature of car ownership and travel distance simultaneously. Also, as an important part discusses the mediating effects of car ownership and travel distance. In order to build a framework of integrated and discrete choice models (DCM), the SEM methodology is used to explain the relationship between car ownership and travel distance. Furthermore, in order to investigate how the artificial environment influences travel mode choices through the influence of car ownership and travel distance, this paper is sourced from the National Household Travel Survey (NHTS) dataset and many measurements of artificial environments in the Baltimore metropolitan area. This study has the result of giving transportation planners a better understanding of how the environment built affects the choice of travel modes. This study also explains the consequences of developing effective and targeted preventative measures to reduce the use of cars.

Y. Ding & Lu., (2017) conducted research that would find a connection between online shopping, in-store shopping, and other dimensions of activity travel behavior. This research was conducted because of the significant effect of online shopping toward the in-store shopping and on other particular activities such as convenience activities and chain trip behavior. The method used in this research is a structural equation modeling (SEM) framework method. The data are taken from a GPS-based travel activity journal in Shang in the Beijing region. There are several results in this research. First, there is a positive effect of the frequency of online purchases toward the frequency of in-store shopping and online search. Also, there is a positive effect of the frequency of in-store shopping toward the frequency of online searches. The negative effect of online purchases toward the frequency of convenience activities was also found in this

research. This shows that with online shopping, vacation trips outside the home can be reduced.

The paper that is conducted by McGoldrick & Caulfield., (2015) aims to help policy makers make transportation initiatives that are expected to encourage sustainable modes of travel. This is done by examining changes in the nature of car ownership in the Greater Dublin Area (GDA) and aims to categorize the level of household car ownership between 2006 and 2011 using population census data. In order to reveal the impact of a series of individual, household and transportation characteristics on the average level of car ownership, this paper uses a multinomial logistic regression model combined with a geographic information system (GIS). The age of the individual, the year their household was built, the density of residence and modes of travel to work were found to have an impact on changes in the level of car ownership. The decrease in the average car ownership rate is seen to be significantly affected by the availability of trains rather than being affected by bus transportation.

Having the willingness to explore the reasons why Indian people are concerned with car ownership made Verma, (2015) conducted a paper by discussing factors related to it such as attitude, safety, time, cost and environment. This paper is expected to answer some questions related to the desire of Indians to own a car, and how dependence of Indian society with private car ownership. This paper will also provide answers regarding what conditions might make Indians switch to public transportation or to a mode of sustainable travel to improve transportation sustainability. After exploring various reasons related to the above, researchers can also determine the fundamental factors that cause car ownership trends to occur in the Indian environment and what policies can be done to overcome these problems. The methodology used in this study consisted of an online survey using a structured questionnaire. To get accurate and representative responses, samples were obtained from various cities in India. In the results obtained, the main contributing factors related to car ownership and utilization trends in India and the policy implications that can be done are shown from the statistical analysis and interpretation of the data collected.

In his study, Shen et al., (2017) conducted research related to the growth in the

number of car ownership in China. This study examines citizen preferences related to car ownership over the unique policy of the Chinese government regarding the waiting system for car plates. The Chinese government has adopted an auction and lottery system to control the growth of private vehicles. In this policy, license plates will be auctioned at a price that is quite expensive. Then, if the car buyer is willing to wait for a long time, the buyer will have the opportunity to have a license plate for free. Practically, this policy can affect car ownership in China. With the Bayes theorem hierarchy methodology, the researchers found out what effect this policy had on the Chinese government. The data used is collected through stated preference surveys. From the results obtained, it can be concluded that there are 4 criteria from potential buyers.

Based on the fact that indicate if the number of vehicles is increasing, Araghi et al., (2017) conducted this research. This study wants to find out the reasons for ownership and the use of historical cars and their implications. Awareness of historic vehicles is part of cultural heritage with respect to road transportation and mobility, they carry environmental consequences in the future, which is a relevant development from a policy perspective. This study uses exploratory surveys from 15 European countries that are owners of HV (Historic Vehicle). This study also applies a latent class analysis to identify possible segments among historic car owners. There are 7 latent categories identified in this study, namely: recreation owners, reserve owners, repairmen, big fans, next generation fans, frequent drivers and collectors. The results of this study indicate that modern cars are used far greater than historic cars and there are large differences in ownership and the use of historic cars and the reasons behind ownership. Researchers also point out that policy recommendations are needed for decision makers regarding historic cars.

Tao et al., (2019) in the study discussed that people's tendency to underestimate alternative modes of transportation and the strong desire to use private cars is related to car ownership. This makes the community become indifferent and unwilling to use transportation modes that can reduce environmental pollution such as public transportation. Therefore, this study aims to investigate matters that potentially affect the relationship between car ownership and attitudes towards public modes of

transportation from an international comparative point of view that includes Guangzhou, China with Brisbane, Australia. By using the SEM method, this study provides an analysis that proves that car ownership has a significant relationship to the difference between public transportation services and car use in Guangzhou and Brisbane. In Brisbane, environmental concerns have a more significant influence on attitudes to modes of transportation. This study states that local policies need to be informed to the community in order to promote ST.

A study by He & Thøgersen, (2017) investigated the reasons why the Guangzhou community in China prefers private cars over public transportation which has an influence on car ownership. The underlying reasons for deciding to buy a car for the people of Guangzhou as a mode of transportation will be discussed. The SEM method is used to analyze exploratory factors and logistic regression analysis using AMOS 21 and SPSS 21. It is found in this study that cars as the first choice of transportation mode continue to increase each year with car ownership also growing rapidly.

Factors of private car ownership are examined in a study conducted by N. Wu., (2016). Longitudinal data from 2001 to 2011 from the perspective of 32 cities in China were used to complete this study. This study applies a fixed and random effects model and is compared where 8 explanatory variables are chosen to include characteristics of the economy, transportation, and urban characteristics. In order to measure the elastic relationship between private car ownership and the regression of this study using multiple natural logarithmic models. The results shown in this study are that there are various variations of private car ownership between cities and regions. The influence of the factors toward these variations is also shown in the results of this study.

Cao et al., (2019) in their study focused on how the characteristics of the built environment influenced the ownership of a vehicle. This study combines 2 methods namely quantitative and qualitative methods in the Oslo and Stavanger metropolitan areas in Norway. The distance from the residential area to the city center and the size of the accessibility of regional destinations are known to have an influence on vehicle ownership. This is proven by using quasi-longitudinal analysis. The study found that inward relocation tended to reduce it whereas conversely outward relocation of housing

tended to increase car ownership. In addition, for vehicle ownership preferences, city population density also has an important influence.

The next research that is conducted by Ding., (2018) concerns the effect of car ownership and travel mode choices on transportation energy consumption and emissions. In order to analyze the effect of the built environment on car ownership and travel mode preferences, this study uses 2 methods. The two methods are multinomial integrated multinomial logit (MNL) and structural equation models (SEM). Traffic analysis zones (TAZ) are also used for spatial contexts in which individuals make travel decisions accommodated, and spatial heterogeneity. The researcher also applies the maximum likelihood (MLR) approach with the aim of estimating model parameters. Thus, the results of this study show the relationship between the built environment on travel behavior and people's choice to have a private car.

Ding & Cao, (2019) conducted research that wanted to investigate the relationship between the influence of work locations on car ownership. This research was conducted based on data from the Washington metropolitan area. It is aims to prove the effect of the artificial environment on residential locations and workplaces on car ownership. The data can also be used to control the facial dependencies arising from spatial aggregation. In this research, the researcher developed a multilevel cross-classification model. The results of this research indicate that working environment conditions, especially public transport, are found to have an influence on car ownership as the chosen travel mode.

A research conducted by Hidayatno., (2019) stated that energy consumption in the transportation sector has a significant impact on the total carbon footprint produced in urban areas, the transportation sector of 70% of logistical activities believed to be one of the significant contributors. The purpose of this study was to analyze the effect of e-commerce on the volume of urban logistics transportation. However, the way people buy goods has changed as a result of the growth of e-commerce in urban areas. Thus, this phenomenon brings a higher number of shipments which has a more significant influence on energy consumption and emissions in urban areas. Quantitative and qualitative approaches were carried out in this research. In order to suggest

conceptualization to expose the urban logistics system, this paper uses a causal loop diagram. After that, researchers used a system dynamics approach using Stock Flow Diagrams (SFD) with historical data to determine and estimate the total consumption of urban goods. The results of this research found that the variant mode has different energy consumption, total shipments per year, and emissions. Several factors such as the cost of energy consumption and the cost of the duration of the transportation distance will be considered in terms of transportation costs.

Yan et al., (2019) conducted a study aimed at exposing the effectiveness of parking policies to reduce the use of cars as a travel mode choice. This research was conducted using responses from tourists to different parking attributes such as money and time costs associated with parking. This research uses survey data preferences on commuting at the University of Michigan, Ann Arbor. In the results, a joint model of travel mode and parking location selection model was adopted in this paper. The same research has been done before but the study paid less attention to variables not related to prices such as duration of parking time and parking distance. It was also discussed in this study as a weakness of previous research.

S. Li & Zhao, (2017) conducted a study that has a purpose to survey the car ownership and the car utilization by people living near to metro stations in Beijing, China. In this study the researcher wants to reveal that car are still used at high rates even public transportation services are often recommended as playing an important role in decreasing car usage. Through several methodologies such as Count Variable Regression, Poisson and Negative Binomial Regression, also Likelihood-Ratio tests (LR tests) to examine which of the methods was more suitable for the case study. The final results present that negative binomial regression was more suitable from the entire model.

By considering the application of the MCDM methodology to assess the sustainable development of transportation infrastructure projects, Yang et al., (2016) conducted a study. This study was also carried out by considering various transportation, social, financial and environmental criteria. Based on the data generated, it is known that there are two evaluation factors that are most significantly related to

sustainable development. These factors are the perspective of ST and the criteria for reducing energy consumption of traffic. From the results of this research it is also known that the Tamhai Light Rail Project (TLR) and the Tambai Expressway Project (TE) so far are the optimal portfolio of ST infrastructure projects. This will strengthen the relationship between activity-based cost evaluation (ABC) and carbon footprint in the life cycle assessment that is affected by transportation energy consumption.

Ge & Li, (2018) in their research discussed an analytical system-level energy model for the cellulosic biofuel production system is proposed. This research also established by considering the interrelationships between each process. In order to address the alternative option to fossil fuels utilization as the impact of the increasing the number of transportations. The result of this research consumption is optimized under the constraint of biofuel yield and solved using Particle Swarm Optimization (PSO) algorithm, optimal solution results in a 21.09% reduction in the total energy consumption compared to the baseline case.

The research conducted by Chai et al., (2016) selected the BMA model to choose the core factors associated with energy consumption of road transportation in China. In the first step, this research evaluates the historical trends in road transport energy consumption and GDP in developed countries in order to determine the characteristics of the development of road energy consumption. After that, this research uses path analysis to evaluate the mechanism of impact of factors related to road transport energy consumption with the purpose to explore the current status and future trends of road energy transportation in China. This research was conducted based on the selection of models as well as univariate (ETS & ARIMA) and multivariate (multiple regression) models, the transportation of energy consumption roads was analyzed and predicted. The results show that road transport energy consumption rises 0.33 percent for every percent increase in GDP and by 1.26 percentage points for every percent increase in urbanization.

Due to the increasing growth of e-commerce that has brought about major changes in the transportation system, there have been many studies exploring the impact of e-commerce on shipping systems. However, Zhou & Wang., (2014) were motivated to

explore its impact on personal travel. This is because some online shoppers also do in-store shopping to have a different experience than online shopping. When a buyer conduct in-store shopping, buyers can immediately choose and compare the items they want. Therefore, it is very important to know the relationship between online shopping and shopping trips for transportation planners to prepare for changes that will continue to develop in this technological era. This research uses 2009 National Household Travel Survey (NHTS) data. Using the structural equation modeling (SEM) method, this research proves that there is a two-way connection between online shopping and shopping trips. The results found are that online shopping drives shopping trips while shopping trips tend to withstand the desire to shop online. In addition, there are several exogenous factors that influence online shopping and shopping trips.

In order to study the factors that can influence energy consumption, Wu et al., (2018) made a paper that systematically developed the existing method. The differences and similarities in energy consumption in the transportation sector in China and the US are compared using the TAPIO elastic analysis. Based on the model developed in this paper, researchers can explain the reasons why the two countries show differences in decoupling and can discuss relevant policy implications for energy conservation and emission reduction in the transportation sector. The results showed that the energy consumption of the transportation sector in both countries in 2000-2015 had a weak overall economic growth in the long run.

Liu et al., (2016) in their paper reviewed and summarized research on sustainable consumption in China specifically in three areas of consumption: food, residential energy and mobility (transportation). Analysis of the transition in consumption practices under the influence of social-technical, material infrastructure, and 'lifestyle' innovations provides a good starting point for identifying policy options to promote more sustainable consumption practices. The researcher recommends applying the Social Practice Approach (SPA) which combines the human body and social structure to understand the problem of sustainable consumption. In this paper the researchers also recommend shifting attention to a better understanding of the issue of Chinese consumption by indicating the relationship between the provision of sustainable products and the diverse sustainable consumption practices.

A research conducted by Amiril et al., (2014) evaluated the factors and performance of the sustainability of transportation infrastructure projects. The framework of the relationship between sustainability and performance factors for Malaysian railway infrastructure projects is also shown in this study. This research was conducted based on a literature review that analyzed the theoretical aspects of the research work on sustainability and performance factors in infrastructure projects. Based on research results, it is known that sustainability and performance factors can be categorized in environmental, economic, social, engineering / resource use and project management. This research promotes the implementation of sustainability strategies. Especially in the Malaysian railway project environment, economic, social, resource utilization and project management.

Sonmez et al., (2017) in their paper uses an artificial bee colony algorithm by proposing three different mathematical models to estimate Turkey's energy demand for transportation. The purpose of this study is to estimate the demand for transportation energy in Turkey as an increase in growth in transportation utilization. Linear, exponential, and quadratic mathematical expression forms are used to estimate transportation energy demand. The data used for the training and testing phase of the model is 43 years old historical data from 1970 to 2013. The algorithm of artificial bee colonies shows the results of the suitability of the optimization method for transportation energy planning and policy development in Turkey. In 2034, Turkey's energy demand will double from 2013. This also shows the results obtained from the scenario.

Traivivatanan et al., (2017) conducted research aimed at analyzing the impact of transportation restructuring. The analysis was carried out through three potential energy scenarios, namely the reference scenario (REF), the canceled scenario, and the achievement scenario. Based on the 2012 database as a reference year, an analysis of Thailand's energy situation and its estimates from 2013 to 2035 are shown using the Long-Term Alternative Energy Planning or LEAP system. The results show that the transportation and industrial sectors are classified as energy intensive users. The overall results of this study clearly show that greenhouse gas emissions can be reduced, through

mitigation options which are demand-side management and transportation infrastructure development.

Hanbury et al., (2018) in this paper analyzed the full environmental costs of the entire "life cycle" enabling renewable energy technology. It aims to compare directly with traditional forms of electricity generation or other renewable energy technologies that compete for ST. The purpose of this study is also to better understand the environmental impact of geothermal energy through the LCA assessment methodology, with a stochastic approach. The results obtained from this study indicate that geothermal power has a low environmental impact relative to other methods of energy production used in transportation.

Amakpah et al., (2016) in this paper wanted to find the relative quantitative importance of mitigation options in each index available for energy optimization in the transport route. This study conducts critical analysis to assess the long-term energy optimization and sustainability of the energy-dependent transportation sector. In order to critically assess the 2050 Pathway Calculator structural framework, researchers use energy flow analysis and meta-analysis to critically assess the 2050 Pathway Calculator structural framework. The results in this paper are the flow of energy in 2050 and the transport pathway from the analysis that has been done.

Shi et al., (2019) conducted research related to the increasing of e-retail. This has triggered curiosity about the effect of E-Shopping toward shopping travels undertaken by consumers. This research creates a regression model that aims to show the factors that provide the influence of E-Shopping toward shopping travels. Data used in this research were collected from 710 respondents in Chengdu, China. The data collected also has limitations on the goods being traded, namely clothing and shoes, electronics, food and beverages, and cosmetics. This research provides results the factors that influence E-Shopping and consumer shopping travels are significantly determined by sociodemographic, internet utilization, car ownership, also location. In addition, it was also found that E-shopping has a substitution effect on the frequency of the number of shopping travels.

Challenges related to climate change, sustainability, energy security and pollution can be overcome by utilizing solutions from a 100% renewable economy (García-Olivares et al., (2018)). This was discussed by this study based on several potential sources of investment needed for a 100% renewable transportation system and calculation methods. Also based on reviewing technologies and systems that are proposed or proven as alternatives to fossil fuel-based transportation to estimate the fixed capital and energy costs that are embedded for new fleet and transportation infrastructure. The study also discusses their prospects for entering the post-carbon era, from the perspective of technology and energy. Although it does not always correspond to an increase in consumption of unlimited resources, the results of the analysis conclude that renewable transportation is 100% feasible. Material and energy limitations as well as the main obstacles of each transportation sector for this transition are presented in this study.

Energy mix model for transportation sector in Indonesia is proposed in research that is conducted by Deendarlianto et al., (2017). This research explores a variety of feasible technology options and includes three competing objectives, which are energy consumption, fuel subsidy, and CO2 emission. The literature is reviewed on the basis of their used analysis method and contribution. The result concludes that the most effective strategy to energy decreasing consumption and finally fuel subsidy is through retirement program of old vehicles.

One of any other ways that have an important role in reducing energy consumption in urban areas is to develop public transportation Chang et al., (2018). Therefore, this study was conducted to analyze the impact of urban development on the energy consumption of private transportation and public transportation. This study takes data from 2013 to 2015. This research develops a scenario that is using alternative vehicles with hydrogen fuel cells in public transportation. The methodology or tools in this study are LEAP (Long Term Alternative Energy Plan), GREET (The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation), MARKAL Energy System Modeling Tool, and STIPART (Stochastic Impacts by Regression on Population, Prosperity, and Technology). The results in this study indicate that

hydrogen fuel cell vehicles are a trend of future car development, can effectively reduce the energy consumption of public transportation and total urban energy consumption, and as city development makes hydrogen fuel cell vehicles play an important role in urban green development.

In order to simulate its urban motorized passenger transport system for analyzing various policies under different scenarios and determining their potential effects in decreasing energy consumption and CO2 emissions in the upcoming years, Batur et al., (2019) conducted a research that evolves a systems dynamics (SD) model for Istanbul, Turkey. This research is based on historical data forecasting from 2000 until 2015 and model validation processes, the energy consumption and the CO2 emissions related to motorized passenger transport. The results are a model validation for a critical step to assess the accuracy and reliability of the developed model with actual statistics and Business as usual scenario (BAU) Future. The result of scenario shows that current development plans will affect minimally on the transport caused by energy consumption and CO2 emissions in the city as the impact of the increasing number of motorized trips and trip lengths, especially from cars.

The next study has a purpose to simulate the dependency of travel behavior on fuel availability when the infrastructure of transportation energy is stressed with infrastructure of alternative fuel as a synergistic approach to climate adaptation and mitigation. This study is conducted by Beheshtian et al., (2018) and also developed a quantitative method. Through the concerns about the impact of the changing climate on energy sector is major and worsening over time. It also indicates the spatial distribution of vulnerable elements in both transportation and fuel infrastructure, overall system resilience during disasters, and the daily commuter impact of vulnerable energy infrastructure, for successful integrated planning responses to climate adaptation and mitigation.

This research that was conducted by Cui & Li, (2014) has a purpose to explore the energy efficiency by comparing transportation energy efficiency and by calculating the relationship between the outputs and the inputs. Transportation energy efficiency evaluates the effects of the inputs, which is vital to the energy usage performance of

transportation sector. The challenge of this research is to find the potential energy efficiency. The results present that transportation energy efficiency is affected by transport structure and management measures significantly.

The purposes of the next research that was conducted by Paladugula et al., (2018) are to know the comparison between the framework and projections of energy consumption with emissions from India's transportation sector up to 2050. The five modeling teams developed baseline projections for India's transportation sector as part of inter-model comparison exercise under the Sustainable Growth Working Group (SGWG) to identify the role of road transport in energy demand and emissions. The researcher analyzes energy demand and emission trends from passenger vehicles two wheelers (2 W), three wheelers (3 W), passenger cars, or light-duty vehicles (LDV), and buses (Bus) and from freight transport light heavy-duty trucks (LHDT), medium heavy-duty trucks (MHDT), and heavy heavy-duty trucks (HHDT). The researcher estimates trends in India's road transportation sector assuming no policy changes in the future based on the result of this study with the impact that will cause the transportation demand, which will continue growing very fast. The results present that CO2 emissions from transportation will increase by 4.1–6.1% per year, leading to an increase of seven times in 2050, as the effect of transportation energy consumption.

Feng & Wang, (2018) conducted research using a global meta-frontier approach to identify energy efficiency and the current level of energy efficiency, inefficiency, and savings in China's transportation sector that is likely to experience changes. This study takes data from the period 2006 to 2010. Fact that the country's transportation sector utilizes a high level of energy and CO2 emissions-intensive. To addresses this serious challenge, the researcher mentions considerable significance about the promotion of energy savings and CO2 emissions reduction. This research is using DEA (Data Envelopment Analysis) in order to measure China's transportation energy efficiency and savings potential. In this research, it is known that energy efficiency in China's transportation sector has decreased for the first time in 2006 to 2010. This occurs because management efficiency has decreased and there is an expansion in regional technology gaps.

The main problem was discussed by Salvi & Subramanian, (2015) addresses to the high level of air pollution in urban areas caused by the effects of ST. This research will also focus on technical problems and control strategies to overcome the transportation system using hydrogen that is problematic. It is important to know that the majority of the transportation vehicle fleet consumes fuel derived from fossil resources in the world. As the results of this study, the researcher gives the model framework as solution to the increasing population and transportation vehicles that add up to more energy consumption that bring to environmental pollution and creating fuel scarcity overtime.

In this study, Garmsiri et al., (2016) presented the integration of transportation energy with a net zero energy community utilizing captured waste hydrogen from chlor-alkali plants. The method that is discussed in this research is integrating the energy use in transportation using hydrogen to fulfil the community energy needs and to reach net zero energy balance. This study also discussed the climate change is the result of GHG emissions. The transport sector is identified as one of the key sectors contributing to climate change in industrialized countries, approximately 20% of all GHG emissions. In order to address this challenge, the researcher proposed the alternative energy carriers such as hydrogen can be used to allow renewable energy resources to replace the role of hydrocarbon fuels in the transportation sector.

Peng et al., (2018) in this paper proposed a model framework in order to reduce the energy consumption applications of cooperative communications. The model is proposed in ITS (intelligent transportation systems) networks are suggested for reducing the total energy consumption. This paper presents the solution of how to reduce the energy consumption of the conventional transportation by adopts the CMIMO-SM (cooperative multiple-input-multiple-output) technique into ITS networks for the energy consumption reduction. The result shows that the excellent results are depend on the ITS scenarios and the prefer transmission scheme will present a better energy consumption performance in ITS.

Urban development can be seen from the sustainability of the transportation. Reduction of energy and CO2 emissions will be very important in achieving successful

transportation sustainability. Cheng et al., (2015) provide solutions in order to overcome the very complex urban transportation system. The solution is to create an intelligible system dynamics model with a 30-year period (1995-2025) with a purpose to simulating the effect of transportation management policies and also to analyze the potential of these policies to reduce energy and CO2 emissions. Taxes on fuel, motorcycle parking management, and free bus services are analyzed as three policies of the transportation management policy. The city of Kaohsiung which was chosen as the object of this research is an industrial center also the second largest metropolis in Taiwan. This research is expected to help in planning a valid urban transportation management strategy and also can help agents operating in transportation in order to find operational strategies and successfully meet the main goal of reducing energy consumption and CO2 emissions.

Wang et al, (2014) in this study proved that China became the biggest energy consumer in the world in 2009. China grows very large around one third of the total world energy consumption, even the proportion in China contributes for around 20%. China's transportation energy savings and several theoretical methods and technical schemes focused on consumption have recently been reported and will be examined in this study. As such, this study discusses and analyzes the current status of China's transportation energy consumption. Discussions and analyzes were carried out on four different transportation sectors (road, railroad, waterway and civil aviation). The study also explores trends in energy consumption in Chinese transportation and sectors. The overall results of this study, several policy suggestions are proposed related to saving energy in China.

The research conducted by Yin et al., (2015) examined the future development of the transportation sector in China. Some aspects tested were service demand, final energy consumption, and CO2 emissions, and their interactions with global climate policy. An integrated assessment model namely the Global Change Assessment Model (GCAM) will be developed in this assessment. It aims to evaluate the long-term energy consumption and CO2 emissions of the transportation sector from a global perspective in China. The next goal is to address the rapid growth of energy demand from China's transportation sector in the past two decades. A concern for national energy security,

local air pollution, and carbon dioxide (CO2) emissions, and there is broad consensus that China's transportation sector which will continue to grow in the coming decades arises due to the demand for allergies in the last 2 decades. This research also suggests, due to lower load factors, and rapid modal shifts from less energy intensive walking and cycling towards more energy intensive modes such as LDVs (Light-Duty Vehicle) and air transport. The overall results highlight the importance of future reasonable service demands growth, modal shifts and technology development, but also that the transport sector can play an important role in CO2 mitigation.

The potential to increase the mode of public transportation has been explored with the aim of realizing sustainable urban planning. This is also related to reducing CO2 emissions and energy consumption in the hope that it can reduce road safety and create a greener city. A research that is conducted by Ercan et al., (2016) aims to assists policy makers or city planners by proposing possible public transportation policies to be used. This research provides results that is to reduce energy consumption and CO2 emissions, marginal and ambitious scenarios should be applied. This result is obtained through the process of model validation of the behavior of US passenger transportation modes of choice for the potential of transit transportation to reduce CO2 emissions by the use of several possible policy scenarios.

The aim of the study conducted by Li et al., (2018) is the desire to develop city-level national energy that compares cities in terms of transportation energy consumption and CO2 emissions in the urban passenger transportation sector. This study uses detailed travel activity data that takes into account differences in city level in terms of economic development, population, and shape of the city. The data is based on a consumption framework while CO2 emissions are based on personal travel activities. The results show that 396 Mt of CO2 emissions resulted from urban passenger road transportation in 2010 in China. The next result is that as the size of the city increases, there is an increase in the energy use of urban passenger transportation per capita. The increase in emissions shows that ST in the future cannot be refused, in line with energy consumption.

Meng et al., (2016) in this study compared two case studies, namely the Bus Rapid

Transit (BRT) case study and the Normal Bus Transit (NBT) case study. This study was conducted by using several evaluation methods and analyzing the sustainability of innovations in the urban public transportation system in order to determinate the consistency of the results achieved. The integrated life cycle approach framework, material flow analysis (MFA), Cumulative Energy Demand (CED), exergy analysis (EXA), Energy Assessment (EMA), and emissions (EMI) are also used in this study. It aims to comparing and testing the energy efficiency of high-speed city bus transportation systems with regular bus transportation in China. As demonstrated by a series of sustainability factors calculated through an integrated approach to this study, the Bus Rapid Transit (BRT) system has shown better energy and environmental effectiveness than Normal Bus Transportation (NBT).

Nowadays, China's transportation is being confronted with alarming energy and environmental challenges. Therefore, Hao et al., (2017) conducted a study with the purpose to discuss energy efficiency standards in the road, water, aviation, railroad and pipeline sectors in China. Researchers in this study intend to improve energy efficiency to stabilize between several transportation sectors. The energy efficiency standards to overcome these challenges is given in this study. Likewise, the recommendations are given for the integrity of the policy framework for all transportation sectors. Taking into account the energy consumption of each sector, the costs and the potential for increased energy efficiency, the researcher suggests identifying priorities. Specific examples are like heavy duty vehicles which should have the same priority as passenger vehicles. The study also proposes to enhance the scientific basis for energy efficiency standards, create policies with full consideration and incorporate intelligence from the research community to establish policy rationality.

ST could be implemented in order to create a healthy environment and an improvement of city planning. According to a research that is conducted by (Mohareb & Felix, 2017) there are 2 factors that can give effect to the sustainability of city planning, namely the design of streets in the city and modes of transportation. This study aims to examine developing cities in terms of modes of transportation and also to find the proper method in planning streets in cities using the comparison analysis method. Developing cities in Egypt and Lebanon are the objects of this research. These

developing cities were chosen as the object of case studies because they have many disadvantages such as traffic congestion, lack of pedestrian paths or cycling paths, lack of affordable public transportation, and new modes of informal transportation that have emerged in recent years which have had a major influence on the selection of citizens' transportation modes.

S. Yang & He, (2016) in this study presented the theory that China's provincial economy is an independent economic entity. Nowadays, air pollution which is triggered by the enormous use of energy causes the impact of China's economic growth very quickly. This study discusses one of the main emitters, namely the road transportation sector. It is also known that during the last few decades the significant impact on the Chinese road transport sector was caused by fluctuations in international oil prices. Panel data from 31 Chinese provinces except Hong Kong, Macao and Taiwan were used to explore China's land transportation fuel demand systems (i.e. gasoline and diesel) in this study.

Hakimelahi et al., (2016) conducted a study aimed at identifying the impact of fuel consumption patterns on estimated travel demand. This research is also conducted to address the world oil demand which is predicted to increase by more than 40% in 2030, especially in Asian countries such as China and India, where the development of the transportation industry is always increasing. This study focuses on developing travel demand modeling based on fuel consumption. CUBE software to be used in this study with the aim of analyzing and measuring estimated travel demand related to fuel consumption. Through ArcGIS9.2 & ArcGIS9.3 software and travel request models developed using CUBE5 and TransCAD4.5 transportation planning software packages in the GIS platform. The results show the parameters of car ownership, which directly affect energy consumption.

Based on the previous research above, it can be concluded that there are 5 factors that affected the lack of ST. Those factors are the growth of private vehicle, government policy, raised of online shop phenomenon towards logistic transportation, community travel behavior, and built environment infrastructure aspects. These factors are key to the creation of ST which can also impact on energy consumption, given that

transportation requires energy as a driver. This research is desire to find for solutions to the factors related to the lack of ST using the TOC method. TOC is a focus for improvement tools, philosophy management methodology to help focusing and eliminating the undesirable (Bertolini, 2008).

This research conducts assessment on various studies that examined transportation utilization relation to SGDs. The purpose is to relate the SGDs agenda from Islamic perspective orientation value, this has similarity with the research conducted by Dariah et all., (2016), where they did the research to answer how to implement the SGDs trough out the Islam perspective value. Several previous reviews on papers related to the lack sustainable factors have been identified. Table 2.4 shows the previous researched related to the lack of ST factors.

Table 2. 4 Previously Published Research Papers

NO	Research (year)	Approach	Topic discussion	Challenge
1	Le Vine et al., (2018)	Empirical Study	A nationwide study of Factors Associated with Household Car Ownership in China	Society Economic Growth and Low-Cost Car
2	Lee et al., (2017)	Empirical Study, Model	Relationships Between the Online and In-store Shopping Frequency	Potentially Significant Ramifications for Shopping Related Vehicle Travel
3	Ding et al., (2017)	Empirical Study, Model	Exploring the influence of built environment on travel mode choice considering the mediating effects of car ownership and travel distance	The Impact of car Ownership

NO	Research (year)	Approach	Topic discussion	Challenge
4	Y. Ding & Lu., (2017)	Empirical Study, Model	The interactions between online shopping and personal activity travel behavior: an analysis with a GPS-based activity travel diary	The Increase of Car Utilization
5	McGoldrick and Caulfield., (2015)	Empirical Study, Model	Examining The changes in Car Ownership Levels	Sustainable Transportation
6	Verma, (2015)	Case Study, Numerical Case Study	Growing Car Ownership and Dependence in India and its policy implications	Sustainable Transportation; Car Dependence
7	Shen et al., (2017)	Case Study, Numerical7Case Study	Car Ownership Policies in China: Preferences of Residents and Influence on The Choice of Electric Cars	Car Ownership Policy
8	Araghi et al., (2017)	Model, Numerical Case Study	Identifying Reasons for Historic Car Ownership and Use and Policy Implications: An Explorative Latent Class Analysis	Vintage Car Ownership Policy

NO	Research (year)	Approach	Topic discussion	Challenge
9	Tao et al., (2019)	Empirical Study, Model	The role of Car Ownership in Attitudes Towards Public Transport: A comparative Study of Guangzhou and Brisbane	The Impact of Car Ownership
10	He & Thøgersen, (2017)	Model	The Impact of Attitudes and Perceptions on Travel Mode Choice and Car Ownership in A Chinese Megacity	Transportation Mode Preferences
11	N. Wu., (2016)	Model, Empirical Study	The Determinants of Private Car Ownership in China: Findings from The Panel Data	Private Car Ownership
12	Cao, (2019)	Empirical Study, Model	Examining the Effects of the Built Environment on Auto Ownership in Two Norwegian Urban Regions	Car Ownership

NO	Research (year)	Approach	Topic discussion	Challenge
13	Ding., (2018)	Model	Joint Analysis of The Spatial Impacts of Built Environment on Car Ownership and Travel Mode Choice	Transportation Mode Preferences
14	Ding & Cao, (2019)	Empirical Study	The Built Environment at Residential and Work Locations Effect on Car Ownership: An Application of Cross-Classified Multilevel Model	Travel Behavior Effect on Vehicle Ownership
15	Hidayatno., (2019)	Model	Model Conceptualization on E-Commerce Growth Impact to Emissions Generated from Urban Logistics Transportation: A Case Study of Jakarta	E-commerce Effect Towards Energy Consumption of Logistic as The Transportation
16	Yan et al., (2019)	Model, Empirical Study	The Effectiveness of Parking Policies to Reduce Parking Demand Pressure and Car Use	Car Usage as The Transportation Mode Choices

NO	Research (year)	Approach	Topic discussion	Challenge
17	S. Li & Zhao, (2017)	Model	Exploring Car Ownership and Car Use in Neighborhoods Near Metro Stations in Beijing: Does the Neighborhood Built Environment Matter?	Car Usage as The Transportation Mode Preference
18	Yang et al., (2016)	Numerical Case Study	Sustainable Public Transport Infrastructure Project Decisions	Climate Change
19	Ge & Li, (2018)	Model	Energy Consumption Optimization	Mitigating Global Climate Change and Enhancing Energy Security
20	Chai et al., (2016)	Model	Transportation Energy Consumption	Energy Consumption Demand is of Great significance in This New Normal Period
21	Zhou & Wang., (2014)	Model	Explore the relationship between online shopping and shopping trips: An analysis with the 2009 NHTS data	The Increase of Car Utilization

NO	Research (year)	Approach	Topic discussion	Challenge
22	Wu et al., (2018)	Model	Transportation Energy Consumption	Energy Consumption
23	Liu et al., (2016)	Empirical Study	Sustainable Consumption	China and Sustainable Consumption
24	Amiril et al., (2014)	Literature Review	Transportation Infrastructure Project Sustainability Factors and Performance	Sustainable Transportation
25	Sonmez et al., (2017)	Model	Estimating Transportation Energy Demand in Turkey Using the Artificial Bee Colony Algorithm	Sustainable Energy
26	Traivivatanan et al., (2017)	Model, Empirical Study	Impact of Transportation Restructuring on Thailand Energy Outlook	Energy Efficiency
27	Hanbury et al., (2018)	Model	Life Cycle Analysis of Geothermal Energy for Power and Transportation	Renewable Energy: Geothermal

NO	Research (year)	Approach	Topic discussion	Challenge
28	Amakpah et al., (2016)	Model	Energy Flow Analysis on Transportation in China	Energy Optimization of Transportation
29	Shi et al., (2019)	Empirical Study	Does e-shopping replace shopping trips? Empirical evidence from Chengdu, China	E-Shopping Impact Toward Sustainable Transportation
30	García-Olivares et al., (2018)	Model	Transportation Renewable Energy	100% Renewable System
31	Deendarlianto et al., (2017)	Literature Review	Reviews of Renewable and Sustainable Energy	Transportation Energy Modeling
32	Chang et al., (2018)	Empirical Study, Model	Impact of Urban Development on Residents' Public Transportation Travel Energy Consumption in China	Transport Energy Consumption Public
33	Batur et al., (2019)	Empirical Study, Model	Impact Assessment of Supply-side and Demand-side Policies on Energy Consumption and CO2 Emissions from Urban Passenger	Transportation Energy Consumption

NO	Research (year)	Approach	Topic discussion	Challenge
34	Beheshtian et al., (2018)	Empirical Study	Impacts and Implications of Climatic Extremes for Resilience Planning of Transportation Energy	Transportation Energy Pollutant Impact
35	Cui & Li, (2014)	Literature Review, Empirical Study	The Evaluation of Transportation Energy Efficiency	Transportation Energy Efficiency Three-Stage
36	Paladugula et al., (2018)	Empirical Study, Model	Assessment of Energy and Emissions for India's Transportation	Sustainable Energy Consumption
37	Feng & Wang, (2018)	Empirical Study	Analysis of Energy Efficiency in China's transportation Sector	Renewable and Sustainable Energy
38	Salvi & Subramanian, (2015)	Model	Sustainable development of Road Transportation Sector Using Hydrogen Energy System	Sustainable Energy Consumption by The Effect Increasing Sustainable Transportation
39	Garmsiri et al., (2016)	Model	Transportation Energy Integration	Greenhouse gas emissions by fuel transportation triggered climate change

NO	Research (year)	Approach	Topic discussion	Challenge
40	Peng et al., (2018)	Model	Intelligent Transportation System	Sustainable Infrastructure: Transportation
41	Cheng et al., (2015)	Empirical Study	Urban Transportation Energy and Carbon Dioxide Emission Reduction Strategies	Energy and Carbon Dioxide Emission Reduction
42	Wang et al, (2014)	Literature Review	Transport Energy Consumption	Energy Consumption
43	Yin et al., (2015)	Literature Review, Empirical Study	Transportation Energy Consumption and CO2 Emissions	CO2 Mitigation
44	Ercan et al., (2016)	Empirical Study, Model	Investigating Carbon Footprint Reduction Potential of Public Transportation in United States: A System Dynamics Approach	Energy Reduction and CO2 Mitigation
45	Li et al., (2018)	Model, Empirical Study	Future Energy Use and CO2 Emissions	Sustainable Transportation
46	Meng et al., (2016)	Model, Empirical Study	Energy Efficiency of Urban Transportation System	Cumulative Energy Demand of Transport

NO	Research (year)	Approach	Topic discussion	Challenge
47	Hao et al., (2017)	Model	Energy Efficiency Standards in China's Transport Sector	Fuel Consumption
48	Mohareb & Felix (2017)	Model	Affordable and Common Modes of Transportation in Developing Cities and Their Effect of The Sustainability of Streets	Sustainable Transport
49	S. Yang & He, (2016)	Empirical Study, Model	Fuel demand, Road transport Pollution Emissions and Residents' Health Losses in The Transitional China	Road transport Fuel Demand System
50	Hakimelahi et al., (2016)	Empirical Study, Numerical Case Study	Fuel Consumption Monitoring for Travel Demand Modeling	Fuel Consumption Impact of Sustainable Transportation

2.2.4. Quality Function Deployment Previous Research

The study that conducted by Bolar et al., (2017) explored what factors affect customer satisfaction towards infrastructure utilization using the Quality Function Deployment (QFD) method, also known as the House of Quality. Refers to sustainability parameters which are economic, social, technological, maintenance efficiency, safety and environmental conditions based on customer survey by California Transportation. In

order to obtain indicators to predict the response of customers that can help the decision-making process in implementing QFD.

This study examined the customer satisfaction regarding public mode utilization. Using QFD methodology Deveci et al., (2019) were measure the characteristic of the service quality such as convenient level and safety based on customer expectation. Principal Component Analysis (PCA) is also used in this study which aims to help identify which dependent variable has a strong correlation between each variable. Between QFD and PCA and then will integrated by an interval-valued intuitionistic fuzzy (IVIF), meanwhile QFD utilization through the process of technical improvement explored the beneficial information in order to helping the decision-making process of what factors should be developed or eliminated.

As a step to eliminate design conflicts and implementation difficulties, which ensures high operability of the solution being developed. The study conducted by Mao et al., (2019) using the QFD methodology aimed to discuss the Critical Infrastructure Systems (CISs) as a systematic approach to strive the increasement of the resilience from various hazards that might occur with an electric power system case study scenario. Through analysis of requests from stakeholders which are then converted into technical improvement or as a determining parameter so that it can be correlated with other parameters determined to be able to calculate the strength of the relationship between various factors that exist in the CISs resilience improvement. The outcome indicates the viability of the suggested system with comprehensive examples and execution capable of defining the trade-offs between attempts to enhance resilience at various stages of the CISs lifecycle.

Babbar & Hassanzadeh Amin, (2017) researched about environmental concerns for supplier selection that lead to Green Supply Chain Management. Quantitative and qualitative approaches are carried out in research for multi-criteria assessment related to environmental, social, and economic aspects. Then described in five main objectives, namely cost, defect rate, CO2 emission, weight of suppliers, and punctuality. In the process the QFD method is used to determine the weight and magnitude of the value of

the influence of the relationship between the determinant variables assisted by the fuzzy method, to manage the uncertainty of the variables used in this study.

Pandey, (2020) conducted a research for airport services design that was integrated with airlines based on customer demand oriented. Based on the current high competition in the aviation sector in meeting customer satisfaction, this research attempt to explore of the development what needs to be improved in order to create a strategic operational system. QFD method combined with Fuzzy in research is used to analyse the customer needs which will then be used as requirements and parameters in design development. The findings of this research indicate that the approach methodologies are used is quite practical as a decision-making mechanism focused on consumer preferences. Table 2.5 below shows the previous researches which use QFD methodologies.

Table 2. 5 Previous Research with QFD

No	Research	Objective Study	Methods
1	Bolar et al., (2017)	Identify the factor that affect user satisfaction related with infrastructure utilization refer to the sustainability parameter in economic, environment economic, social, technological, maintenance efficiency, safety and environmental.	Quality Function Development (QFD)
2	Deveci et al., (2019)	Examined the customer satisfaction regarding public transportation based on service quality related with customer expectation.	Quality Function Development (QFD), Principal Component Analysis (PCA), Interval-Valued Intuitionistic Fuzzy (IVIF)
3	Mao et al., (2019)	Examined needs of improvement toward Critical Infrastructure Systems (CISs) aimed at increasing its resilience.	Quality Function Deployment (QFD)

No	Research	Objective Study	Methods
4	Babbar & Hassanzadeh Amin, (2017)	Identify the supplier selection with the green criteria, targeted Green supply chain management (GSCM).	Quality Function Deployment (QFD), Fuzzy
5	Pandey, (2020)	Explore the needs of the development, for airport services design that was integrated with airlines based on customer demand oriented.	Quality Function Deployment (QFD), Fuzzy

2.3. Deductive Study

Deductive study or deductive reasoning is designated to test the existing theory in its objective to develop hypothesis in the research. The basis theory of Thinking Process and TOC Tools (Current Reality Tree, Future Reality Tree) is described as follows:

2.3.1. Theory of Constraints Thinking Process

TOC goals are about New global principles of manufacturing think logically and consistently about the problems, able to determine "cause and effect" relationships between their actions and the results Goladratt et al., (1983). Referring to Şimşit et al. (2014) mentioned that TOC is a technique management philosophy process which is focused on the weakest object(s) in the chain to improve the performance of systems. Umesh and Nancy, (2014) explained the TOC teaches how to identify and remove a constraint. A constraint is the most important factor whether in an organization or personal life that needs to be improved. Something that stands in the way of achieving a goal, a special obstacle which when addressed, gives us leverage to achieve a goal. TOC provides a series of guiding principles and concepts, supported by a set of logistical tools to manage work flow through the system and a set of logical tools (trees) to identify system constraints and design and implement effective ways to break them

(Dettmer, 1998).

In order to constructs the way of thinking process, Bertolini, (2008) explained a method called the five focusing steps that introduced by Goladratt, Eliyahu M. and Cox, (1983) for addressing system problems on a continuous improvement basis . The steps are:

1. **Identify the constraint**: Identify the operation that is limiting the productivity of the system. This may be a physical or policy constraint.
2. **Exploit the constraint**: Achieve the best possible output from the constraint. Remove limitations that constrain the flow, and reduce non-productive time, so that the constraint is used in the most effective way possible.
3. **Subordinate other activities to the constraint**: Link the output of other operations to suit the constraint. Smooth work-flow and avoid buildup of work-in- process inventory. Avoid making the constraint wait for work.
4. **Elevate the constraint**: In situations where the system constraint still does not have sufficient output, invest in new equipment or increase staff numbers to increase output.
5. **If anything has changed, go back to step one**: Assess to see if another operation or policy has become the system constraint. This step supposed to be consistent with a process of ongoing improvement.

The Thinking Processes divided into five logic diagrams, Four Trees and a Cloud and a set of logic rules. The diagrams applying two different types of logic. Three of the trees, Current and Future Reality Trees and the Transition Tree use cause and effect logic, by constructing connections between observed effects and causes on the basis of sufficient cause (Mabin, 1990). There are five main fragments of the Systems Thinking Process tools (Sproull & Nelson, 2015), proposed into this several:

1. The Current Reality Tree (CRT)
2. The Conflict Resolution Diagram (CRD, Evaporating Cloud and Conflict Diagram)
3. The Future Reality Tree (FRT)
4. The Prerequisite Tree (PRT)
5. The Transition Tree (TT)

The five main fragments of System Thinking Process also shown in the Figure 2.1. below.

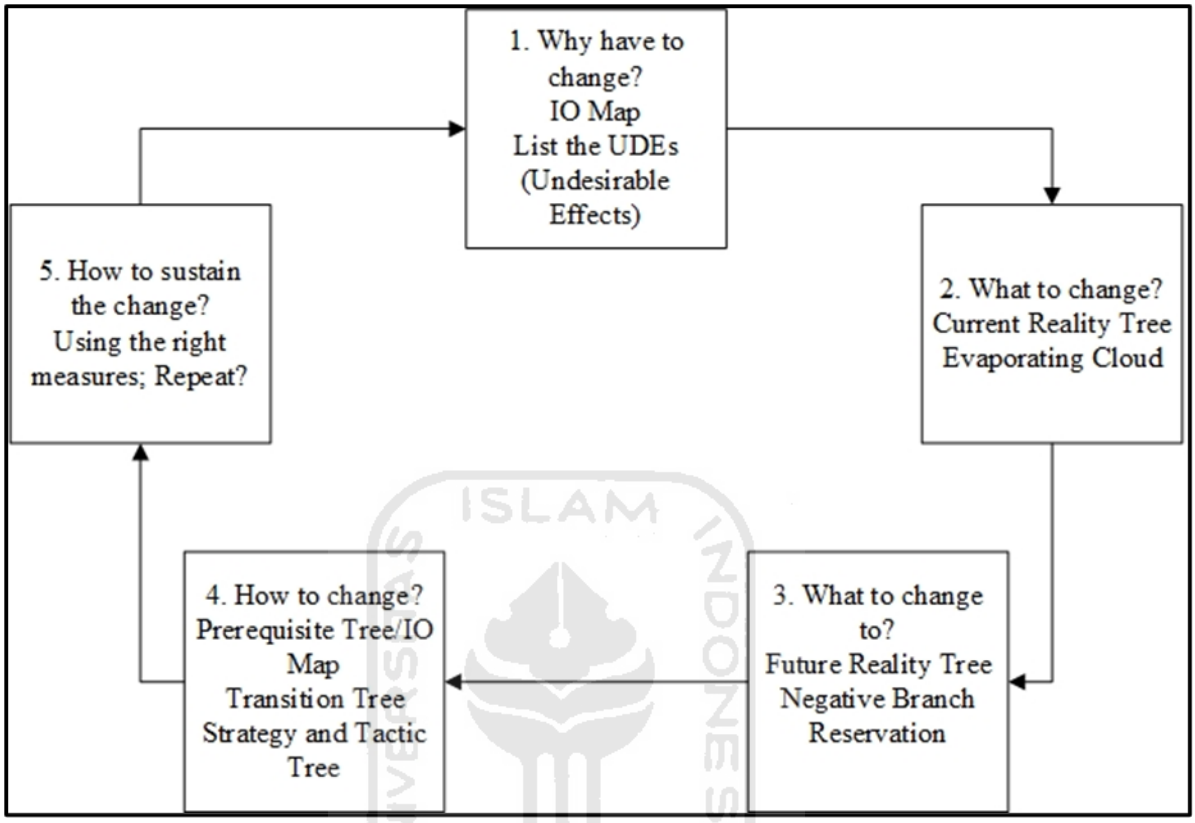

Figure 2.1 Five Focusing Steps Expanded Question

2.3.2. Current Reality Tree (CRT)

According to the Rahman (2002) in Şimşit et al., (2014) defined CRT as a logical structure that depicts the state of reality as it currently exists in a given system. Dettmer, (1998) explained The CRT is designed to identify a chain of cause and effect from the clearly visible indications that the system isn't performing as it should the undesirable (negative) effects backward to the hidden root causes. CRT expose that a distinct professedly unrelated undesirable effects (UDEs), commonly derive from the same root cause. The current reality, as a system analysis tool, provides the answer to the question what to change. The next step is to provide more question about the context of each entity. In implementing the TOC, these entities are called as UDEs (Hutchin, 2001). Figure 2.2. below show The CRT diagram.

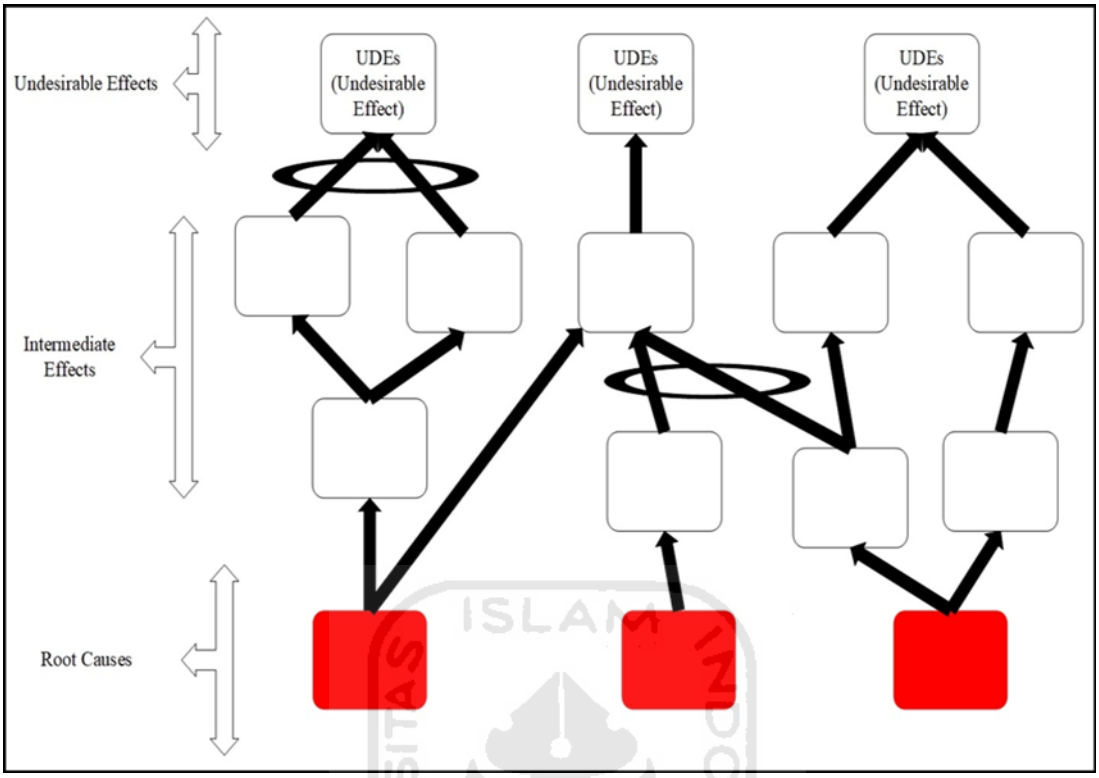

Figure 2. 2 CRT (Current Reality Tree) Diagram

2.3.3. Evaporating Cloud

A constraints identified in the CRT can often be seen as a conflict or ambiguity between two opposing actions, the thinking process tool for such situations called as Evaporating Cloud (EC) (Cozier, 2015). A logical tool that helps to solve conflicts without contradiction to each other's. First the conflict is diagrammed, by verbalizing the conflict (prerequisites), the reasons for the conflict (requirements) (Cox III & Schleier, John G., 2010), and the over- all objective that causes both requirements to be necessary, and in the process, reveal the reasons for the conflict that exists in their reality and prevents them from achieving the desired objective (Cozier, 2015). Assumptions are show up by identify the relation between objectives, requirements, and prerequisites. Those assumptions are then challenged to develop breakdown solutions. EC also known as a Conflict Resolution Diagram (CRD) (Schragenheim, 1998).

Based on Sproull & Nelson, (2015) concludes, that there are 3 components how EC can be build:

a. Objectives (in global level scale): What is the desire for the entire aspect for each other?
b. Requirements: Asking why do you want what you want?
c. Prerequisites: Determine what is it that you really want?

Referring to Mabin, (1990), formulated (Dettmer, 1998) theory that the EC is intended to achieve the following purposes:

a. Confirm the existence of the conflict
b. Identify the conflict cause a major problem
c. Resolve the conflict
d. Avoid compromise
e. Determine zero contradictive solution for both side
f. Create new finding solutions to problems
g. Reveal why problem can exist in depth way
h. Identify all assumptions underlying problems and conflicting relationships

Figure 2.3. below shows the EC framework diagram.

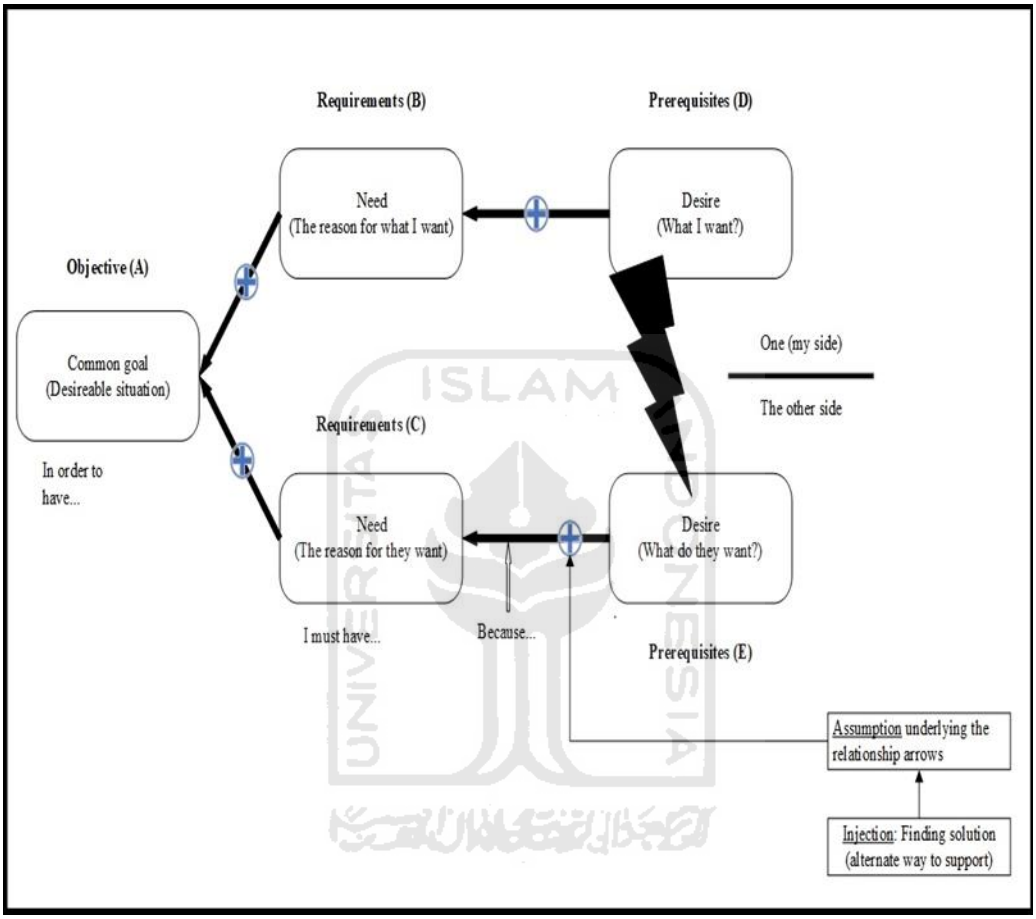

Figure 2.2 EC (Evaporating Cloud) Diagram

2.3.4. Future Reality Tree

According to Newbold, (1385) developing the solution was the further step for thinking process, this involved the construction of the Future Reality Tree (FRT). While FRT is the vision of where the object desire to carry, includes key items need to put into place and the benefits the analyst want to obtain (Bergland, 2016). After the CRD is complete, the constraint-breaking already proceed until as far as most problem-solving methodologies ever take anyone: idea generation. At this point, the analysts must

explore how to implement the new idea which found (Dettmer, 1998). The FRT use to understand of cause and effect through the existing causalities and the expected results (positives effects) of actions (Newbold, 1385), meanwhile FRT process that uses sufficiency logic to present the cause-effect of how each of the injections (idea) should result in the desired effects (DEs) (Cox III & Schleier, John G., 2010).

In opinion of Sproull & Nelson, (2015) An FRT is constructed using sufficiency-based logic with the [IF][THEN] statements. What to identify is the desired effects expected to happen as a result of implementing the idea. The FRT also can be utilized to provide advanced warning (logical radar) for any negative effects that have future potential to appear. Any negative effects found or negative branches in the processing tree, it gives the opportunity to develop an injection (idea) to overcome the negative effect and make it positive again. It's such as going ahead of time where the events not appear yet, more negative effects can be found and overcome, the more powerful of idea will become and the implementation becomes more succeed to gain the advantage of idea. Refer to Dettmer, (1997); Balderstone, (1999) in (Mabin, 1990) provide guidelines for communicating any reservations about the validity of the elements and connections within the trees. Below the FRT serves the following purposes:

1. Enables effectiveness testing of new ideas before committing resources to implementation
2. Determines whether proposed system changes will produce the desired effects without creating negative side effects
3. Reveals through negative branches, whether (and where) proposed changes will create new or collateral problems as they solve old problems, and what additional actions are necessary to prevent any such negative side effects from occurring
4. Provides a means of making beneficial effects self-sustaining through deliberate incorporation of positive reinforcing loops
5. Provides a means of assessing the impacts of localized decisions on the entire system
6. Provides an effective tool for persuading decision makers to support a desired course of action
7. Serves as an initial planning tool

Figure 2.4 shows the diagram of FRT, this diagram shows the FRT process inside the TOC methodology.

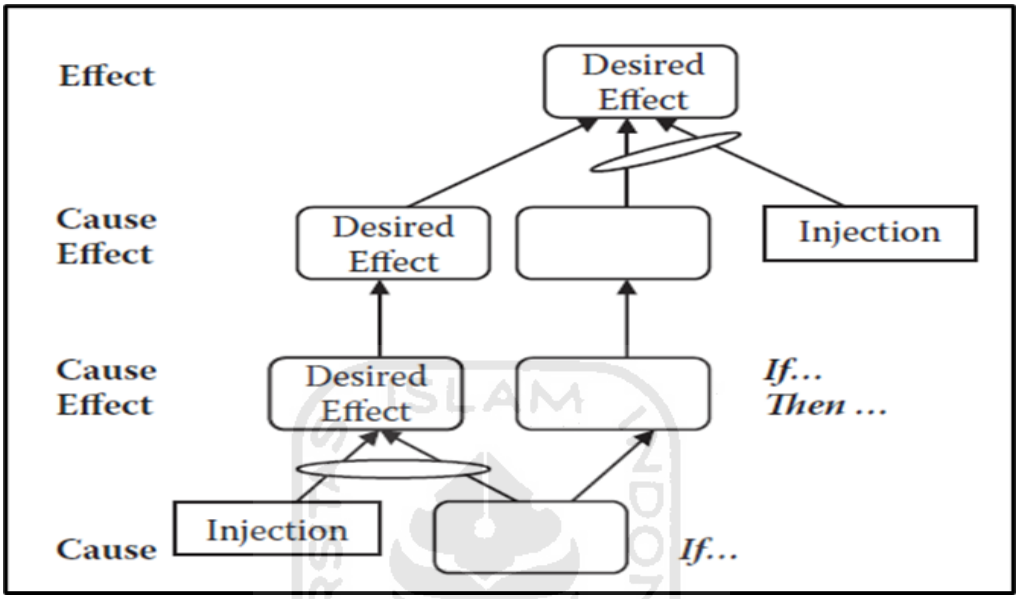

Figure 2.3 FRT (Future Reality Tree) Diagram

2.3.5. Quality Function Deployment: House of Quality

Quality Function Deployment (QFD) according to Bossert, 1991) is a method designed to be able to support systematic mechanism of the development process, with the utilization of the House of Quality (HOQ) as a tool that capable to identify the needs or desires of users with technical criteria by looking for the characteristic of the relationship between both aspect and the weight of its importance's. Maritan, (2015) states QFD aim to measure rating numerical metrics, to be graphically depicted, and to build a database that is simple to interpret and helpful as an efficient, constructive decision support tool used in terms of relationship.

Referring to the Morrell, (1987) QFD is a method for process improvement planning that provides customer-oriented product design innovations. Based on Yoji Akao and Shigeru Mizuno as the inventors of the QFD methodology in Maritan, (2015)

mentioned that QFD specific methods for driven quality assurance at every cycle of product development to create a coordination scheme between divisions such as product planning, design, manufacturing, etc. Sullivan on Maritan, (2015) explained that the utilization of QFD commonly in high technology implementation and related with the transportation. Utne, (2009) and Abdel-basset et al., (2018) defined QFD as a tools that allows to make several parameter from the requirements of the stakeholder do not only for the user (customer) but every element has a concern seek for development, integrated with the technical improvement. Figure 2.5 below shows the concept of the QFD methodology utilization in the House of Quality matrix-chart.

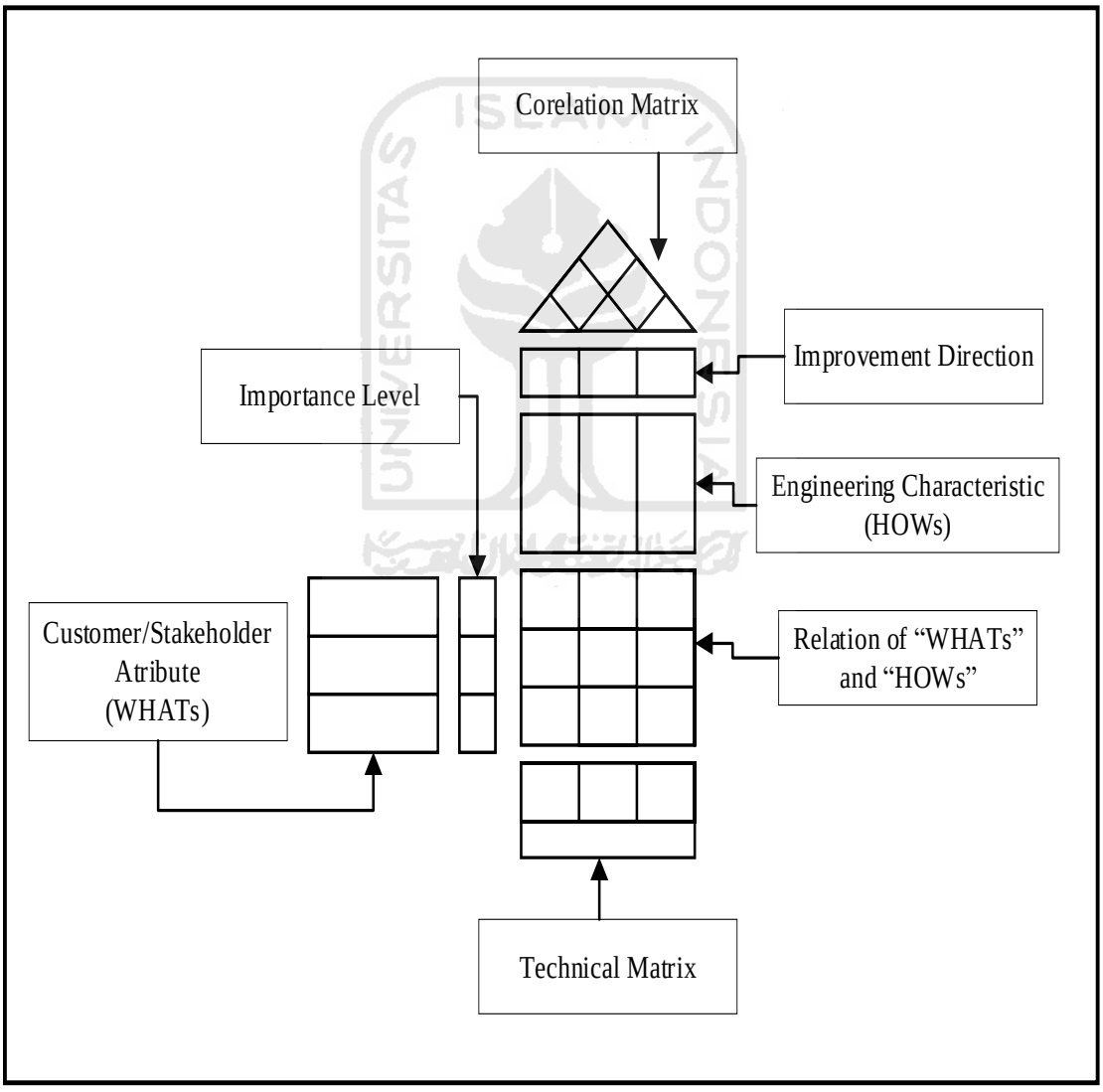

Figure 2.4 House of Quality

In the Figure 2.5, it is shown the House of Quality matrix-chart, below is an explanation of HOQ:

1. "WHATs" in the HOQ chart, presenting what a specific need for the customer or the stakeholder that will use as a requirement, Utne, (2009)
2. Importance Level, Maritan, (2015) has a function to describe the level of priority or how much importance the requirements for the user or stakeholder to be implement
3. Relation of WHATs and HOWs refer to the Natee et al., (2016) represent a comparison to measure the strength of the trait of the interaction between customer or stakeholder requests and engineering characteristics
4. The Technical Matrix in the HOQ matrix-chart according to Natee et al., (2016) has the role of giving an absolute weight score obtained from the importance weight which shows the magnitude of the priority or impact of Engineering Characteristics ("HOWs") on customer requirements ("WHATs") and responded by functional target, that sometimes refer to technical priority.
5. "HOWs" based on Maritan, (2015) represent how engineering characteristic for the quality of the improvement design
6. Improvement Direction provides decision for the technical improvement whether to be targeted, or the higher is better, or the lower is better based on Deveci et al., (2019) and (Utne, 2009)
7. Correlation Matrix based on Abdel-basset et al., (2018) represent the interdependencies among the engineering characteristic

2.4. Literature Review Conclusion

The research that conducted by researcher for this research, is similar with the research that conducted by Diao, (2018) which is to evaluate the policies in order to pursue towards ST in Singapore, as well as to analyse the reciprocal impacts caused by policies whether in line with the concept of ST or not. On the other hand, this research also has significant difference with Diao, (2018). This research not only focus on reviewing policies interaction with each factor willing to support the sustainability of transportation system, but also to present the improvement of design framework in order to achieve the ST goal.

CHAPTER III

RESEARCH METHODOLOGY

3.1. Research Object and Location

This study is using a literature-based review approach in order to provide an overview of the research field. It is also having a purpose to discover relevant peer-reviewed studies based on previously formulated research questions and to evaluate each contribution. The topic of this research is limited to sustainable infrastructure namely transportation and focuses on the topic of ST. Based on the findings from the main paper, ST is discovered has an impact on transportation system. There are several Target Electronic Databases (EDs) used in this study. Among them are Elsevier (sciencedirect.com), Springer (springerlink.com), and Google Scholar (scholar.google.com). This study also uses DI. Yogyakarta as a research location, by collecting the voices of transportation system users in DI. Yogyakarta as the object of research.

3.2. Problem Identification

The initial step of this research is problem identification. Literature review of several articles will obtain identification of problems and related to find problems, obstacles and challenges for the implementation of ST in the world. It also aims to find out how it is possible to monitor or study its use. Based on the results found, the methodology is applied research, using the literature to map the problems that arise related to ST. This review consists of four steps:

1. Formulation of questions for research.
2. Selection and evaluation of studies.
3. Analysis of the selected article content.
4. Description of results.

The second step in this study is aimed to gather Voice of Customer (VC) from transportation system users in Yogyakarta, or stakeholders. To identify what increase the user desire to be improved or feels necessary. Expert discussions were also carried out in this study, as practitioners and academics who participated in developing and observing the transportation system in Yogyakarta, with the aim of identifying transportation system conditions that were still not optimal in the towards ST.

3.3. Problem Formulation

This research is using problem formulation in order to formulate the solution of the problem and also as a fundamental to create a conclusion and recommendation. As the focus of this research, a visual diagram framework is designed in order to assists researcher to gain understanding on relations between the UDEs. It is also expected to pinpoint the root cause of the UDEs and determines conflicts that usually maintain the causes for an undesirable situation and presents the future states of the system. The possibility of negative results from changes can also be identified and minimized before implementing changes.

3.4. Literature Review

The literature review in this research is aimed to discover previous studies related to research topics. In literature analysis phase, the main concern is to present high quality and trusted insights on the topic of interest. There are 3 major stages that will be followed by the researcher in order to identify the sample articles for this research. Those 3 major stages are, namely:

1. Research on the main database is carried out in more detail.
2. Filtering research to find out their relationship with the research topic
3. Comprehensive review of selected articles.

3.5. Data Collection

The type of data collection in this study uses 2 types of data:

1. Literature review:

   Appropriate literature reviews, such as journals, proceedings, and books were used for this study drawn as a data for this study. Secondary data is also used in this study with the aim to support the hypotheses and research statements in this study. There are 2 types of literature reviews conducted in this study, namely inductive studies and deductive studies. Inductive studies are used to obtain information related to previous research to position this research and to formulate the uniqueness of this research. Therefore, deductive studies are used to obtain relevant basic theories and to facilitate writers in determining the correct theory.

2. Interview and Expert Discussion:

   Data in the form of questionnaire results from transportation system users and discussions with experts who have been involved in infrastructure design projects related to the research conducted.

3.6. Data Collection Method

Data collection is done by:

1. Literature review:

   The literature review data collection method in this study categorizes the qualitative approach. Databases are collected by the researcher from Elsevier, Springer, and Google Scholar. Collected studies are dated from 2011 to 2018, in all fields using the terms: (“SDG” OR “Sustainable Development Goals” OR “SDG Goal 9”) AND (“sustainable transportation” OR “lack of sustainable transportation” OR “energy consumption” OR “CO2 emission” OR “traffic congestion”). The initial stage that can be done is to look for problems, obstacles and challenges related to ST within the SDG. This can ensure the implementation of ST. Then the writer also looks for challenges that might

stop and hinder ST. Based on the journals discussed earlier, it can be concluded that the lack of ST is the main focus of this research. The next stage is to determine certain terms and time periods which are also determined by the researcher. In this research the researcher will only consider scientific papers from journals and reviews related to Environmental and Social Sciences, Transportation and its policies and also the field of Energy Renewal which is also available in English. In the final stage, the researcher examines all abstracts for all titles that are broadly related to the topic of SGDs (for example, titles that mention SDGs) and reads full articles of all texts related to this research topic. This also applies to articles that do not provide abstracts. Furthermore, the researcher discuss with Doctor of Philosophy at university with the aim to supervise the researcher to identify additional studies. Based on the analysis of the article, only those that contain explicit references to the SDGs are used. In the appendix A there are 50 list of selected articles in the bibliographic portfolio with the number of citations for each. A recent framework was built based on state-of-the-art recommendations from the scientific literature.

2. Field Study:
   a. Expert interview

      Interviews were conducted directly to the Expert in via online video call communication to obtain the necessary data.

   b. Questionnaire

      To fulfill the proposed framework based on customer demand assessment, the researcher needs to collect the data for identifying important criteria, and the weight level of importance. Important level criteria determination using Likert scale from 1 to 5 this questionnaire fills by the user of transportation systems in DI. Yogyakarta.

3.7. Data Processing

After collecting data, the next step is to analyze the data using specified methods that can help in data processing, analyzing, and interpreting.

3.7.1. Data Processing of Literature Review

In this process, the main idea is to resolve the problem in ensuring the estimated ST. Through the findings from previous research, it was decided that the main topic in this study was the lack of ST, refer to the ST Indicator Guidelines. It then aims to answer three questions in the Thinking of Process (TOC), namely: “What to Changed?”, “What Must Be Changed?”, and “How to Cause Change?”. After that, the researcher discusses the constraints that exist in the system. The key word used is excessive energy consumption "AND" ST. The researcher then finds a journal to choose as the main resource in defining UDEs.

The next stage the researcher will turn a set of systemic problems from 50 journals into a core problem to identify the main obstacles or problems in ST. The journals discussed in the literature review will be the main source of expert opinion. The lack of ST will be the main UDE in the effort to answer the question "What to Change?" and the lack of ST at the same time also becomes the UDE that wants to be eliminated. The result of finding root cause UDEs of lack of ST then will be evoke in CRT diagram.

The next stage is taken after discovering the fundamental cause of the lack of ST by identifying specific changes to the conflicting needs and requirements of ST. There will be certain conflicts that cause other destinations to shatter as ST develops and successes. The Conflict Resolution diagram will highlight this problem to be resolved. The conflicting side was decided in the realization of ST (Goal 9) between building a new area that was well planned, both in terms of the shape of the area, infrastructure, technology, to regulations that are preferential and aimed at empowering people to be

able to run ST before an area is inhabited. Contrary to maintaining an area in the process so that the implementation of ST development is carried out gradually and periodically. The challenges in each assumption and the best solution will be found by formulating the problem with consideration from both sides, namely ST and sustainable consumption. This will answer the question "What Must Be Changed?" Or does the achievement of ST really affect consumption and sustainable production negatively or positively.

The last stage is to make a diagram that shows the future state of the Future Reality FRT. This diagram illustrates the results of changes incorporated into ST that are designed to eliminate UDEs from the lack of ST. Future expectations of ST are shown in this diagram. The Thinking Process then discussed in the Islamic Point of View which related to the lack of ST based on the sources of divine revelation in the Quran and a collection of hadith.

3.7.2. Data Processing of Quantitative Method

a. Measurement Scale

The researcher uses a Likert Scale as a benchmark in the preparation of questionnaires distributed to respondents. Each statement describes the weighted score with using a Likert scale consisting of highly important, important, quite important, not important and highly not important. Table 3.1 shows the description of Likert scale.

Table 3.1 Likert Scale

Weight Description	Weight Score
Highly Important	5
Important	4
Quite Important	3
Not Important	2
Highly Not Important	1

b. Data Sufficiency-Test

The data sufficiency test can be used to find out what is the minimum population sample of a required data, with 90% confidence level and maximum error of 10% used in this study to determine the data sufficiency criteria for further processing data in this study.

c. Validity Test

Validity test is used in this research to show the feasibility of the questions in the questionnaire and the questionnaire can define a variable. The Pearson correlation test is used to correlate each indicator score with the total indicator score. The method used in testing the level of validity with internal validity, which is testing the conformity among parts of the instrument as a whole and to measure it by using item analysis. Using a significance level of 5%, the value of R table used in this study is 0,195.

d. Reliability Test

Reliability Tests used in this research to interpret to the extent that the results of a test can be trusted or relied upon. The results of a measurement can be trusted if in several measurements of the same group of subjects with the acquisition of results that are relatively the same, as long as the aspects measured in the subject have not changed. Used Alpha Cronbach Coefficient by 0,6 with significance level of 5%.

e. QFD (Quality Function Deployment)

The QFD methodology is used in this research in order to implement comprehensive matrix-chart to document information, perceptions and decisions which are known as the HOQ. The preparation of HOQ is intended to map the issues of What and How. These are the following for preparing HOQ:

a. VC (Voice of Customer) Identification

The process is to gather the data from respondent to identify customer need or demand.

b. Matrix Compilation

This planning matrix is based on the interpretation of research object data. Setting the goals or objectives is a combination of the priorities of ST needs with the priorities of consumer needs.

3.8. Operational Definition

There are 3 operational definitions of variables used to describe the characteristics of each variable investigated in this study, which are mentioned as follows:

1. Literature Review

   The literature review in this study is originated from an academic journal on the topic of ST. The researcher analyzes journals that discuss ST critically by determining constraints in current knowledge.

2. Constraints

   The constraints in this case is the probability of conditions that prevent ST. Constraints collected from previous journals are defined as Undesirable Effects (UDEs). UDEs are used to define problem explanations in the Thinking Process diagram of the Current Reality Tree.

3. House of Quality (HOQ)

   The HOQ in this study has function to identify and analyze the user of the transportation system that needs to be integrated with the engineer characteristic.

3.9. Tools and Analysis

This research is using several tools in order to conduct the research synthesis and analysis, namely:

1. Mendeley Desktop®

   The tool is used for the arranging journal and help to selection and analysis paper and journal, it also helps to create the references.

2. Microsoft Visio®

   The tool is used to interpret the problem explanation into diagram of CRT, EC and FRT.

3. IBM SPSS®

   The tool is used to test the validity and the reliability of the data that obtained from respondents.

3.10. Research Flowchart

Research flowchart shows the stages taken by the researcher in conducting this research. First, the researcher determines the problem identification. After that, the researcher searches for literature reviews that match the problem identification that has been determined. Then, the researcher collects data obtained from previous journals / research with similar topics. After that, using the TOC method the researcher will determine what problems are found in the journal / research. Assuming that there are no problems, the researcher has to look for another appropriate literature review. The problems found will be summarized in Current Tree Reality. After that, by using CRD the researcher will find the purpose / goal to be achieved or how to overcome these problems. The next step is to inject Islamic values that can alleviate to overcome the problem. From these Islamic values, the writer makes a FRT diagram which contains problems by overcoming them from an Islamic perspective.

The next step is the findings obtained from the TOC process will be applied to the QFD method. To set the standard criteria needed to implement ST. Then the respondents were collected through a questionnaire containing questions about the demand for improvement in the sustainability of the transportation system in DI. Yogyakarta in accordance with the specified attributes. Respondent data that obtained then passes the data sufficiency test process, followed by the validity and reliability test. Respondent data that has been processed is then applied to the QFD matrix stage which is often called as the HOQ. In the HOQ process the data that has been obtained is then calculated to determine the weight of customer importance and also the weight of technical importance. From all the processes outlined above, the study concludes with a

discussion of results and conclusions. Figure 3.1 shows the flowchart of research of this research.

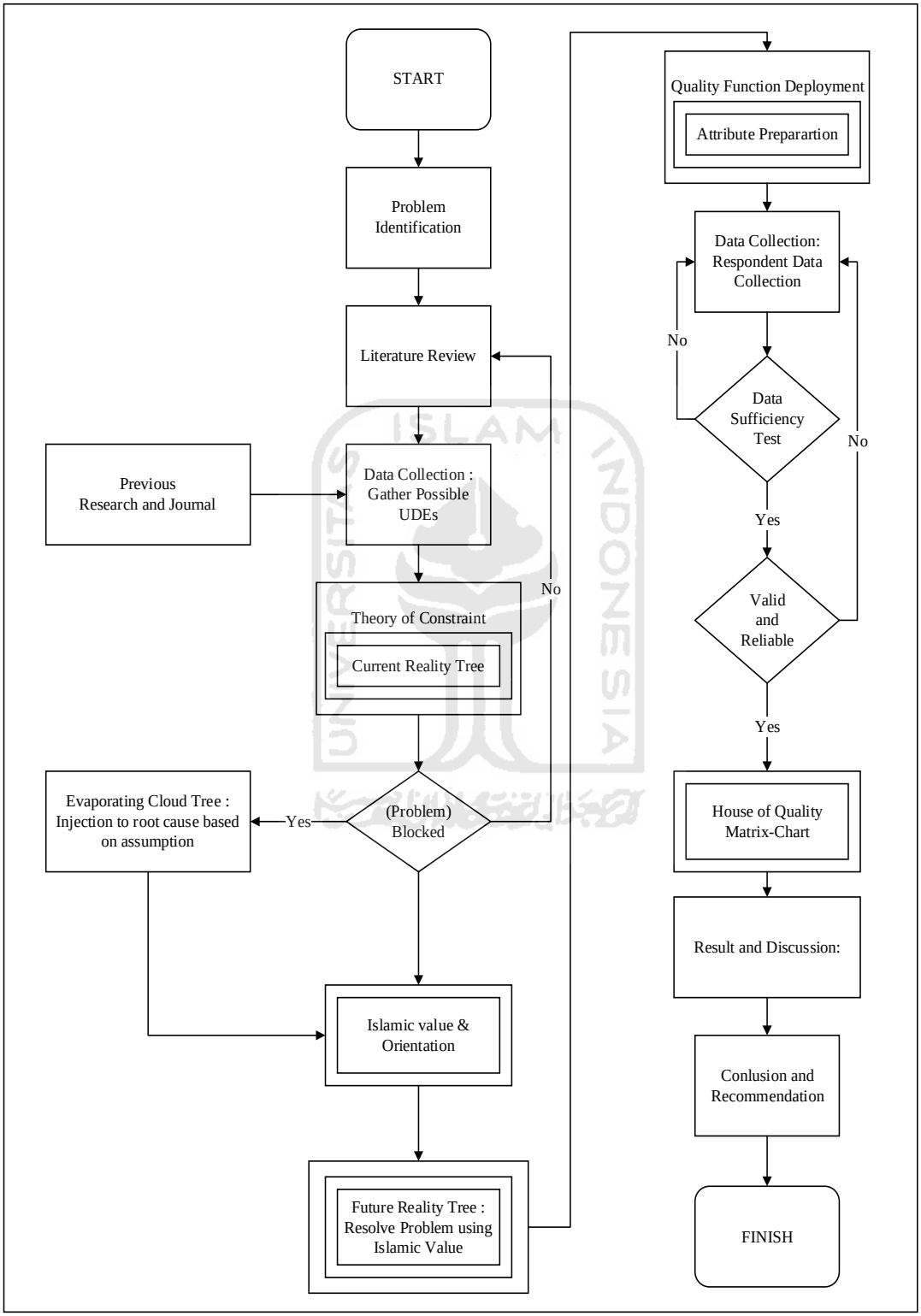

Figure 3.1 Research Flowchart

3.11. Results and Discussion

The next step that will be taken after data processing is an analysis and discussion of the results of the visual diagram of CRT, EC, and FRT. The researcher also adds an Islamic fundamental to discuss the problem on the excessive energy consumption and ST that will prosper the public. The section provides the initial suggestion in the conclusions and recommendations section also explains in detail that the theories applied in selected objects can produce visual representations of problems and solutions. The final step in this stage ends with a discussion of the results obtained from the Quality Function Deployment analysis process. Related to the discussion of determining functional targets, as an action taken to design an improvement in ST.

3.12. Conclusion and Recommendation

This section contains conclusions as an evaluation of all activities carried out in the study. Therefore, the researcher also provides some suggestions for future research on the topic of ST.

CHAPTER IV

DATA COLLECTING AND PROCESSING

4.1. Data Synthesis of Sustainable Transportation

This study uses Systematic Literature Review (SLR) with 50 papers as data to be processed which have correlation to the main topic. The papers were taken from some of the largest electronic database sources such as Science Direct, Elsevier and Google Scholar. The chosen paper focuses on efforts to reduce energy, emission and private vehicle use with topics limited to ST. The paper used was also selected from several publishers which can be seen in the following graph in the Figure 4.1 below.

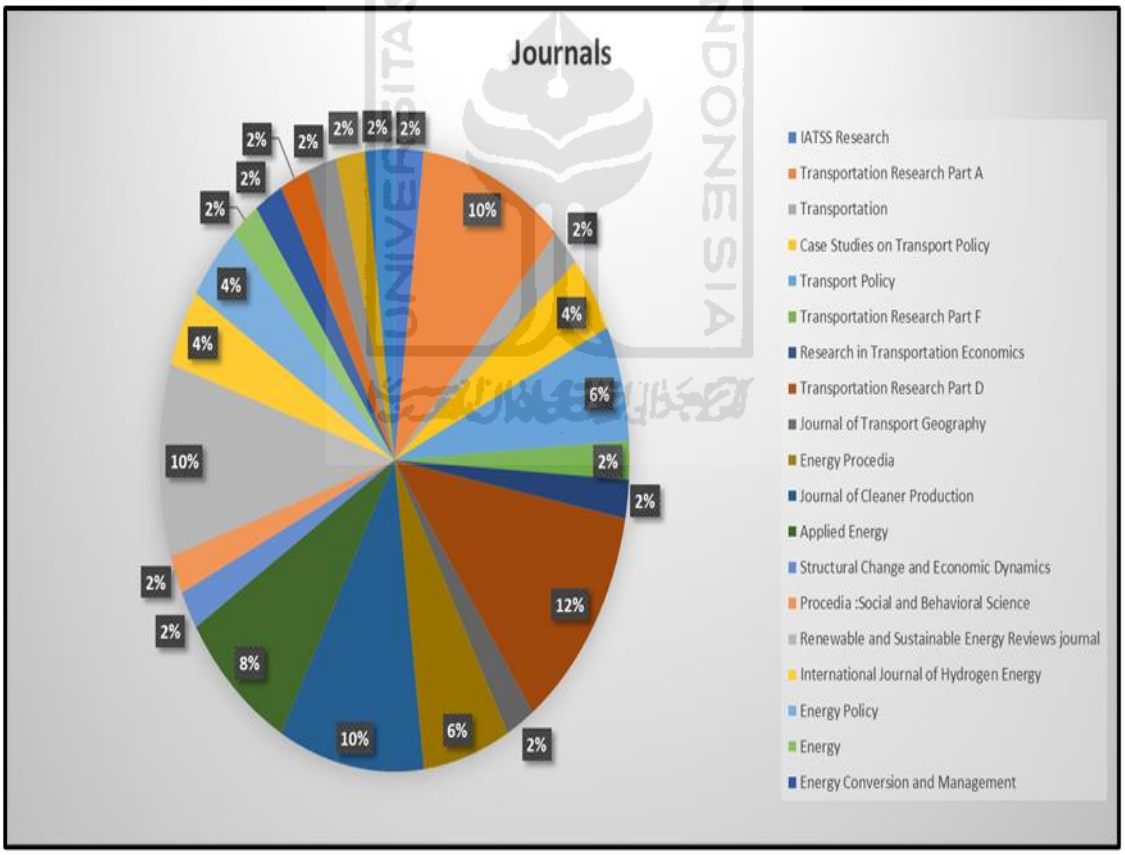

Figure 4.1 Journal's Publisher

As we can see from the graph above, Journal of Transportation Research Part D is the biggest contributor publisher with 12%. Then followed by several publishers, namely the Journal of Cleaner Production, Renewable and Sustainable Energy Reviews journal and Transportation Research Part A, which became the second largest contributor, amounting to 10%. Then the third largest contributor is the Applied Energy publisher, which is as much as 8% while the rest is relatively the same in the range of 2% to 6%.

The papers used in this research were taken from 2014 - 2018. As seen in Figure 4.2 below, papers that published from 2017 and 2018 have the highest number of journals with 12 papers. Meanwhile, the least number of papers were taken from 2014. This shows that research that discusses ST is increasing every year.

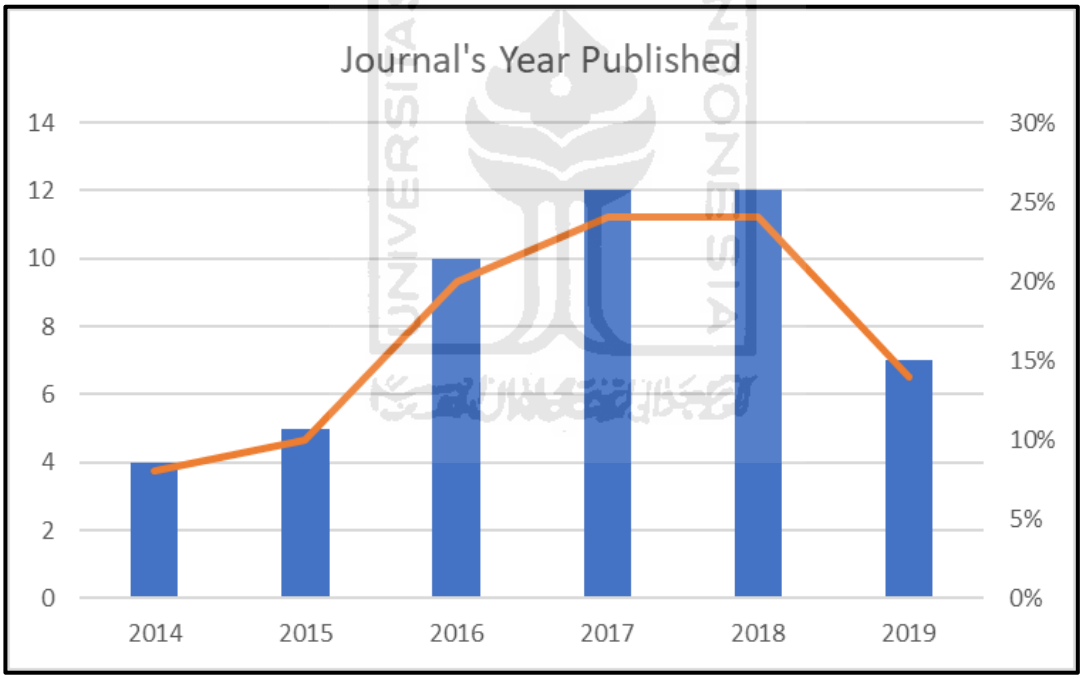

Figure 4.2 Journal's Year Published

The researcher also classified papers based on the frequency of approach used. It can be seen in Figure 4.3; previous researchers applied a set of approaches to study sustainability in the transportation sector. The approach by designing a model is the most frequently used method with a frequency of 30 times. Thus, followed by the empirical study approach with a frequency of 26 times. Meanwhile, for other approaches, namely case study, numerical case study and literature review are rarely used with frequencies ranging from 2-5 times. This is because for the topic of ST, empirical study and model approach are needed to find the best solution to make ST in the future. The Figure 4.3 shows the approach or methodology that were used in the previous research.

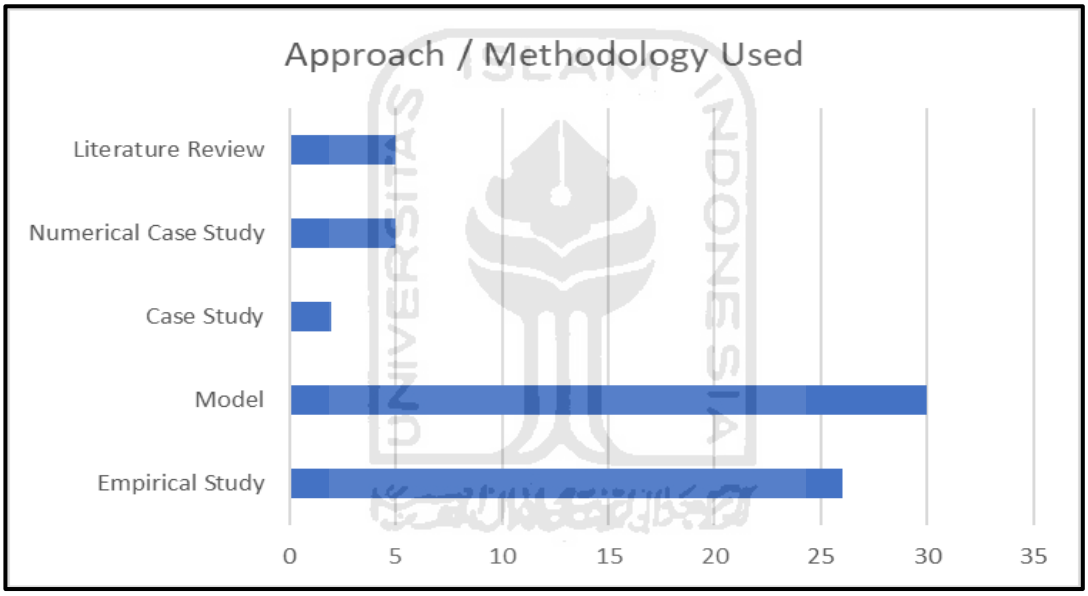

Figure 4.3 Approach / Methodology Used

Lastly, researcher also classified journal's source based on the country where data collected. It can be seen that China is the country that most frequently used for collecting data with total 22 journals. Then the second country is the United States with total 10 journals and the rest of other countries has an average number of 1 journal, as the figure 4.4 shows the journal counts of previous research.

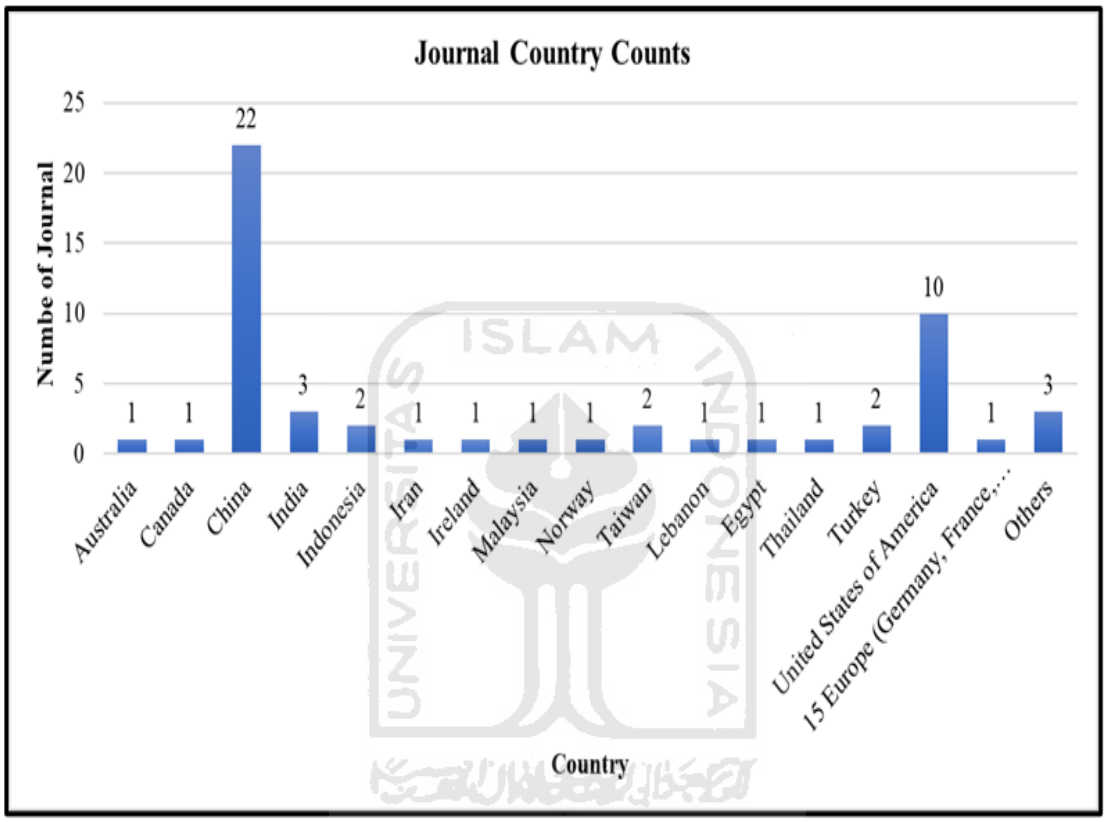

Figure 4.4 Journal Country Counts

4.2.Data Analysis

4.2.1. Systematic Literature Review Data Analysis

The number of journals collected using the SLR method is 50 journals with inclusion and exclusion that has been decided in previous chapter. The figure 4.1 shows the SLR Data analysis from previous research.

Table 4 1 SLR Data Analysis

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
1	A nationwide study of factors associated with household car ownership in China	2018	Scott Le Vine, Chenyang Wu, John Polak	IATSS Research	Contributes to the body of literature regarding phenomenon by drawing on a unique data resource: the 2011 wave of the China Household Finance Survey	Car ownership is growing very rapidly in urban area of China	Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
2	Relationships between the online and in-store shopping frequency of Davis, California residents	2017	Richard J. Lee, Ipek N. Sener, Patricia L. Mokhtarian, Susan L. Handy	Transportation Research Part A: Policy and Practice	Explore the effect of personal characteristics, attitudes, perceptions, and the built environment on the frequencies of shopping online and within three distinct shopping settings.	The lack of transportation sustainability for shopping-related vehicle travel	Empirical Study, Model
3	Exploring the influence of built environment on travel mode choice considering the mediating effects of car ownership and travel distance	2017	Chuan Ding, Donggen Wang, Chao Liu, Yi Zhang, Jiawen Yang	Transportation Research Part A: Policy and Practice	Applied the integrated SEM and DCM approach to investigate how the built environment affects travel mode choice through influencing car ownership and travel distance	The high demand of vehicle resulting in great energy consumption and CO2 emission as the reflection of built environment effect to sustainable transportation	structural equation model (SEM) and discrete choice model (DCM)

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
4	The interactions between online shopping and personal activity travel behavior: an analysis with a GPS-based activity travel diary	2017	Yu Ding, Huapu Lu	Transportation	Investigates the relationships between online shopping, in-store shopping and other dimensions of activity travel behavior using a structural equation modelling framework.	Online shop is inefficient to replace in-store shopping trips in order to reduce the number of travels in regards to sustainable transportations efficiency	Empirical Study, Model
5	Examining the changes in car ownership levels in the Greater Dublin Area between 2006 and 2011	2015	Paul McGoldrick, Brian Caulfiel	Case Studies on Transport Policy	Examine the changing nature of car ownership in the Greater Dublin Area (GDA) and to determine the characteristics of households most likely to have changed their car ownership levels between 2006 and 2011.	Lack of sustainable travel modes	Empirical Study, Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
6	Growing car ownership and dependence in India and its policy implications	2015	Meghna Verma		Focuses on studying the antecedents of car ownership in India with respect to; attitudinal factor, safety factor, time & cost factor and environmental factors and addresses questions like; why people in India wish to own a car, how dependent car owners are on their cars, in what circumstances they may be willing to shift to sustainable modes like, public transport, etc.	The methodology consists of an online survey, using structured questionnaire, with car owners which has been done on sample basis in different Indian cities with an attempt to obtain unbiased and representative responses.	Case Study, Numerical Case Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
7	Car ownership policies in China: Preferences of residents and influence on the choice of electric cars	2017	Xiaofang Yang, Wen Jina, Hai Jiang, Qianyan Xie, Wei Shen, Weijian Han	Transport Policy journal	Examine the influence of car ownership policies on the choice of electric cars, which is also new to the literature	Traffic congestion	Case Study, Numerical Case Study
8	Identifying reasons for historic car ownership and use and policy implications: An explorative latent class analysis	2017	Yashar Araghi, Maarten Kroesen, Bert van Wee	Transport Policy journal	Aims to provide a first exploration of historic cars and reasons for ownership and use and policy implications.	Old/historical car emissions (high emessions)	Model, Numerical Case Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
9	The role of car ownership in attitudes towards public transport: A comparative study of Guangzhou and Brisbane	2019	Sui Tao, Sylvia Y. He, John Thøgersen	Transportation Research Part F	Aims to bridge this knowledge gap by investigating the relationship between car ownership and attitudes towards public transport in two vastly different metropolises, Guangzhou, China and Brisbane, Australia, while taking account of environmental concerns, past behaviour and socio-demographic characteristics.	Reluctance behaviour to use public transportation	Empirical Study, Model
10	The impact of attitudes and perceptions on travel mode choice and car ownership in a Chinese megacity: The case of Guangzhou	2017	Sylvia Y. He, John Thøgersen	Research in Transportation Economics	Analyze the intentions to buy a car and how car-ownership, together with other personal, situational and attitudinal factors, influences travel mode choice in a Chinese megacity.	Fast-growing car ownerships.	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
11	A study on the determinants of private car ownership in China: Findings from the panel data	2016	Na Wu, Shengchuan Zhao, Qi Zhang	Transportation Research Part A	Examines the determinants of private car ownership in China. The target cities are 32 provincial capital cities and the target period is from 2001 to 2011. In	CO2 increasement as the impact of lack of sustainable transportation	Model, Empirical Study
12	Examining the effects of the built environment on auto ownership in two Norwegian urban regions	2019	Xinyu (Jason) Caoa, Petter Næss , Fitwi Wolday	Transportation Research Part D	Sheds light on influences of built environment characteristics on auto ownership.	The increasing number of auto ownership	Empirical Study, Model
13	Joint analysis of the spatial impacts of built environment on car ownership and travel mode choice	2018	Chuan Ding, Yunpeng Wang, Tieqiao Tang, Sabyasachee Mishra, Chao Liu	Transportation Research Part D	Contributes to examine the impacts of the built environment on commuter's driving behavior at both spatial zone and individual levels.	High transportation energy consumption AND emissions	Model
14	How does the built environment at residential and work locations affect car ownership? An application of cross-	2019	Chuan Ding, Xinyu Cao	Journal of Transport Geography	Develops a cross-classified multilevel model to examine the influences of the built environment at both residential and	Negative influenced of car ownerships	Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
	classified multilevel model				workplace locations on car ownership, while controlling for spatial de- pendency arising from spatial aggregation.		
15	Model Conceptualization on E-Commerce Growth Impact to Emissions Generated from Urban Logistics Transportation: A Case Study of Jakarta	2019	Akhmad Hidayatno, Arry Rahmawan Destyanto, Muhammad Fadhil	Energy Procedia 156	Generate a basic understanding of the e-commerce's impact on the emissions generated from transportation logistics activity.	E-commerce acivity driving to unsustainable system transportation	Model
16	The effectiveness of parking policies to reduce parking demand pressure and car use	2019	Xiang Yan, Jonathan Levine, Robert Marans	Transport Policy	Calibrates a joint model of travel mode and parking location choice, using revealed-preference survey data on commuters to the University of Michigan, Ann Arbor, a large university campus.	High intensity of private car utilization in the city area	Model, Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
17	Exploring car ownership and car use in neighborhoods near metro stations in Beijing: Does the neighborhood built environment matter?	2017	Shengxiao Li, Pengjun Zhao	Transportation Research Part D	Explore car ownership and car use in people living close to metro stations.	Lack of sustainable transportation related with the unsupported built environment	Model
18	Incorporating carbon footprint with activity-based costing constraints into sustainable public transport infrastructure project decisions	2016	Chih-Hao Yang, Kuen-Chang Lee, Hui-Chiao Chen	Journal of Cleaner Production	This study considers the application of a multi-criteria decision-making (MCDM) methodology that can be applied to assess the sustainable development of transport infrastructure projects, taking into account a range of transport, social, financial and environmental criteria.	Lack of quality and value sustainable of mass transportation infrastructure	Numerical Case Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
19	System-level energy consumption modeling and optimization for cellulosic biofuel production	2018	Yuntian Ge, Lin Li	Applied Energy journal	Set the characteristic the fundamental relationships between total energy consumption and biofuel pro- duction parameters in cellulosic biofuel production systems.	Lack of sustainable energy driving to the lack of sustainable transportation	Model
20	Analysis of road transportation energy consumption demand in China	2016	Jian Chai, Quan-Ying Lu, Shou-Yang Wang, Kin Keung Lai	Transport ation Research Part D	Analyze the historical trends in road transportation energy consumption and GDP in developed economies to find out the development characteristics of road energy consumption.	The total energy consumption in the economy has been proportionally rising	Model
21	Explore the relationship between online shopping and shopping trips: An analysis with the 2009 NHTS data	2014	Yiwei Zhou, Xiaokun (Cara) Wang	Transport ation Research Part A	Disentangles the bidirectional connections between online shopping and shopping trips.	The idea of an online shop can be an alternative solution to reduce mobility density through	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
						shopping travel measurement proved inefficient	
22	Energy consumption in the transportation sectors in China and the United States: A longitudinal comparative study	2018	Ya Wu, Qianwen Zhu, Ling Zhong, Tao Zhang	Structural Change and Economic Dynamics	Comparing a difference and similarities of the energy consumption in transportation sectors between China and USA	Bad impact of the great energy consumption of the transportation sector	Tapio analysitic, Divisia Index Model
23	Promoting sustainable consumption in China: a conceptual framework and research review	2016	Wenling Liu, Peter Oosterveer, Gert Spaargaren	Journal of Cleaner Production	Proposes to move attention to a better understanding of Chinese consumption issues by emphasizing the link between the provision of sustainable products and the diverse sustainable consumption practices.	Over consumption of energy AND emission as the impact unsustainable transportation	Empirical Study
24	Transportation Infrastructure Project Sustainability	2014	Assa Amiril, Abdul Hadi Nawawi, Roshana Takim, Siti	Procedia - Social and Behavioral	Attempts (1) to review transportation infrastructure project sustainability factors and performance, and	Negative impacts of transportation infrastructure	Literature Review

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
	Factors and Performance		Nur Farhana Ab. Latif	Sciences 153	(2) propose a relationship framework between sustainability factors and performance for Malaysia railway infrastructure projects.	project sustainability	
25	Estimating transportation energy demand in Turkey using the artificial bee colony algorithm	2017	Mustafa Sonmez, Ali Payıdar Akgüngör, Salih Bektaş		Estimate transportation energy demand of Turkey using the artificial bee colony algorithm by using mathematical model	A rapid increase in the energy demand for many sectors and limited energy resources	Model
26	Impact of Transportation Restructuring on Thailand Energy Outlook	2017	Suthee Traivivatanaa, Weerin Wangjiraniran, Siripha Junlakarn, Niphon Wansophark	Energy Procedia 138	Explore the impact of the transportation restructuring via three possible energy scenarios; the cDépartement Systèmes Énergétiques et Environnement - IMT Atlantique, 4 rue Alfred Kastler, 44300 Nantes, France reference scenario (REF), the undone	Energy demand increasement because economic growth and the necessities of transportation sector	Model, Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
					scenario, and the achievement scenario. The REF scenario was developed based on the previous policy targets (up to the year 2012) with systematic planning and implementation.		
27	Life cycle analysis of geothermal energy for power and transportation: A stochastic approach	2018	O. Hanbury, V.R. Vasquez	Renewable Energy	The purpose of this work is to better understand the environmental impacts of geothermal energy via a LCA assessment methodology.	There is an environmental bad impact from geothermal energy for power and transportation	Model
28	Energy Flow Analysis of China 2050 Pathways Energy Calculator with Special Emphasis on Transportation	2016	Steve-Wonder Amakpah, Gengyuan Liu, Yan Hao, Linyu Xu	Energy Procedia	Holistically aims to find the relative quantitative importance of mitigation options in each set indicators available for energy optimization in transport pathways.	GHG emissions, energy demand for fossil fuel energy-dependent sectors has raised so it is become the	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
						global concerns	
29	Does e-shopping replace shopping trips? Empirical evidence from Chengdu, China	2019	Kunbo Shi, Jonas De Vos, Yongchun Yang , Frank Witlox	Transportation Research Part A	Aim to explore whether e-shopping for four types of goods (clothes and shoes, electronics, food and drink, and cosmetics) replaces shopping trips. In addition, regression models are constructed to demonstrate the determinants of e-shopping and shopping travel behaviors.	Highly accelerated process of urbanization, traffic congestion has ended up one of the greatest challenges for numerous cities	Empirical Study
30	Transportation in a 100% renewable energy system	2018	Antonio García-Olivares, Jordi Solé, Oleg Osychenko	Energy Conversion and Management	Reviews the technologies and systems that are being proposed or proven as alternative to fossil-fuel based transportation, and their prospects for their entry into the post-carbon era, from both technological and energetic viewpoints.	There are major challenges that present world economy faces such as energy security, sustainability, greenhouse gasses, pollution and climate change	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
						impacts due to renewable energy system (global transport)	
31	Scenarios analysis of energy mix for road transportation sector in Indonesia	2017	Deendarlianto, Adhika Widyaparaga, Bertha Maya Sopha, Arief Budiman, Imam Muthohar, Indra Chandra Setiawan, Alia Lindasista, Joewono Soemardjito, Kazutaka Oka	Renewable and Sustainable Energy Reviews	Presents energy mix model for transportation sector in Indonesia.	Lack of consideration energy demand on Indonesian road transportation sector which becomes higher and led to several crisis in the future	Literature Review

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
32	Impact of urban development on residents' public transportation travel energy consumption in China: An analysis of hydrogen fuel cell vehicles alternatives	2018	Xiaoying Chang, Tao Ma, Ran Wu	internatio nal journal of hydrogen energy	Analyzes the impact of urban development on public transport and private transportation energy consumption from 2013 to 2015; and uses hydrogen fuel cell vehicles alternatives in urban public transport as a scenario.	Development of public transportation infrastructure as a solution to reduce energy consumption that is still not fully supported from the aspects of policy, infrastructure, and resource prices	Empirical Study, Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
33	Impact assessment of supply-side and demand-side policies on energy consumption and CO2 emissions from urban passenger transportation: The case of Istanbul	2019	Batur, İrfan Bayram, Islam Safak Koc, Muammer	Journal of Cleaner Production	Aims to develop a systems dynamics (SD) model for Istanbul, Turkey to simulate its urban motorized passenger transport system for analyzing numerous policies under different scenarios and assessing their potential effects in reducing energy consumption and CO2 emissions in the upcoming years.	An alarming condition in supply and demand of energy in the future to support the sustainability transportation sector	Empirical Study, Model
34	Impacts and implications of climatic extremes for resilience planning of transportation energy: A case study of New York city	2018	Arash Beheshtian, Kieran P. Donaghy, H. Oliver Gao, Sahar Safaie, Richard Geddes	Journal of Cleaner Production	Introduced an infrastructure of alternative fuel as a synergistic approach to climate-adaptation and mitigation, and advanced a quantitative method to simulate the dependency of travel behavior on fuel availability when the infrastructure of	The transportation energy sector in metropolitan areas cause climatic extreme change	Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
					transportation energy is stressed or under attack.		
35	The evaluation of transportation energy efficiency: An application of three-stage virtual frontier DEA	2014	Qiang Cui,Ye Li	Transportation Research Part D journal	Transportation energy efficiency is newly defined and its inputs and outputs are obtained through literature review.	Unstable transportation energy efficiency	Literature Review, Empirical Study
36	A multi-model assessment of energy and emissions for India's transportation sector through 2050	2018	Anantha Lakshmi Paladugula, Nazar Kholod, Vaibhav Chaturvedi, Probal Pratap Ghosh, Sarbojit Pal, Leon Clarke, Meredydd Evans, Page Kyle, Poonam Nagar Koti, Kirit Parikh, Sharif Qamar,	Energy Policy	Focuses on comparing the framework and projections of energy consumption and emissions from India's transportation sector up to 2050.	Since 1995, the premature death was the terrible effect by particulate matter concentration of emission that has increased 50% in this recent	Empirical Study, Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
			Sangeetha Ann Wilson				
37	Analysis of energy efficiency in China's transportation sector	2018	Chao Feng, Miao Wang	Renewable and Sustainable Energy Reviews	Analyzes energy efficiency and the savings potential in China's transportation sector from 2006 to 2014 from the perspectives of technological progress, technology gaps, and management efficiency	The country's transportation sector uses high energy levels and intensive CO2 emissions	Empirical Study
38	Sustainable development of road transportation sector using hydrogen energy system	2015	B.L. Salvi, K.A. Subramanian	Renewable and Sustainable Energy Reviews	Reviews the main problems of high air pollution levels at many urban cities and sustainability of the transportation fuels, and addressing their control measures using hydrogen energy system.	The energy crisis caused by the lack of sustainable transportation practices in the application of alternative energy which tends to be friendly for the	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
						environment in the future	
39	Integration of transportation energy processes with a net zero energy community using captured waste hydrogen from electrochemical plants	2016	Shahryar Garmsiri , Seama Koohi-Fayegh , Marc A. Rosen, Gordon Rymal Smith	internatio nal journal of hydrogen energy	The objective of this paper is to demonstrate gaseous waste reduction and waste energy recovery for use in community and transportation. Furthermore, to demonstrate the benefits of integration of transportation energy with a net zero energy community while utilizing vehicle's energy storage	The problem of climate change which has become a global scale as a result of increasing emissions in various countries	Model
40	Energy-efficient cooperative transmission for intelligent transportation systems	2018	Yuyang Peng, Jun Li, Sangdon Park, Konglin Zhu, Mohammad Mehedi Hassan, Ahmed Alsanad	Future Generatio n Compute r Systems	Applications of cooperative communications in ITS networks are proposed for reducing the total energy consumption.	Congestion and accidents in the transportation system have become a global problem	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
41	Urban transportation energy and carbon dioxide emission reduction strategies	2015	Yung-Hsiang Cheng, Yu-Hern Chang, I.J. Lu	Applied Energy	This paper present solutions for a sustainable urban transportation system by establishing a simplified system dynamics model with a timeframe of 30 years (from 1995 to 2025) to simulate the effects of urban transportation management policies and to explore their potential in reducing vehicular fuel consumption and mitigating CO2 emissions.	The global transport system's energy demand increases along with the immense growth of vehicle following by emission as the impact of lack sustainable transportation	Empirical Study
42	Transport energy consumption and saving in China	2014	Y.F. Wang, K.P. Li, X.M. Xu, Y.R. Zhang	Renewable and Sustainable Energy Reviews	Reviewing the existing reports, we discuss and analyze the current status of China's transport energy consumption including four different transport sectors: road, railway, waterway and civil	China has become the biggest energy consumption of transportation in the world’s perspective	Literature Review

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
					aviation, and outline the trend of China's transport energy consumption and the four sectors.		
43	China's transportation energy consumption and CO2 emissions from a global perspective	2015	Xiang Yin, Wenying Chen, Jiyong Eom, Leon E. Clarke, Son H. Kim, Pralit L. Patel, Sha Yu, G. Page Kyle	Energy Policy	Develops a detailed China transportation energy model that is nested in an integrated assessment model — Global Change Assessment Model (GCAM)—to evaluate the long-term energy consumption and CO2 emissions of China's transportation sector from a global perspective.	Based on the recent data, the analysis shows that for the upcoming decades the CO2 will rapidly grow if there is no relevant contribution of policies	Literature Review, Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
44	Investigating carbon footprint reduction potential of public transportation in United States: A system dynamics approach	2016	Tolga Ercan, Nuri Cihat Onat, Omer Tatari	Journal of Cleaner Production	Aims to propose possible public transportation policies to be adopted by policy makers or urban planners.	The current mode of conventional transportation is very dependent on fossil fuels AND new innovation will not be enough, without a reduction in the number of vehicles on the road to reduce this dependency, only with a solution to move away from fossil fuels in favor of other fuel options.	Empirical Study, Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
45	Future energy use and CO2 emissions of urban passenger transport in China: A travel behavior and urban form based approach	2018	Peilin Li, Pengjun Zhao, Christian Brand	Applied Energy journal	Present study extends the existing activity, modal share, energy intensity, fuel/carbon intensity (ASIF) modeling framework by disaggregating travel activity into key structural components and city-specific factors for 288 prefectural level cities in China.	In China, when the size of the city was enlarged the energy use of passenger transportation increased per capita in urban areas which also produced 396 Mt of emissions from CO2	Model, Empirical Study
46	Energy efficiency of urban transportation system in Xiamen, China. An integrated approach	2016	Fanxin Meng, Gengyuan Liu , Zhifeng Yang, Marco Casazza, Shenghui Cui, Sergio Ulgiati	Applied Energy	Explores the consistency of the results achieved by means of several evaluation methods, and explores the sustainability of innovation in urban public transportation systems.	Energy inefficiency in the present years that will give a bad impact toward sustainable energy in the next decades	Model, Empirical Study

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
47	An overview of energy efficiency standards in China's transport sector	2017	Han Hao, Zongwei Liu, Fuquan Zhao	Renewable and Sustainable Energy Reviews	Comprehensively reviews the energy efficiency standards in China's road, water, aviation, railway and pipeline transport sectors.	Alarming circumstances for China's energy security, environmental protection, and climate change	Model
48	Affordable and Common Modes of Transportation in Developing Cities and Their Effect of The Sustainability of Streets	2017	Nabil Mohareb and Mary Felix	Procedia Environmental Sciences	Aim to analyse the basic elements and accessibility factor for the sustainability of transportation	Urban areas have enormous increasement of daily trips by private vehicle which are never unsolved to meet the balance of population	Model

No	Title	Year	Author	Journal Name	Objective	Issue	Methodology
49	Fuel demand, road transport pollution emissions and residents' health losses in the transitional China	2016	Sheng YANG, Ling-Yun HE	Transportation Research Part D	Investigate the China's road transport fuel (i.e., gasoline and diesel) demand system by using the panel data of all 31 Chinese provinces except Hong Kong, Macau and Taiwan.	Resident health losses as the impact of air pollution	Empirical Study, Model
50	Fuel Consumption Monitoring for Travel Demand Modeling	2016	Ali Hakimelahi, K.V Krishna Rao, S.L. Dhingra, Sina Borzooei	Transportation Research Procedia	Investigate the impact of fuel consumption patterns on travel demand estimation. This paper evaluates and calibrates travel demand estimation by CUBE software and its relation to fuel consumption, with use of data provided by Sharif University, for the city of Shiraz, Iran in 1999	Inefficient use of transportation will lead to consumerism, environmental pollution, economic losses in the form to time, and capital waste.	Empirical Study, Numerical Case Study

4.2.2. Theory of Constraint Data Analysis

The next step is to identify UDEs. This is conducted in order to analyse the problem with the aim of answering the first question in the TOC or Thinking Process, which is "What to Change?". UDE is an obstacle to getting better results or higher performance, or obstacles to achieve ST. Following is UDE collected from 50 papers shown in Table 4.2 below.

Table 4.2 Undesirable Effects

No	Journals	Possible UDEs
1	Le Vine et al., (2018)	A nationwide study of factors associated with household car ownership in China
		Car ownership is growing very rapidly in urban area of China
		Extravagance rural society on spending in buying car
		No regulation to rule the car ownership
		China's motorization process is poorly understood, in part due to a scarcity of relevant data
2	Lee et al., (2017)	Relationships between the online and in-store shopping frequency of Davis, California residents
		The lack of transportation sustainability for shopping-related vehicle travel
		Triggered by the rise of online shopping in the current era
		Online and in-store shopping activities are found to have the same intensity
		People who shop online are categorized as shopaholic and will continue to do online shopping or in-store activities.
3	Ding et al., (2017)	Exploring the influence of built environment on travel mode choice considering the mediating effects of car ownership and travel distance
		The high demand of vehicle resulting in great energy consumption and CO2 emission as the reflection of built environment effect to ST
		Higher demand for automobile use in cities AND the vehicle miles travelled (VMT) has been rapidly increasing.

No	Journals	Possible UDEs
		People who live in residential which have long travel distance to their workstation or school, tend to increase their opportunity making private vehicle as the main preferences
		The differential of region of workplace and residential has quite double travel average value rather than in the different location
4	Y. Ding & Lu., (2017)	The interactions between online shopping and personal activity travel behaviour: an analysis with a GPS-based activity travel diary
		Online shop is inefficient to replace in-store shopping trips in order to reduce the number of travels in regards to ST efficiency
		Frequent online buyers tend to do shopping trips
		Shopper that already search the good's information in online shop still come to store to check the goods in physical
5	McGoldrick and Caulfield., (2015)	Examining the changes in car ownership levels in the Greater Dublin Area between 2006 and 2011
		Lack of sustainable travel modes
		Increasing number of car utilization in Greater Dublin Area (Europe) in 1990s until this recent year
		Residential density and the mode of travel to work had an impact on the change in car ownership levels over the study period
		Less of mass transportation especially train (railway transportation) to support the density of the residents
		The impact of bus transport on car ownership levels was less apparent
6	Verma, (2015)	Growing car ownership and dependence in India and its policy implications
		Congestion and pollution
		Unrelenting growth of vehicles
		Indian perspective: Prestige to have car
		Ease of buying a car with instalment
7	Shen et al., (2017)	Car ownership policies in China: Preferences of residents and influence on the choice of electric cars
		Traffic congestion
		Inaccurate vehicle ownership policy (Plat lottery/Buy)
		The car ownership policy doesn't work in rich people

No	Journals	Possible UDEs
		Improper subsidies for electric car
		People more willing to buy electric car (increment of car ownership) than using mass transportation
8	Araghi et al., (2017)	Identifying reasons for historic car ownership and use and policy implications: An explorative latent class analysis
		Old/historical car emissions
		Policies across different countries regarding HV admission to urban areas have not been always congruent in 15 European countries
		Lack of academic study concern on the issue
9	Tao et al., (2019)	The role of car ownership in attitudes towards public transport: A comparative study of Guangzhou and Brisbane
		Reluctance behaviour to use public transportation
		Lack of environmental concern for those who can afford to buy a car
		Pride to have a private vehicle (egoistic)
		Undervalue alternative transport modes
10	He & Thøgersen, (2017)	The impact of attitudes and perceptions on travel mode choice and car ownership in a Chinese megacity: The case of Guangzhou
		Fast-growing car ownerships.
		Car is not for necessary purpose, only pride.
		Reluctance to ride public transportation
		There is still no regulation that it can handle the problem of increasing private vehicles and calls for public transportation properly
11	N. Wu., (2016)	A study on the determinants of private car ownership in China: Findings from the panel data
		CO2 increasement as the impact of lack of ST
		Transportation sector management is the biggest contributor for the carbon footprint
		Half of the transportation emission car is assisting for the carbon footprint
		Very rapid increasement number of cars in a decade (2001-2011)
		Lack of public transportation convenience compare to private car
12	Cao, (2019)	Examining the effects of the built environment on auto ownership in two Norwegian urban regions
		The increasing number of auto ownership

No	Journals	Possible UDEs
		Outward residential relocation tends to increase auto ownership and
		The long distance from the dwelling to the main city center (hard
		Lack infrastructure of regional destination accessibility
		Lack of built environment
13	Ding., (2018)	Joint analysis of the spatial impacts of built environment on car ownership and travel mode choice
		Transportation energy consumption and emissions
		Increasing number of car ownerships
		Lack of built environment (urban design) that affect travel behaviour
		Uneven public transportation accessibility
14	Ding & Cao, (2019)	How does the built environment at residential and work locations affect car ownership? An application of cross-classified multilevel model
		Negative influenced of car ownerships
		Greenhouse-gas emissions
		Traffic safety problem and congestion
15	Hidayatno et al, (2019)	Model Conceptualization on E-Commerce Growth Impact to Emissions Generated from Urban Logistics Transportation: A Case Study of Jakarta
		E-commerce activity driving to unsustainable system transportation
		70% total emission are from logistic activity, meanwhile online shop has high frequency delivery
		Traffic congestion
		Increasing carbon footprint
16	Yan et al., (2019)	The effectiveness of parking policies to reduce parking demand pressure and car use
		High intensity of car utilization in the city area
		Ineffective of car utilization policies (parking price)
		People tend to pay more rather than choosing alternative mode
17	S. Li & Zhao, (2017)	Exploring car ownership and car use in neighbourhoods near metro stations in Beijing: Does the neighbourhood built-environment matter?
		Lack of ST related with the unsupported built environment

No	Journals	Possible UDEs
		Railway station (mass transportation) that still not available in every district or urban residential
		There is remain bus transportation sector not changing from the fossil energy to the gas or electric power system
		Traditional built environment more triggered to own private car
18	Yang et al., (2016)	Incorporating carbon footprint with activity-based costing constraints into sustainable public transport infrastructure project decisions
		Lack of quality and value sustainable of mass transportation infrastructure
		Improper strategies management of environment for infrastructure projects derive to the unsustainable transportation condition in the recent time
		Adaptation of policies for mitigation measures as a representation of climate disaster awareness that may arise in the future, is still quite shortage.
19	Ge & Li, (2018)	System-level energy consumption modelling and optimization for cellulosic biofuel production
		Lack of sustainable energy driving to the lack of ST
		Fossil fuels has high potential to increase GHG (global greenhouse gas) emission
		Meanwhile biofuel that can saving GHG emission, has low capacity to fulfil the required energy
20	Chai et al., (2016)	Analysis of road transportation energy consumption demand in China
		The total energy consumption in the economy has been proportionally rising
		China's rapid economic development, industrialization and accelerated urbanization, transportation demand has been increasing
		China's transportation energy consumption accelerated significantly with an average annual growth rate of 9.8% from 2000 to 2008
		There is a policy issues for energy savings in the Chinese transportation industry
		A reduction in energy intensity in the past was not enough to prevent an increase in energy consumption
21	Zhou & Wang., (2014)	Explore the relationship between online shopping and shopping trips: An analysis with the 2009 NHTS data

No	Journals	Possible UDEs
		The idea of an online shop can be an alternative solution to reduce mobility density through shopping travel measurement proved inefficient
		There is no practical field evidence that can state absolutely that an online shop can be the main solution in reducing individual shopping trips and increasing its efficiency
		The effect of online shopping on shopping trips, is still quite debate whether it being substitute or complementary.
		From the research results obtained, most of the online shop activities in an area. The most dominating effect tends to be a complementary rather than a substitute
		Online shoppers in high intensity possibly having more shopping trips at the same time AND the need to feel and experience some of the commodities in physical store might be the reason
22	Wu et al., (2018)	Energy consumption in the transportation sectors in China and the United States: A longitudinal comparative study
		Bad impact of the great energy consumption of the transportation sector
		Global climate change, influences human health and ultimately impacts the sustainable development of human society
		Environmental pollution pressure gets worse
23	Liu et al., (2016)	Promoting sustainable consumption in China: a conceptual framework and research review
		Over consumption of energy AND emission as the impact unsustainable transportation
		Household was contributed 13% of energy consumption for direct transportation energy
		A lot of study were proved that there is big increasement of number vehicle in recent time AND for forecasting in the future condition from the actual condition estimation
		Less of previous research that were concerned less-carbon transportation option for main mechanism to implement in the real situation
24	Amiril et al., (2014)	Transportation Infrastructure Project Sustainability Factors and Performance
		Negative impacts of transportation infrastructure project sustainability

No	Journals	Possible UDEs
		Disturbance of human life and ecosystem The environment and social dislocation Considerable land use, long-term investment, and huge resource
25	Sonmez et al., (2017)	Estimating transportation energy demand in Turkey using the artificial bee colony algorithm A rapid increase in the energy demand for many sectors and limited energy resources The travel habits of the citizens are changing to prefer using private cars instead of public transportation Growing population and urbanization as well as socio-economic development in Turkey have caused a rapid increase in the energy demand for many sectors
26	Traivivatana et al., (2017)	Impact of Transportation Restructuring on Thailand Energy Outlook Energy demand increasement because economic growth and the necessities of transportation sector Forecast result in 2035 from the recent data of (2012) shows that the demand of energy from transportation sector dramatically increase Transportation sector is the highest contributor as the greenhouse gas emitter
27	Hanbury et al., (2018)	Life cycle analysis of geothermal energy for power and transportation: A stochastic approach There is an environmental bad impact from geothermal energy for power and transportation The construction, operation, and re-cultivation of renewable energy power generation facilities may cause global warming Lack of renewable energy technologies understanding Less concerned with environmental costs
28	Amakpah et al., (2016)	Energy Flow Analysis of China 2050 Pathways Energy Calculator with Special Emphasis on Transportation GHG emissions, energy demand for fossil fuel energy-dependent sectors has raised so it is become the global concerns More than a quarter of overall energy use is allocated to the transportation sector, causing 22% of global energy end-use-related CO2 emission Energy optimisation and CO2 emission reduction cannot be achieved

No	Journals	Possible UDEs
		The critical energy governance issues
29	Shi et al., (2019)	Does e-shopping replace shopping trips? Empirical evidence from Chengdu, China
		Highly accelerated process of urbanization, traffic congestion has ended up one of the greatest challenges for numerous cities
		Shopping is one of the activities that cannot be separated from the fulfilment of life, where one of the densities of traffic is also triggered on the shopping trip of each individual in an area.
		Besides e-shopping have substitution impact, it is having an impact which function as the complementary
		People who own private vehicle which also purchase online more frequently, at the same time tend to have small possibility to substitute e-shopping for shopping trips.
		E-shopping has a promotion impact on the market for shopping demand, which indicated based on result 70% of respondents indicated that e-shopping increases the frequency of total shopping, which is combined with conventional shopping and e-shopping.
30	García-Olivares et al., (2018)	Transportation in a 100% renewable energy system
		There are major challenges that present world economy faces such as energy security, sustainability, greenhouse gasses, pollution and climate change impacts due to renewable energy system (global transport)
		Global transport is still heavily dependent on fossil fuels (mostly, oil)
		Global transport causes millions of traffic accidents every year
		Governments have not yet supported a coordinated policy initiative such as major restructuring of infrastructure and an internationally coordinated policy action
31	Deendarlianto et al., (2017)	Scenarios analysis of energy mix for road transportation sector in Indonesia
		Energy demand on Indonesian road transportation sector becomes higher
		Limited availability, high subsidy and environmental concern
		Oil-based fuels such as gasoline and diesel are not viable choices in the future
		Less concern from government and lack of policy

No	Journals	Possible UDEs
32	Chang et al., (2018)	Impact of urban development on residents' public transportation travel energy consumption in China: An analysis of hydrogen fuel cell vehicles alternatives Development of public transportation infrastructure as a solution to reduce energy consumption that is still not fully supported from the aspects of policy, infrastructure, and resource prices Increasingly dense populations tend to increase the use of transportation Improper subsidy policy on fuel cells to replace it with hydrogen fuel Access to use of hydrogen fuel cells still tends to be expensive both in terms of vehicle prices, fuel prices, and hydrogen fuelling stations
33	Batur et al., (2019)	Impact assessment of supply-side and demand-side policies on energy consumption and CO2 emissions from urban passenger transportation: The case of Istanbul An alarming condition in supply and demand of energy in the future to support the sustainability transportation sector Energy consumption per capita is predicted to increase dramatically by high passenger travel behaviour The high demand for fuel from year to year in the future because of the high demand for mobility (travel demand) There is still lack of sufficient research that concern on the impact of transportation policy towards energy and the emission
34	Beheshtian et al., (2018)	Impacts and implications of climatic extremes for resilience planning of transportation energy: A case study of New York city The transportation energy sector in metropolitan areas cause climatic extreme change Gasoline and diesel which are the main energy sources of urban transportation are non-renewable and are considered to be the main contributors to pollution The vulnerability of the motor fuelling supply chain and its impact on travel behaviours in time of climatic hazards has been relatively understudied and under-funded
35	Cui & Li, (2014)	The evaluation of transportation energy efficiency: An application of three-stage virtual frontier DEA

No	Journals	Possible UDEs
		Unstable transportation energy efficiency In China, the rapid economic growth has triggered inconsistencies between energy supply and demand In terms of various transportation sectors in several countries, there are differences in energy efficiency There is a problem in utilizing the transportation industry's energy
36	Paladugula et al., (2018)	A multi-model assessment of energy and emissions for India's transportation sector through 2050 Since 1995, the premature death was the terrible effect by particulate matter concentration of emission that has increased 50% in this recent India has 20 out of 40 of the world's most polluted cities as estimated by concentrations of particulate matter (PM2.5). India was categorized as the world's third largest importer of unrefined oil and the rate of reliance on oil imports
37	Feng & Wang, (2018)	Analysis of energy efficiency in China's transportation sector The country's transportation sector uses high energy levels and intensive CO2 emissions The problem of high energy consumption and CO2 emissions is far from being fundamentally solved from the current policy High-speed trains have grown rapidly but become the highest supplier in energy consumption and CO2 emissions
38	Salvi & Subramanian, (2015)	Sustainable development of road transportation sector using hydrogen energy system The energy crisis caused by the lack of ST practices in the application of alternative energy which tends to be friendly for the environment in the future Petroleum-based fuels, like gasoline and diesel has 95% of utilization Increasement of fossil fuel utilization continuously also increasing the pollution level
39	Garmsiri et al., (2016)	Integration of transportation energy processes with a net zero energy community using captured waste hydrogen from electrochemical plants

No	Journals	Possible UDEs
		The problem of climate change which has become a global scale as a result of increasing emissions in various countries Current fuels that are still dependent on the use of fuels containing hydrocarbons as the main source which have a lot of severe impacts on the environment The utilization of alternative energy is still not comprehensive in various transportation sectors at this time Transportation and energy sector are regularly seen as independent from the infrastructure sector of the community
40	Peng et al., (2018)	Energy-efficient cooperative transmission for intelligent transportation systems Congestion and accidents in the transportation system have become a global problem The rapid development of netizen makes traffic more congested Undeveloped ITS challenges such as traffic control, navigation system control and traffic diagnosis in urban resident transportation could lead to the traffic accident. Intelligent Transportation Systems / ITS which is expected to help road security, has limited energy and energy charging.
41	Cheng et al., (2015)	Urban transportation energy and carbon dioxide emission reduction strategies The global transport system's energy demand increases along with the immense growth of vehicle following by emission as the impact of lack ST. The increasement of energy demand in 2004 until 2030 of petroleum consumption which transportation sector as the main contributors In the context of urban transport systems, most research studies focused only on CO2 emissions and energy consumption AND the interactions between various transportation subsystems are not considered along with lack of research into the influence of transportation policies
42	Wang et al, (2014)	Transport energy consumption and saving in China China has become the biggest energy consumption of transportation in the world’s perspective

No	Journals	Possible UDEs
		Has biggest population in the world which have high transportation activity that causing potential GHG emission
		For next decade China is facing critical period of development of ST due to climate disaster issue based on the forecasting from the current data condition
43	Yin et al., (2015)	China's transportation energy consumption and CO2 emissions from a global perspective
		Based on the recent data, the analysis shows that for the upcoming decades the CO2 will rapidly grow if there is no relevant contribution of policies
		The increasement of vehicle utilization (private cars, buses, plan, ship) especially road transportation AND decreasing of walking and cycling utilization as the environmentally friendly alternative mode
44	Ercan et al., (2016)	Investigating carbon footprint reduction potential of public transportation in United States: A system dynamics approach
		The current mode of conventional transportation is very dependent on fossil fuels AND new innovation will not be enough, without a reduction in the number of vehicles on the road to reduce this dependency, only with a solution to move away from fossil fuels in favour of other fuel options.
		90% in overall riding share was dominated by private vehicles utilization per person along with the number per trip
		Most public transportation still use the fossil energy as the main resources AND the number of public transportation availability doesn't linear with the number of growth personal trips
45	Li et al., (2018)	Future energy use and CO2 emissions of urban passenger transport in China: A travel behaviour and urban form-based approach
		In China, when the size of the city was enlarged the energy use of passenger transportation increased per capita in urban areas which also produced 396 Mt of emissions from CO2
		Based on the analysis: urban trip rate (people behaviour of travel distance) in China cities exceed more than 70% of the needs of mobility

No	Journals	Possible UDEs
		Polycentric and Monocentric cities as the absolute single solution doesn't have big significant to reduce the number of urban mobility AND energy use in order to create ST.
		In megacities the gasoline consumption mostly consumed by Private Vehicles and Taxis is 36% higher in monocentric cities than polycentric cities AND diesel and natural gas mostly consumed Public Buses and Taxis are 24% and 13% higher in polycentric cities than monocentric
		Although many policies that direct people to encourage using alternative energy, gasoline still has big number of consumptions for urban passenger transportation energy
46	Meng et al., (2016)	Energy efficiency of urban transportation system in Xiamen, China. An integrated approach
		Energy inefficiency in the present years that will give a bad impact toward sustainable energy in the next decades
		The global transportation system worldwide increased from 23% in 1973 to 28% in 2012
		The number of vehicles in China has increased over the past 10 years, from 16.1 million in 2000 to 62.9 million in 2009 due to urbanization and population growth
		Based on inefficiencies in the recent year it has been predicted that oil consumed by road transport will increase at an annual rate of 6% with the total amount reaching 363 million tons by 2030 if no new energy conservation policy is implemented
47	Hao et al., (2017)	An overview of energy efficiency standards in China's transport sector
		Alarming circumstances for China's energy security, environmental protection, and climate change
		China's energy consumption has grown rapidly over the past few decades
		Passenger vehicle market raised over recent years has increased from 1.2 million in 2000 to 21.1 million in 2015 for their total sales
		In China, light duty commercial vehicles AND heavy-duty vehicles have high intensity of utilization
		Heavy-duty vehicles having high fuel consumption rate (FCR)

No	Journals	Possible UDEs
48	Mohareb & Felix (2017)	Affordable and Common Modes of Transportation in Developing Cities and Their Effect of The Sustainability of Streets Urban areas have enormous increasement of daily trips by private vehicle which are never unsolved to meet the balance of population Lack of comprehensive transportation planning due the increasement of motorization and growth population Research in general abandon the aspect of the needs of the users (social; community liveability and health impact, economic; cost and efficiency, environment; climate or any related to the local environment) AND only focuses on mechanism of the transportation modes
49	S. Yang & He, (2016)	Fuel demand, road transport pollution emissions and residents' health losses in the transitional China Resident health losses as the impact of air pollution The demand of the fossil fuels is quietly high as a main choice among urban people Road transportation sector has committed as the biggest contributor of emission residue
50	Hakimelahi et al., (2016)	Fuel Consumption Monitoring for Travel Demand Modelling Inefficient use of transportation will lead to consumerism, environmental pollution, economic losses in the form to time, and capital waste. More the 50% of oil demand in the whole world consumes by transportation sector AND especially road transportation sector contribute 80% oil demand The continuous use of oil which is not immediately sought for a solution, not only has a negative impact on the economic but also exacerbates bad air quality Someone who has status as professional tends to consume more fuel than unemployment AND every 1 car ownership in an individual can provide a springboard increase in fuel consumption with significant a trip rate

4.3. Data Processing

In data processing the researcher will envision each UDE using TOC logical thinking diagrams. It is conducted in order to identify the root causes of unsustainable transportation in the CRT, determine conflicting problems using EC, and provide Injection based on Islamic values in the FRT. The diagram will explain in detail in the CRT sub-content of the data processing in the next page.

4.3.1. Current Reality Tree

In order to answer "What to Change?" of the unsustainable transportation, the next step that has to be conducted is interpreting the collected UDEs into CRT. The CRT will be divided into three charts which are from social, economic and environmental aspect. This stage the process of the root cause finding was collected from several UDEs of previous research and through brainstorming with the urban planner expert who is experienced with transportation system.

In the analysis phase of the CRT diagram in the figure 4.5, the results show that the main root of the problem (UDEs) is the absence of ST in terms of technology or application and awareness of a responsible environmentally friendly transportation system, due to weak supporting factors from the economic, social, and environment. The cause of the absence of a ST program in terms of economic factors, in this case includes the unequal distribution of access to public transportation, which causes the time and cost needed inefficient to be able to access public transportation. This is because the planning of an area that is less integrated between the urban planner and urban transportation expert, so that an area tends to be seen only in terms of fulfilment of each individual population, then planning an area or dwelling tends to focusing on providing business activities and comfort infrastructure access for resident private vehicles. The figure 4.5 below shows the CRT diagram related with the lack of sustainable transportation.

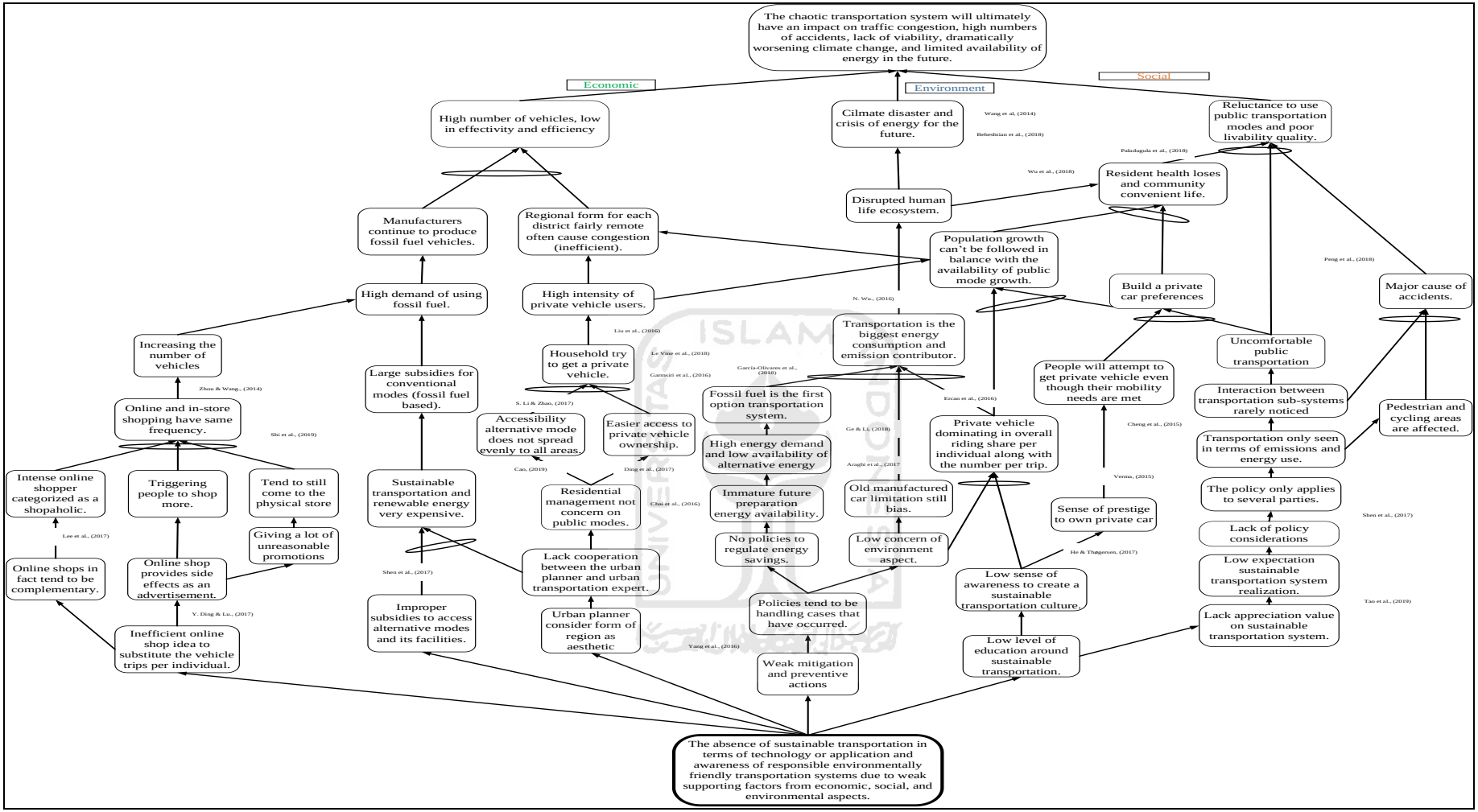

Figure 4.5 Current Reality Tree

Followed by the problem of subsidies, the inaccuracy in the provision of subsidies here is also an indication of negative factor that hinder the progress of the ST program. Determining the price of transportation both in terms of public transportation cost, private vehicle parking rates, fuel prices, and private vehicle prices are factors that cannot be separated from the management of the transportation system so that the price management is efficient. With the aim of controlling people's preferences in choosing their mode to meet their daily mobility needs. The high cost that must be spent in order to access vehicles with alternative energy both from the price of the vehicle itself, fuel (energy), and the fuelling station infrastructure itself. Such problematics is one important component to consider, so that people can move from the "conventional" to the "sustainable".

Meanwhile, the phenomenon of the rise of people shopping online is also one of the causes of the emergence of new problems lately, which at first was unexpected. The ideal of online shop, it is one of the shopping methods offered digitally through online to reduce the number of trips per individual or household by replacing the number of consumer shopping trips (number of shopping travels). Through a delivery service with logistics mode that carries goods in bulk, provided by the platform. In practice, several cases found online shopping are not as substitution toward number of shopping travels, but act as complementary.

The reason is because people who shop online tend to still come to the "physical store" to find out the real condition of the product, besides that other findings show that people shop online are often categorized as shopaholics, who tend to keep shopping as usual to the "physical store", so this only adds twice the number of trips and tend to be inefficient both in terms of cost and time. Of course, as the number of logistic modes increases, it also plays a role in contributing to the density of traffic meanwhile the private vehicle still increases significantly.

In social factors, ST programs are not running due to several conditions. The low level of education in the cultivation of knowledge will negatively affecting the importance of creating a sustainable mobility lifestyle has triggered a lack of

appreciation in using public transportation. The problem causes to a serious issue because of the loss of interest of people to use public transportation.

In a community of people whose economic conditions are still developing, the results of the CRT indicate that this reluctance is often accompanied by excessive pride in the ownership and private vehicles utilization. In a developed community this sometimes happens, often among young people. They do not need private car because daily mobility needs can be fulfil without it, instead triggered by prestige reason. Besides that, the lack of optimal policies that are carried out also becomes another cause related to controlling people traveling patterns. The reluctance to use transportation also arises from the experience of each individual due to the lack of comfort offered by public transportation facilities, it is also often due to the poor maintenance of public facilities which is not performed in regular basis. It could lead to other unfortunate impacts, such as accident.

Meanwhile in ST program, transportation systems should be able to provide a high quality of life worthiness, one indication is the high safety factor in the transportation system. The lack of research and studies about ST related to the interaction between transportation sub-systems is also responsible for the high number of accidents in the transportation system. A review of ST programs from environmental factors, the results of the CRT framework diagram reveal that weak mitigation and preventive actions to tackle the possibility of future climate change disasters become one of the many obstacles that hinder the ST program. The causes found, all occurrences happen due to the chain interaction of various elements namely, the presence of policies that are less serious and decisive related to environmental problems, immature preparation in responds the surge in energy demand as growth in energy needs, the role of fossil fuels that still being a priority in meeting energy needs and the unavailability of alternative energy for the public at with affordable access and prices. The high demand for fossil fuels becomes a chain of problems that arise, so the final impact obtained is the high levels of emissions and all forms of air pollution.

4.3.2. Evaporating Cloud

EC display the opposite of the negative effects of unsustainable transportation. The positive side is then expected to be able to help solving existing problems, namely achieving ST. Figure 4.6 below shows EC

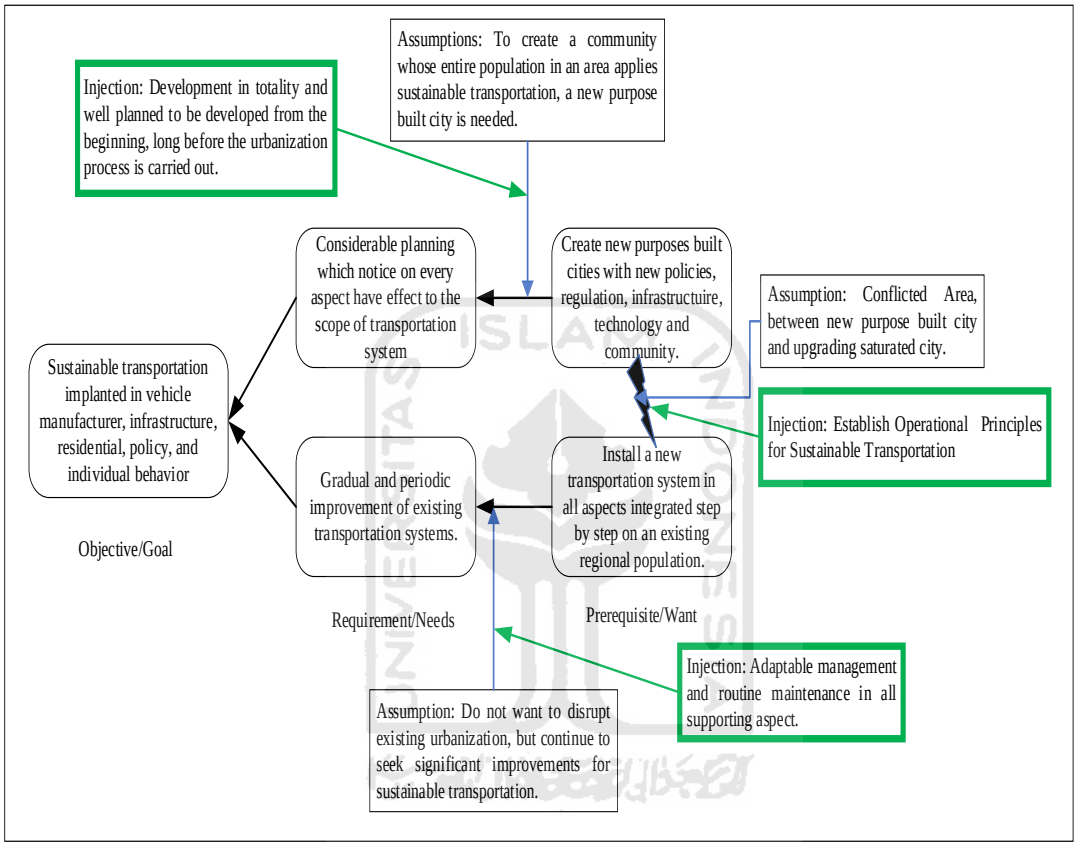

Figure 4.6 Evaporating Cloud Diagram

After getting the results of the analysis of UDEs (negative effects) on the implementation of the ST program, so that is obtained the root of the problem. Then, in the EC stage or also referred to the CRD tries to translate the root of the problem to be changed into the intended target. The target is ST implanted in vehicle manufacturers, infrastructure, residential, policy, and individual behaviour. However, in determining a target, definitely there is conflict in realizing it. Then, this diagram trying to figure out for possible conflicts that arise.

In the CRD diagram analysis as the figure 4.6, in order the transportation sector can be sustainable. Then the scheme and assumptions are needed in determining the

steps to be taken. The choice between building a new area (new purpose-built city) from "zero" that has not yet occurred the process of population, which has more flexibility in conditioning the construction process, so that it has been designed thoroughly both of technology, infrastructure, and policies before it is inhabited. Meanwhile, the scheme and other assumptions is to create improvement in a saturated city (area) which is already populated. Accompanied by providing improvements and maintenance that can be adjusted to the needs and carried out routinely toward the transportation system development.

Thereby both choices are determined as a scheme and the assumptions of two opposing objects, then in this conflict area need to determine the injection (solution). Then the results (injection) of the decision obtained are Establish Operational Principles for ST program. Supported by this injection every schemes or assumptions described above can be carried out.

4.3.3. Future Reality Tree

FRT is a reverse diagram of the CRT. In FRT, there are objectives or positive effects to overcome the problems found in CRT. FRT is form of a more detailed goal arrangement, through detailed procedures to be able to achieve the goals to be achieved in the future. The stages (short terms goals) in FRT diagrams are a form of a positive opponent, from the UDEs (negative effect) which is obtained previously.

To support the achievement of short-term goals so that they can be achieved, it is necessary to have fundamental guidance to control the process, at this stage it is determined to use Islamic values through the Quran and Hadith to be an injection in some short-term goals, in order to realize the main goals that are predetermined. There are also some Islamic values that are included as advocates to turn core issues into positive action. FRT is shown in Figure 4.7 below.

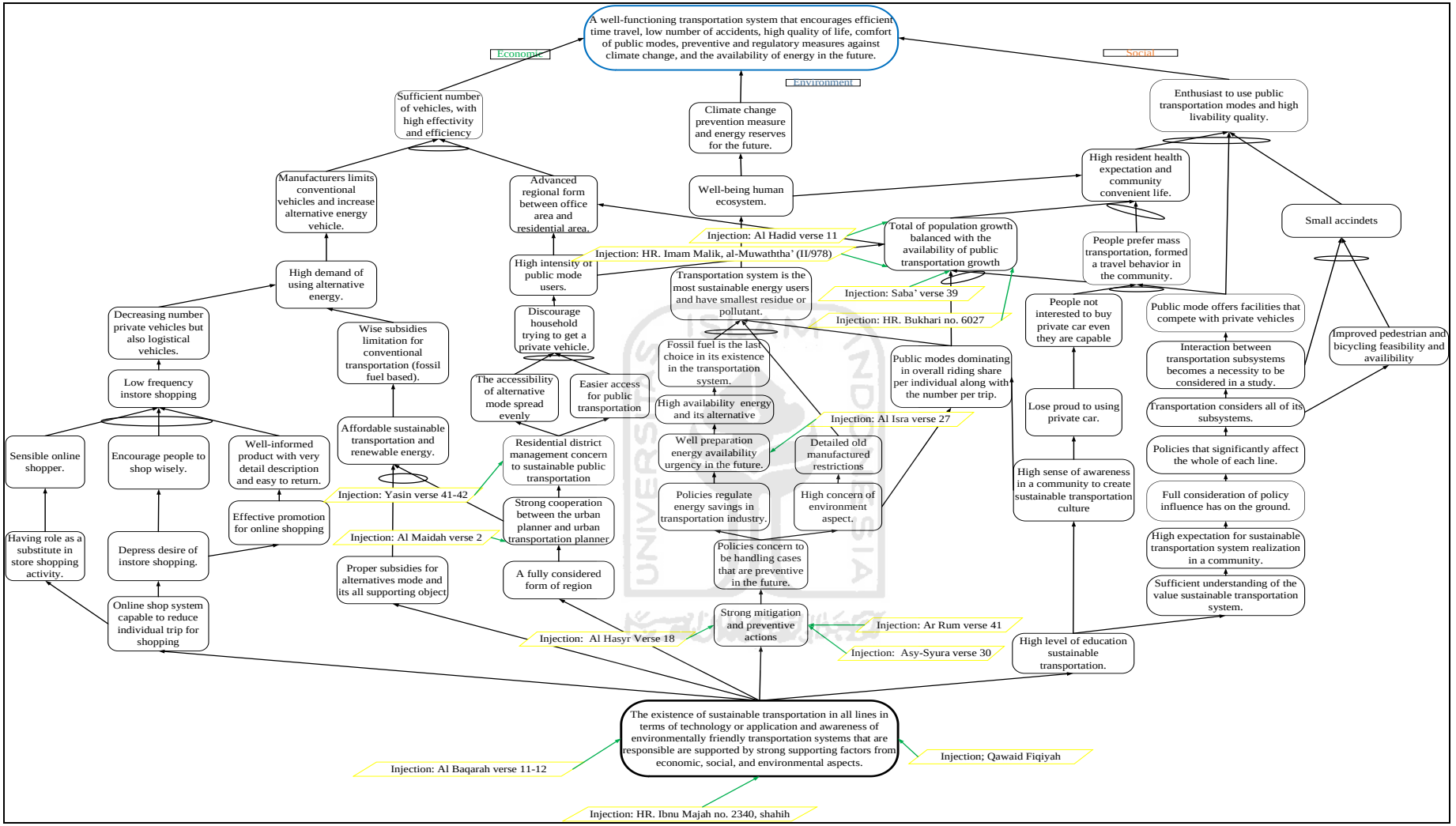

Figure 4.7 Future Reality Tree

The final stage of the TOC diagram in this study is in the form of FRT diagram after uniting two objects that have conflicts in the goal achievement scheme. Afterwards, a more detailed goal is arranged, through detailed procedures to be able to achieve the goals to be achieved in the future. The stages (short terms goals) in FRT diagrams as a figure 4.7 are a form of a positive opponent, from the UDEs which is obtained previously. To support the achievement of short-term goals so that they can be achieved, it is necessary to have fundamental guidance to control the process, at this stage it is determined to use Islamic values through the Quran and Hadith to be an injection in some short-term goals, in order to realize the main goals that are predetermined.

Guidance from Al Baqarah ayat 11-12; *"Do not make trouble on earth," they say, "We are only reformers." In fact, they are the troublemakers, but they are not aware*. Allah tells that human shouldn't make any kind of damage. The big damage on this earth is syirk make company of Allah where Allah Rabull A'lamin is the greatest that doesn't need help from other, because as muslim know in Islam that everyone who syirk to Allah that just waiting for His wrath which could lead a disaster. The smallest damaged in the earth is destroy the nature. Islam in any ways prohibit to make any kind of damage in such a way, there are no toleration. The hadith from Abû Sa'îd Sa'd bin Mâlik bin Sinân al-Khudri Radhyallahu anhu, Rasulullâh Sallallaahu 'alahi wa sallam said," *There must be no danger and no harm to others.* " (HR. Ibnu Majah no. 2340, shahih). As the hadith explanation then as a result there are a principle (qawaid fiqhiyyah) for this fundamentals value refer to the Andirja, (2019). The qawaid fiqhiyyah, the danger must be eliminated as much as possible. Since this principle has no contradiction, this is applied as a main guidance in the existence of ST in all lines. In terms of technology or application and awareness of environmentally friendly transportation systems that are responsible are supported by strong supporting factors from economic, social, and environmental aspects.

The economic aspects were applied al ayat; "*And cooperate with one another in virtuous conduct and conscience, and do not cooperate with one another in sin and hostility. And fear God. God is severe in punishment.*" In order to make strong cooperation between the urban planner and urban transportation planner (engineer), so that built environment could be done to support the ST. Meanwhile, from Qur'an Yasin ayat 41-42 "*Another sign for them is that We carried their offspring in the laden Ark. And We created for them the like of it, in which they ride.*" The *ayat* told that Noah A'laihissalam as the second father of all humanity was saved by Allah with his people who a believer, but from that *ayat* also known based on Quran in early period of human civilization Islam already familiar with the mass transportation long before the human civilization was formed until now based on *firman* of Allah. Since this *ayat* has no contradiction with the ST values, then this injection applied as a guidance in order to set high intensity of public mode user to support the ST program, so that the infrastructure developer and the user can be prioritizing the public transportation to increase its intensity of utilization.

The climate disaster, weak mitigation and energy scarcity issue as the negative impact of transportation sector activities related to the environment aspect, to address this Al Hasyr ayat 18; "*O you who believe, fear Allah and every individual should pay attention to what he has done for tomorrow (the hereafter); and fear Allah, indeed Allah is All-Knowing what you do*" The next surat As-Syura ayat 30; *"Whatever misfortune befalls you, it is because of what your hands have earned; and yet He pardons much."* Meanwhile Ar rum ayat 41; "*It has been seen that damage on land and on the sea is caused by the deeds of human hands, so that Allah give some of what they have done to felt, so that they might return (to the right path)*". Those ayat mentioned that what disaster that or issue that occurred it is not happened except because their mistake. Indeed, with Allah will then they taste what they have done because their sins. This also related with the issue that occurred with ST. The failure to run the ST occurred because stakeholder (user, developer, etc) itself does not concern for the sustainable values that would impact to environment aspect. There are also exist the ayat in above which are as a guidance that mentioned for people should prepare for their tomorrow (*akhirat*). Islam knows in order for their tomorrow they should prepare what the deed that has been done for the future, this is certainly also related with the daily agenda (program),

planning for the future. Then those ayat applied in order to arrange strong mitigation and preventive actions because the issues occurred due to lack of preparedness of preventive actions. Where Al Isra ayat 27; *"The extravagant are brethren of the devils, and the devil is ever ungrateful to his Lord"* told not to be wasteful, then here it is necessary to saving. Then this applied as the injection for guidance in order to create well preparation energy availability urgency in the future.

The injection for social aspect from Al Hadid ayat 11; "*Who is he who will lend God a loan of goodness, that He may double it for him, and will have a generous reward?*". Followed with the surat Saba' ayat 39 "Say, "*My Lord extends the provision to whomever He wills of His servants, or withholds it. Anything you spend, He will replace it. He is the Best of providers*." Supports by hadith HR. Bukhari no. 6027; "*Give intercession (help) undoubtedly you are rewarded, and Allah decides verbally by His apostles what He wants*." The Islamic fundamentals taught to share with others individual or community, this guidance could address the unbalanced population with the mode availability such as ride-sharing, indeed with gender separation. Meanwhile there are hadith from HR. Imam Malik, al-Muwaththa' (II/978); "*One rider (traveler) is a devil, two riders (traveler) are two devils, and three riders (traveler) are a group of travellers*". Explained that for people who want to take a long trip (safar) it will be good if they are not alone. For the sakes of ST, the principle also can apply in daily activity of mobility in terms of ride-sharing, so that those Islamic fundamentals were applied in order to set the total of population growth balanced with the availability of public transportation growth

4.4. Sustainable Transportation Indicator Guidelines

The ST Indicator Guidelines are the findings during the process of establishing the TOC framework. It consists of 3 basic factors which are divided into 12 main parameters as can be seen in table 4.3 and 52 indicators as in figure 4.8. This is because the TOC helps formulate the problems caused by various interrelated factors, on the other hand this method also helps find out what the determinant factor must be exist in the establishing of ST. The table 4.3 shows the basic parameter of ST Indicator Guidelines.

Table 4.3 Sustainable Transportation Basic Parameter

No	Sustainable Transportation Indicators Guidelines		
	Economic	***Social***	***Environment***
1	Affordability and Accessibility	Equity and Fairness	Climate Change Prevention and Mitigation
2	Resource Efficiency	Quality of Liveability	Zero Pollutant
3	Operational Efficiency	Community Travel Behaviour	Biodiversity Protection
4	Land Use Mix and its Planning	Individual Community Education and Awareness	Availability and Energy Reserves

This formation also was obtained from several previous researches which had already formulated indicators, related to ideal standards in the transportation system to be guided by the principle of sustainability. As compiled and formulated by Toth-Szabo & Varhelyi, (2012) in order to control the development process transportation system to be in line with sustainable development programs. Similarly, (Kumar, 2013) and (Litman, 2019)who tried to arrange indicators to be more detailed with a variety of considerations of the mutual relationship of each supporting factor so that the indicators that have been presented at this stage are used as a standard in the Quality Function Deployment method to determine the criteria for determining the sustainability of a transportation system. As can be seen the figure 4.8 shows the ST Indicator Guidelines.

No	*Economic*	*Social*	*Environment*
1	Affordability and Accesbility	Equity and Fairnes	Climate Change Prevention and Mitigation
	Public Modes Availibility	Total Growth Population and Modes Availability Equity	Reduction Greenhouse Gas Emission
	Commute Access and Transit Access Availibility	Individual Chance to Reach Public Modes Facility	Climate Stability Preserve
	Cost Per Trip	Rate of Access to Education and Employment Opportunity	Enviromental Preventive Regulation Availibility
	Ease of Access	Fair and Transparant Regulation	
	Transportation Pricing Management Efficiency		
2	Resource Efficiency (cost, time, distance)	Quality of Livability	Zero Pollutant
	Public Modes Facility Distances	Safety and Security	Clean Air Standarization and Management Plan
	Number of Terminal	Human Health and Wellness	Water Contamination Free
	Passenger Load Capacity Performance	Convinient Level	Noise Level of Traffic
	Energy Consumption of Modes	Walkability and Cycling Comfortability Perfromance	
	Transit Point Length		
3	Operational Effiency (cost, time, distance)	Community Travel Behaviour	Biodeversity Protection
	Improve Mobility	Transportation Preferences	Natural Resouces Availbility
	Vehicle Miles Travel (VMT)	Number of Household Trips	Minimize Non-Renewable Natural Resources Use
	Speed of Mobility	Mobility Culture	Ecosystem Preservation
	Traffic Density	Efficient Mobility Regulation and Auto Ownership	Biodeversity Protection Policy
	Waiting Time and Operating Hours		
	Delay Hours Per Year		
4	Land Use Mix and Built Environment	Individual Community Education and Awareness	Availability and Energy Reserves
	Residential Distance to Workplace or Public Falicilities	Sustainable Modes Appreciation Level	Reduction of Per Capita Fuel Consumption
	Comprehensive Land Use Optimization Policy	Citizen Involvement	Alternatives Energy Availibility
	Infrasructure Density	Community Development Program	Utilization of Alternative Energy
	Public Transportation Distribution	Sustainable Transportation Study and Research	Energy Saving Regulation
	Transit Oriented Development	Environmental Concern	

Figure 4.8 Sustainable Transportation Indicator Guidelines

The results obtained in this literature study, TOC proved to be a tool that makes it easy to find the root of the problem, what conflicts occur in goals, as well as providing solutions to the positive goals that are planned. Through logic tree diagrams that help arrange the framework of logical thinking processes as explained in the previous chapter namely, CRT, CRD and FRT. Its use makes the analysis of literature studies on the topic of ST focused and easily understands the fundamental problems that occur, but also providing the ability to examine the problems that analysed to find what are the main requirement and condition for the realization of ST.

The findings during the TOC process from the beginning stage to the end, it was found that the factors that made ST fail could be carried out due to the lack of concern for the mutual interactions of the three basic factors of ST. The three basic factors are economic, social, and environment. These three basic factors are translated into basic parameters that are connected with each of these factors, then are composed of indicators that serve as a tool to indicate the sustainability of a transportation system. The basic parameters are, from economic factors; Affordability and Accessibility, Resource Efficiency, Operational Efficiency, Land Use Mix and its Planning. Social Factors; Equity and Fairness, Quality of Liveability, Community Travel Behavior, Individual Community Education and Awareness. Last but not least is environmental factors; Climate Change Prevention and Mitigation, Zero Pollutant, Biodiversity Protection, Availability and Energy Reserves.

The failure of the implementation of ST can be known early through a deep insight into the indicators of ST as shown in figure 4.8 so that the evaluation process can be carried out earlier which is then followed by the formulation of strategies or management planning so that ST is able to become applicable to each line in the transportation sector.

4.5. Quality Function Deployment (Data Collection)

Data collection for the study used in the QFD method on the HOQ matrices, was obtained from respondent data in the DI. Yogyakarta region. With a total of 100 respondents, the questionnaire contained requests for what improvement that desires or needed, for those who have had experience in utilizing the DI. Yogyakarta transportation system. Referring to the ST Guidelines Indicator as a consideration for respondents to determine what demand of improvement they desire to improve through the selection of the importance level by offered variable in questionnaire.

a. Gender

Descriptions of the characteristics of respondents by gender are presented in the Table 4.4 and Figure 4.9.

Table 4.4 Gender Table

Gender	Frequency	Percentage
Male	50	50%
Female	50	50%
Total	100	100%

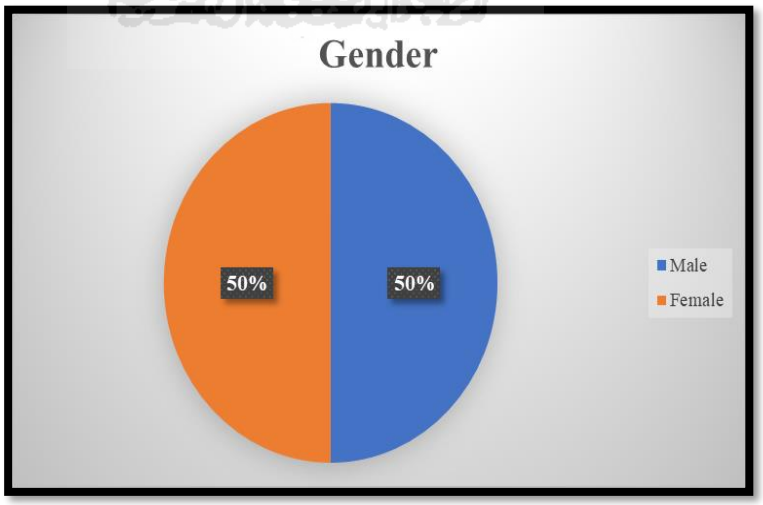

Figure 4.9 Gender Chart

b. Age

Descriptions of the characteristics of respondents by age are presented in the Table 4.5 and Figure 4.10.

Table 4.5 Age of Respondents

Age	Frequency	Percentage
18-20	21	21%
20-22	40	40%
22-25	33	33%
25-30	5	5%
30-40	1	1%
>40	0	0%
Total	100	100%

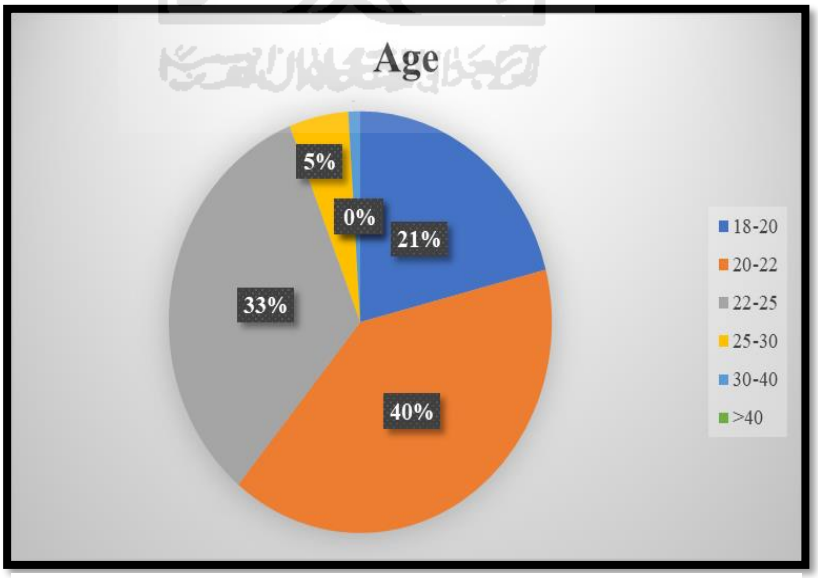

Figure 4.10 Age Chart

c. Status

Descriptions of the characteristics of respondents by age are presented in the Table 4.6 and Figure 4.11.

Table 4.6 Status of Respondents

Status	Frequency	Percentage
Student	91	91%
Worker	7	7%
Tourist	1	1%
Having Experience on DIY. Transportation Project	1	1%
Total	100	100%

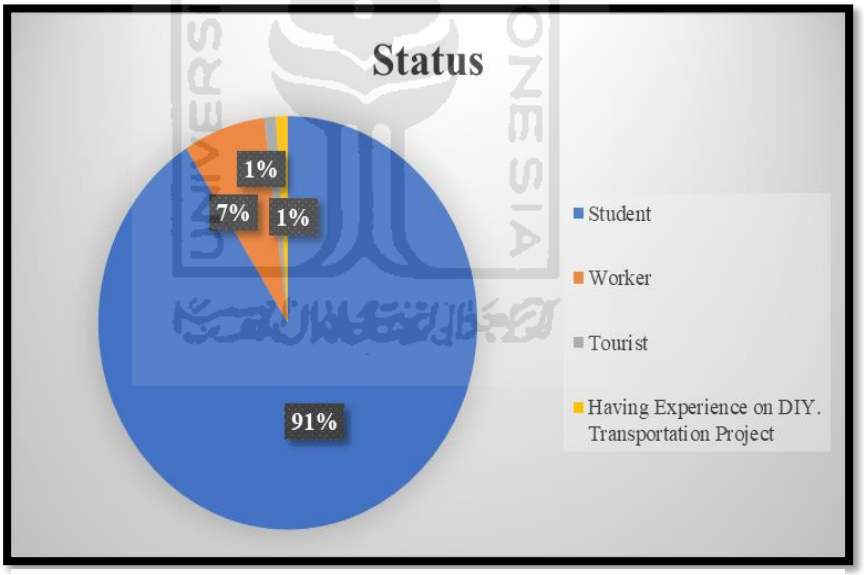

Figure 4.11 Status Chart

4.6. QFD Data Processing

4.6.1. Data Sufficiency-Test

Since the number of people who have accessed the transportation system on D.I. Yogyakarta is unfamiliar with certainty (unknown) so the sampling in this study takes the non-probability method which are Convenience Sampling Vehovar et al., (2016), where the respondents are obtained accidentally by the researcher as well as the characteristic of the questionnaire is used in conditions where researchers are deal with data in the form of ranking (ordinal), for example data to assess which rank is more important among several product attributes following by the data distribution is free Sahu et al., (2015) then this data is categorized as non-parametric that can conclude normality data test doesn't necessary. According to the characteristic of the data was describe above, the recommendation formula Al-Subaihi, (2003) used is a *Sample Size Determination* to find out whether the data was sufficient or not. The recommendation for the amount of data based on VanVoorhis & Morgan, (2007) minimum amounted to 30 respondents. This study that conducted by researchers tested the sufficiency of data obtained from respondents, which are 100 respondents. The Sample Size Determination formula:

$$n' = \frac{Z^2\, p\, (1-p)}{e^2}$$

This calculation uses a 90% confidence level, with maximum error 10%.

Where:

n′ = Required sample

p (1-p) = Population variance. Eriyanto in Alsana, (2018) the proportion value of (*p)* always having between 0 until 1, then p value is:

$$f(p) = p - p2$$
$$\frac{df\ (p)}{d\ (p)} = 1 - 2p$$
$$\frac{df\ (p)}{d\ (p)}$$

$$maximum\ if\ \frac{df\ (p)}{d\ (p)} = 0$$
$$0 = 1 - 2p$$
$$-1 = -2p$$
$$p = 0{,}5$$

Z = Confidence level = 90% = 1,645

e = Maximum error = 10% = 0,1%

The result of the calculation is:

$$n' = \frac{1{,}645^2 . 0{,}5\ (1 - 0{,}5)}{0{,}1^2} = 67{,}65$$

Based on the calculation above, it is shown that *n'* value at 67,65 = 68 data samples, this mean indicates 100 respondents for the data that used in this study was sufficient.

4.6.2. Validity Test

Pearson Correlation test originally is used to measure the strength and direction of a linear relationship of two variables by compare each indicator value with the total indicator value, but the theory allows the Pearson correlation test to be used to test the validity. Followed with the condition if each indicator (ordinal) is correlated with the total score of the indicator (interval). Thus, the validity test in this study uses the Pearson Product Moment method by utilizing SPSS *software* refer to Azwar in Fajarini, (2019). Indicators of each variable will be said to be valid if the value of r count > r table, in this study researchers used a significance level of 5%, with degrees of freedom = N - 2 = 100 - 2 = 98, which can be seen in r table product moment. The following shows several validity data.

a. Affordability and Accessibility

Table 4.7 shows the result of the data validity of Affordability and Accessibility

Table 4.7 Validity of Affordability and Accessibility

No	Variable	R-Count	R-Table	Status
1	Public Modes Availability	0.825	0.195	Valid
2	Commute Access and Transit Access Availability	0.829	0.195	Valid
3	Cost Per Trip	0.584	0.195	Valid
4	Ease of Access	0.736	0.195	Valid
5	Transportation Pricing Management Efficiency	0.692	0.195	Valid

b. Resource Efficiency

Table 4.8 shows the data validity of Resource Efficiency

Table 4.8 Validity of Resource Efficiency

No	Variable	R-Count	R-Table	Status
1	Public Modes Facility Distances	0.683	0.195	Valid
2	Number of Terminal	0.779	0.195	Valid
3	Passenger Load Capacity Performance	0.659	0.195	Valid
4	Energy Consumption of Modes	0.707	0.195	Valid
5	Transit Point Length	0.606	0.195	Valid

c. Operation Efficiency

Table 4.9 shows the data validity of Operational Efficiency

Table 4.9 Validity of Operation Efficiency

No	Variable	R-Count	R-Table	Status
1	Improve Mobility	0.587	0.195	Valid
2	Vehicle Miles Travel (VMT)	0.698	0.195	Valid
3	Speed of Mobility	0.681	0.195	Valid
4	Traffic Density	0.737	0.195	Valid
5	Waiting Time and Operating Hours	0.812	0.195	Valid
6	Delay Hours Per Year	0.768	0.195	Valid

d. Land Use Mix and Built Environment

Table 4.10 shows data validity of Land Use Mix and Built Environment.

Table 4.10 Land Use Mix and Built Environment

No	Variable	R-Count	R-Table	Status
1	Residential Distance to Workplace or Public Facilities	0.625	0.195	Valid
2	Comprehensive Land Use Optimization Policy	0.685	0.195	Valid
3	Infrastructure Density	0.693	0.195	Valid
4	Public Transportation Distribution	0.623	0.195	Valid
5	Transit Oriented Development	0.666	0.195	Valid

e. Equity and Fairness

Table 4.11 shows the data validity of Equity and Fairness.

Table 4.11 Validity of Equity and Fairness

No	Variable	R-Count	R-Table	Status
1	Total Growth Population and Modes Availability Equity	0.761	0.195	Valid
2	Individual Chance to Reach Public Modes Facility	0.831	0.195	Valid
3	Rate of Access to Education and Employment Opportunity	0.783	0.195	Valid
4	Fair and Transparent Regulation	0.752	0.195	Valid

f. Quality of Liveability

Table 4.12 shows data validity of Quality of Liveability

Table 4.12 Validity of Quality of Liveability

No	Variable	R-Count	R-Table	Status
1	Safety and Security	0.746	0.195	Valid
2	Human Health and Wellness	0.733	0.195	Valid
3	Convenient Level	0.853	0.195	Valid
4	Walkability and Cycling Comfortability Performance	0.778	0.195	Valid

g. Community Travel Behaviour

Table 4.13 shows the data validity of Community Travel Behaviour

Table 4.13 Validity of Community Travel Behaviour

No	Variable	R-Count	R-Table	Status
1	Transportation Preferences	0.823	0.195	Valid
2	Number of Household Trips	0.76	0.195	Valid
3	Mobility Culture	0.826	0.195	Valid
4	Efficient Mobility Regulation and Auto Ownership	0.747	0.195	Valid

h. Individual Community Education and Awareness

Table 4.14 shows the data validity of Individual Community Education and Awareness

Table 4.14 Individual Community Education and Awareness

No	Variable	R-Count	R-Table	Status
1	Sustainable Modes Appreciation Level	0.846	0.195	Valid
2	Citizen Involvement	0.827	0.195	Valid
3	Community Development Program	0.789	0.195	Valid
4	Sustainable Transportation Study and Research	0.833	0.195	Valid
5	Environmental Concern	0.629	0.195	Valid

i. Climate Change Prevention and Mitigation

Table 4.15 shows the data validity of Climate Change Prevention and Mitigation

Table 4.15 Validity of Climate Change Prevention and Mitigation

No	Variable	R-Count	R-Table	Status
1	Reduction Greenhouse Gas Emission	0.86	0.195	Valid
2	Climate Stability Preserve	0.869	0.195	Valid
3	Environmental Preventive Regulation Availability	0.874	0.195	Valid

j. Zero Pollutant

Table 4.16 shows the data validity of Zero Pollutant

Table 4.16 Validity of Zero Pollutant

No	Variable	R-Count	R-Table	Status
1	Clean Air Standardization and Management Plan	0.855	0.195	Valid
2	Water Contamination Free	0.806	0.195	Valid
3	Noise Level of Traffic	0.79	0.195	Valid

k. Biodiversity Protection

Table 4.17 shows the data validity of Biodiversity Protection

Table 4.17 Validity of Biodiversity Protection

No	Variable	R-Count	R-Table	Status
1	Natural Resources Availability	0.685	0.195	Valid
2	Minimize Non-Renewable Natural Resources Use	0.871	0.195	Valid
3	Ecosystem Preservation	0.871	0.195	Valid
4	Biodiversity Protection Policy	0.81	1.195	Valid

l. Availability and Energy Reserves

Table 4.18 shows the data validity of Availability and Energy Reserves

Table 4.18 Validity of Availability and Energy Reserves

No	Variable	R-Count	R-Table	Status
1	Reduction of Per Capita Fuel Consumption	0.806	0.195	Valid
2	Alternatives Energy Availability	0.882	0.195	Valid
3	Utilization of Alternative Energy	0.867	0.195	Valid
4	Energy Saving Regulation	0.725	1.195	Valid

4.6.3. Reliability Test

The reliability test in this study was carried out using the Alpha Cronbach Coefficient Widi, (2011), using a significance level of 5%. If r count> 0.60 indicates that it has acceptable stability so that the test results can be declared reliable. Table 4.19 shows the result of Reliability Test.

Table 4.19 Reliability Test

No	Parameter	Cronbach's Alpha	Status
1	Affordability and Accessibility	0.791	Reliable
2	Resource Efficiency	0.719	Reliable
3	Operational Efficiency	0.790	Reliable
4	Land Use Mix and Built Environment	0.673	Reliable
5	Equity and Fairness	0.785	Reliable
6	Quality of Livability	0.773	Reliable
7	Community Travel Behaviour	0.798	Reliable
8	Individual Community Education and Awareness	0.847	Reliable
9	Climate Change Prevention and Mitigation	0.835	Reliable
10	Zero Pollutant	0.737	Reliable
11	Biodiversity Protection	0.819	Reliable
12	Availability and Energy Reserves	0.838	Reliable

4.7. Quality Function Deployment Analysis

4.7.1. "*What*" Customer Demand Analysis

As explained earlier, the function of what analysis is to find out what request of the improvements based on user demand, at DI. Yogyakarta transportation system. In the table below shows the results obtained from the data collected related to the level of desire (importance) of user ratings based on a scale of 1-5 (level of importance), which then obtained the total results of the desire and the average value. Using indicators from the ST Indicator Guidelines as an improvement variable offered to respondents who have previously obtained from related literature studies in the TOC process.

a. Affordability and Accessibility

Table 4.20 shows the customer level of importance of Affordability and Accessibility.

Table 4.20 Variable of Affordability and Accessibility

Affordability and Accessibility					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Public Modes Availability	1	5	451	4.51
2	Commute Access and Transit Access Availability	1	5	444	4.44
3	Affordable Cost Per Trip	1	5	464	4.64
4	Ease of Access	1	5	472	4.72
5	Transportation Pricing Management Efficiency	1	5	442	4.42

b. Resource Efficiency

Table 4.21 shows the customer level of importance of Resource Efficiency.

Table 4.21 Variable of Resource Efficiency

Resource Efficiency					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Public Modes Facility Distances	1	5	437	4.37
2	Sufficient Number of Terminal	1	5	446	4.46
3	High Passenger Load Capacity Performance	1	5	443	4.43
4	Energy Consumption of Modes	1	5	433	4.33
5	Near Transit Point Length	1	5	438	4.38

c. Operational Efficiency

Table 4.22 shows the customer level of importance of Operational Efficiency.

Table 4.22 Variable of Operational Efficiency

Operational Efficiency					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Improve Mobility	1	5	448	4.48
2	Decrease Vehicle Miles Travel (VMT) of Private Vehicle	1	5	447	4.47
3	Speed of Mobility	1	5	415	4.15
4	Free Traffic Density	1	5	465	4.65
5	Waiting Time and Operating Hours	1	5	469	4.69
6	Low Delay Hours Per Year	1	5	452	4.52

d. Land Use Mix and Built Environment

Table 4.23 shows the customer level of importance of Land Use Mix and Built Environment.

Table 4.23 Variable of Land Use Mix and Built Environment

Land Use Mix and Built Environment					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Near Residential Distance to Workplace or Public Facilities	1	5	442	4.42
2	Comprehensive Land Use Optimization Policy	1	5	429	4.29
3	Infrastructure Density	1	5	439	4.39
4	Public Transportation Distribution	1	5	449	4.49
5	Transit Oriented Development	1	5	439	4.39

e. Equity and Fairness

Table 4.24 shows the customer level of importance Equity and Fairness

Table 4.24 Variable of Equity and Fairness

Equity and Fairness					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Total Growth Population and Modes Availability Equity	1	5	446	4.46
2	Individual Chance to Reach Public Modes Facility	1	5	453	4.53
3	Rate of Access to Education and Employment Opportunity	1	5	444	4.44
4	Fair and Transparent Regulation	1	5	458	4.58

f. Quality of Livability

Table 4.25 shows customer level of importance Quality of Livability

Table 4.25 Variable of Quality of Liveability

Quality of Livability					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Safety and Security	1	5	476	4.76
2	Human Health and Wellness	1	5	442	4.42
3	Convenient Level	1	5	468	4.68
4	Walkability and Cycling Comfortability Performance	1	5	459	4.59

g. Community Travel Behavior

Table 4.26 shows the customer level of importance of Community Travel Behavior

Table 4.26 Variable of Community Travel Behaviour

Community Travel Behavior					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Transportation Preferences	1	5	404	4.04
2	Consideration Number of Household Trips	1	5	397	3.97
3	Sustainable Mobility Culture	1	5	435	4.35

4	Efficient Mobility Regulation and Auto Ownership	1	5	442	4.42

h. Individual Community Education and Awareness

Table 4.27 shows the customer level of importance Individual Community Education and Awareness.

Table 4.27 Variable of Individual Community Education and Awareness

Individual Community Education and Awareness					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Sustainable Modes Appreciation Level	1	5	451	4.51
2	Citizen Involvement	1	5	453	4.53
3	Community Development Program	1	5	440	4.40
4	Sustainable Transportation Study and Research	1	5	443	4.43
5	Environmental Concern	1	5	472	4.72

i. Climate Change Prevention and Mitigation

Table 4.28 shows the customer level of importance of Climate Change Prevention and Mitigation.

Table 4.28 Variable of Climate Change Prevention and Mitigation

Climate Change Prevention and Mitigation					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Reduction Greenhouse Gas Emission	1	5	464	4.64
2	Climate Stability Preserve	1	5	457	4.57
3	Environmental Preventive Regulation Availability	1	5	456	4.56

j. Zero Pollutant

Table 4.29 shows the customer level of importance Zero Pollutant.

Table 4.29 Variable of Zero Pollutant

Zero Pollutant					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Clean Air Standardization and Management Plan	1	5	461	4.61
2	Water Contamination Free	1	5	454	4.54

3	Low Noise Level of Traffic	1	5	437	4.37

k. Biodiversity Protection

Table 4.30 shows the customer level of importance Biodiversity Protection.

Table 4.30 Variable of Biodiversity Protection

Biodiversity Protection					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Natural Resources Availability	1	5	447	4.47
2	Minimize Non-Renewable Natural Resources Use	1	5	460	4.60
3	Ecosystem Preservation	1	5	456	4.56
4	Biodiversity Protection Policy	1	5	451	4.51

l. Availability and Energy Reserves

Table 4.31 shows the customer level of importance Availability and Energy Reserves.

Table 4.31 Variable of Availability and Energy Reserves

Availability and Energy Reserves					
No	**Variable**	**Min**	**Max**	**Total**	**Mean**
1	Reduction of Per Capita Fuel Consumption	1	5	450	4.50
2	Alternatives Energy Availability	1	5	453	4.53
3	Utilization of Alternative Energy	1	5	458	4.58
4	Energy Saving Regulation	1	5	466	4.66

4.7.2. *"How"* Quality Characteristic Analysis

After data regarding to customer demand of improvement are gathered the stage requires researchers to decide related to "HOW" technical requirements or also known as quality characteristics, as a result of the necessary to meet customer demand with quality characteristics that are developed, occasionally also introduced as Voice of Company or Voice of Organization (VOO) Bialek et al., (2010). The Quality Characteristics or parameter that used in this study are the parameter of ST Indicator Guidelines, which had previously been obtained from related literature studies during the TOC process. The table 4.32 shows the Quality Characteristic.

Table 4.32 "HOW" Quality Characteristic

No	Parameter
1	Affordability and Accessibility
2	Resource Efficiency
3	Operational Efficiency
4	Land Use Mix and Built Environment
5	Equity and Fairness
6	Quality of Livability
7	Community Travel Behaviour
8	Individual Community Education and Awareness
9	Climate Change Prevention and Mitigation
10	Zero Pollutant
11	Biodiversity Protection
12	Availability and Energy Reserves

4.7.3. Correlation between *Customer Demand* and *Quality Characteristic*

Correlation analysis aims to determine the strength of the relationship between Customer Demand and Quality Characteristics, at this stage the assessment of relationship strength is carried out by expert who are experienced in urban design and infrastructure including the transportation system in DI. Yogyakarta as well as academic

figure of University of Islamic Indonesia. It is aimed to provide an assessment of the strength of the relationship between those two objects. The strength of the relationship is translated into quantitative values applied by HOQ matrices. The figure 4.12 shows the value of the strength of the relationship.

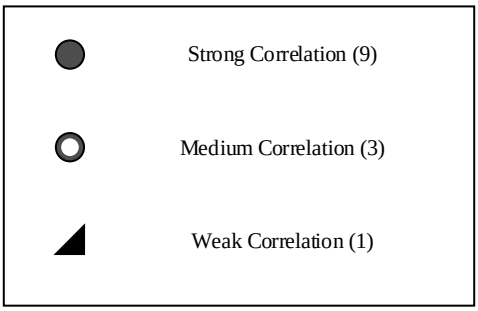

Figure 4.12 Correlation Between Customer Demand and Quality Characteristic

4.7.4. Correlation between Quality Characteristic

Determination of the relationship between Quality Characteristics aims to determine the correlation between one quality response with other quality responses whether influenced by or affect each other, this stage done by expert judgement. Figure 4.13 shows Correlation Quality Characteristic.

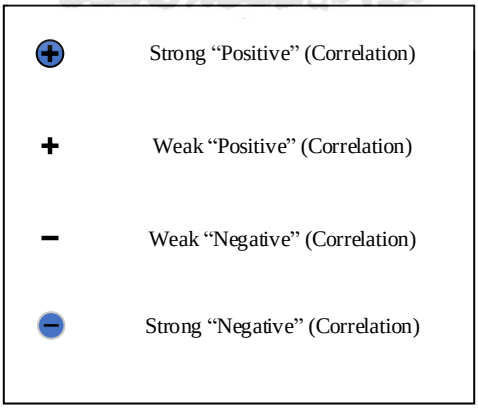

Figure 4.13 Correlation Quality Characteristic

4.7.5. House of Quality (HOQ)

The QFD method serves to describe and translate the demand of customers, as well as how the company's technical capabilities in fulfilling and producing goods or services in accordance with the wants and needs of customers by using the QFD matrices namely House of Quality (HOQ). The HOQ generally is divided into three parts namely, roof, body, and bottom. The body are filled by the Customer Demand of improvement as voice of customer using the data has been collected, then calculated to find out the weight of importance level.

The roof filled by the Quality Characteristic or often relate to technical requirement, that determined the relationship characteristic of each parameter by the expert. The last is the bottom part these are filled by the result of matrix calculation between Customer Demand and Quality Characteristic, also there is one section related with the functional target as decision of the final result, in this study the functional target was done by expert recommendation. The recommendation framework for the design improvement of DI. Yogyakarta Transportation system that will be provided in the next chapter as a final result of QFD method using HOQ matrices. Figure 4.14 shows the roof of HOQ, while Figure 4.15 shows body of HOQ, and Table 4.33 shows bottom part of HOQ or the functional target.

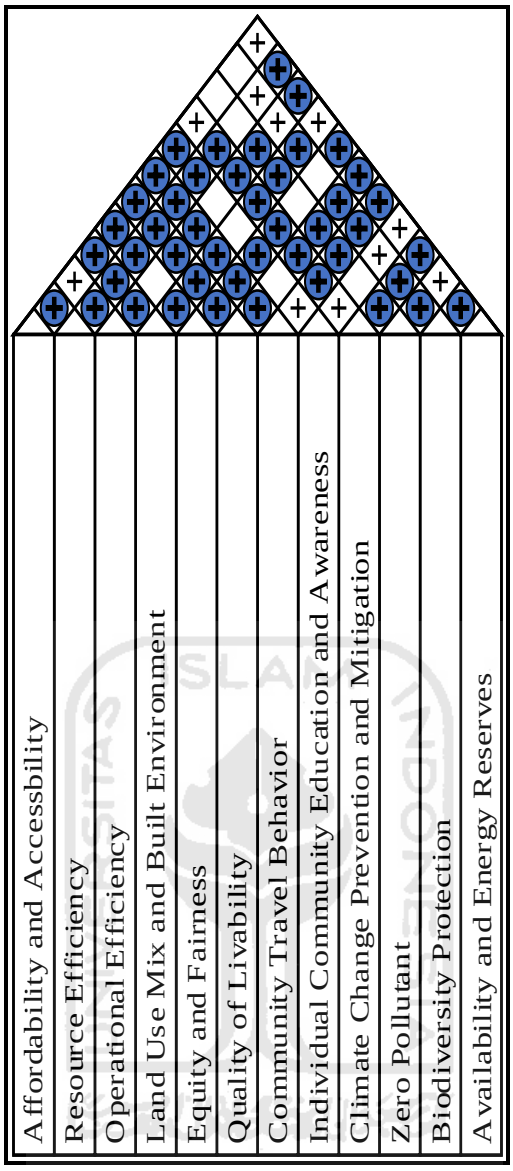

Figure 4.14 Roof of HOQ

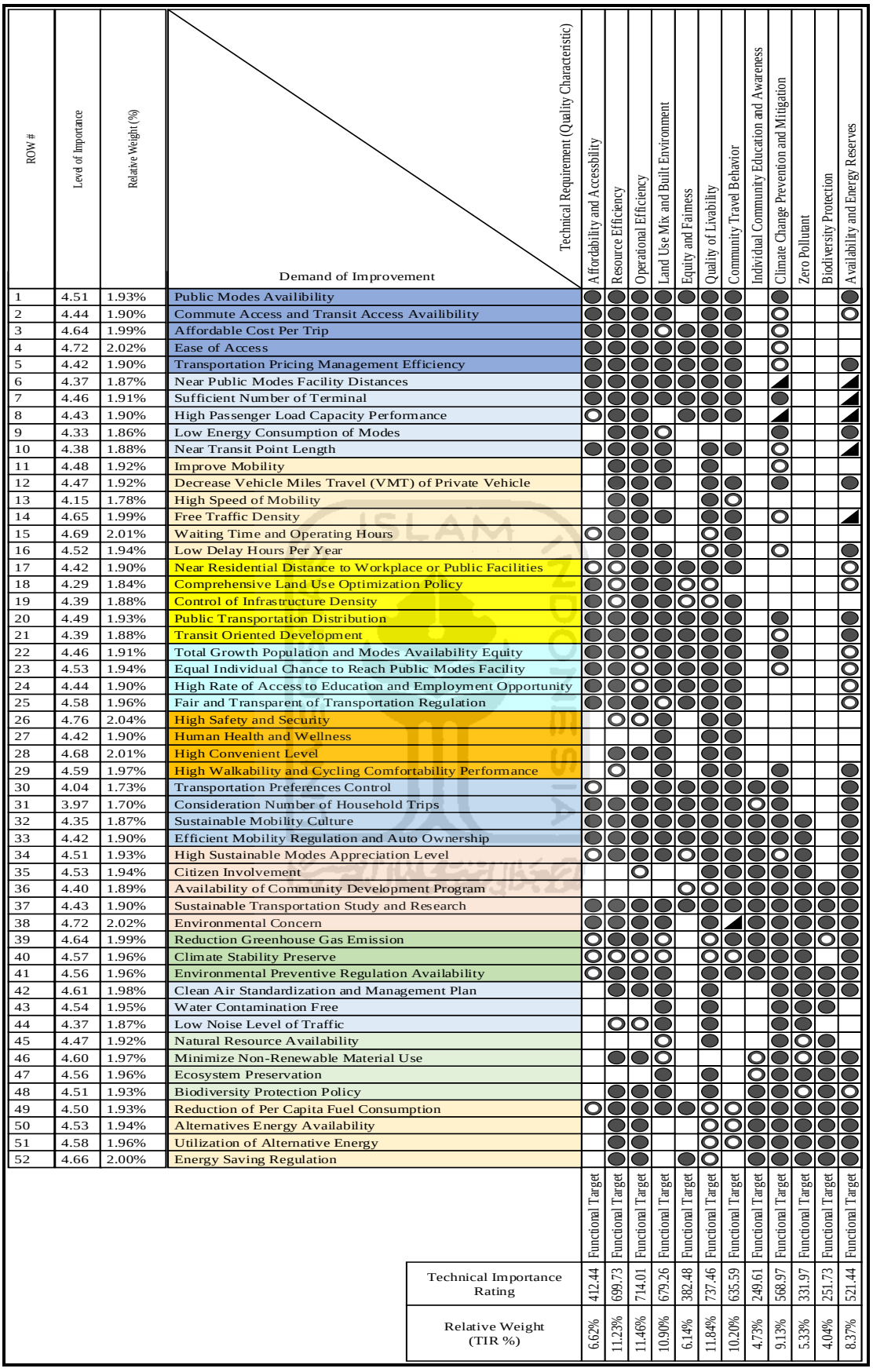

Figure 4.15 Body of HOQ

Table 4.33 Bottom of HOQ (Functional Target)

No	TIR	(%)	Functional Target (ST Target)
1	412.44	6.62%	1. Provide Payment by Reward for Student 2. Rp. 3.500 Per Trip
2	699.73	11.23%	1.Utilization of Student Private Vehicle 2.City Bus Network-Route Expansion
3	714.01	11.46%	1. City Bus with Special Lane (Freeway)
4	679.26	10.90%	1. City Development based on TOD (Transit Oriented Development)
5	382.48	6.14%	1. Provide Transportation: Ride-sharing Program
6	737.46	11.84%	1. Provide Physical Protection Policy for Ride-Sharing 2. Expand Comfort Pedestrian and Cycling Area
7	635.59	10.20%	1. Provide Influencer to Promote ST lifestyle 2. Limitation Street Parking Area of Private Vehicle
8	294.61	4.73%	1. Provide Education Program (seminar) at school or Campus Regarding the Importance of Appreciating Public Transportation 2. Subsidize of Public Facilities to Those Who have Given a Ride-Sharing: Such as Restaurant, laundry, and other Facilities
9	568.97	9.13%	1. Subsidize Public Transportation System Facilities 2. Limiting Possibility to Access Private Vehicle
10	331.97	5.33%	1. Subsidize Modes that Utilized Alternative Energy for Public (Tax and Price) 2. Unsubsidized Conventional Modes (Tax and Price)
11	251.73	4.04%	1. Provide Environmental Impact Analysis on Transportation System and its Infrastructure
12	521.44	8.37%	1. Subsidize Alternative Energy Use Facilities I.e. Prices of Fuel and Fueling Station (Charging Station)

The Functional Target is representing the response of the Technical Importance Rating (TIR) and its weighting (%). Setup of Functional Target in this study was done by expert, below are the proposed recommendation framework for design improvement in DI. Yogyakarta:

1. Based on figure 5.1, the first Quality Characteristic is Affordability and Accessibility with TIR 412,44 and weight 6,62%. Related with Affordability and Accessibility parameter, one of the Indicators is “Cost Per Trip” that

should be affordable to all economic background. Therefore, the decision is to set the Cost Per Trip with two conditions:

a. Provide Payment by Reward for Student

   Since the issue that happened in DI. Yogyakarta according to expert discussion that conduct during the process of research. Student is the big contributor for traffic density in transportation system. The alternative that is implemented as the solution to address the issue, with expectation to increase the possibility student will also contribute toward ST program.

b. Cost of public transportation Rp. 3.500, - per trip.

   The decision taken by referring the Governor's Decree policy no. 96/KEP/2016. The policy is related with the cost per trip of city bus, that also set the cost of Trans Jogja with the exact same cost, which are not categorized as high price for general.

2. Based on figure 5.1, the second Quality Characteristic is Resource Efficiency with TIR 699,73 and weight 11,23%. In order to response the Resource Efficiency, then the decisions are made below:

   a. Utilization of Student Private Vehicle

      According to the discussion with expert, one of the triggers of the heavy traffic in Yogyakarta is the unavailability of an even transportation network in the area of students or universities. The case that occurred in the university area is one of the population centers in Yogyakarta with a fairly high population density and the increasement is pretty significant. Meanwhile, the mobility needs that must be fulfilled are also quite high. As a result, students who are not actually residents of the city being forced to buy private vehicles to meet their daily mobility needs. To reduce the number of growths in the use of private vehicles without having to raise the price much higher which tends to only burden the buyer. In addition, people will still attempt to buy it due to the unavailability of solutions to address the mobility needs, it is necessary to establish a joint vehicle program in the community that utilize student vehicles because the purchase has already occurred.

   b. City Bus Network-Route Expansion

Based on discussion with expert, it is known the issue that occur in DI. Yogyakarta public transportation is the limitation number of terminal (shelter) of public transportation especially in terms of city bus. Therefore, the decision that were taken is to expand the network and city bus routes which could lead to the increase number of terminals as routes and networks grow. Considering to that, DI. Yogyakarta whose area is not too wide, this action very possible to be implemented.

3. Based on figure 5.1, the third Quality Characteristic is Operational Efficiency with TIR 714,01 and weight 11,46%. Among the indicators that exist in Operational Efficiency is the availability of a transportation system that is Free Traffic Density and has a low Delay Hours Per Year rating, then the decisions below are made:
   a. City Bus with Special Lane (Freeway)

      Referring to expert, DI. Yogyakarta actually has public transportation in the city, which is a city bus known as Trans Jogja. Unfortunately, the operation does not run smoothly because the process of public mode system runs without protection that serves to oversee the success of the mode. As a result, Jogja buses are often hampered by traffic jams, even in some cases Jogja buses actually cause traffic jams such as blocking other vehicles roads in traffic light by stopping in a lane that state "go ahead" or by overtaking other road users forcing other vehicles to stop in traffic light and causes obstruction of the road user behind it. Therefore, the decision is to provide City Bus with Special Lane in order protect and oversee the succeed of the operational process meanwhile also reduced the highway users.
4. Based on figure 5.1, the fourth Quality Characteristic is Land Use Mix and Built Environment with TIR 679,26 and weight 10,90%. The indicator that relates to this Quality Characteristic is Transit Oriented Development (TOD), , then the decisions below are made:
   a. City Development based on TOD (Transit Oriented Development)

      Since Land Use Mix and Built Environment is the parameter in ST, then the expert decided that DI. Yogyakarta city infrastructure development for the future must be guided by Transit Oriented Development.

5. Based on figure 5.1, the fifth Quality Characteristic is Equity and Fairness with TIR 382,48 and weight 6,14%. The indicator of the Equity and Fairness is the capability of transportation system that able to provide same opportunity to reach public transportation facilities, then the decisions below are made:
   a. Provide Transportation: Ride-sharing Program

      According to the expert discussion and recommendation for this proposed framework, students are one of the obstacles that contribute to success of ST program in the DI. Yogyakarta transportation system. To integrate decisions, as explained earlier in this stage. Providing a ride-sharing program is an appropriate possibility, using student vehicles for Community Shared Transport that is not open to all publics but is limited to a community known as Ride-Sharing. With the payment method in the form of reward points, for those who use their private vehicle to provide ride-sharing. Where it is very possible to do it especially in the digital era by using an application to provide equal opportunities for every resident of DI. Yogyakarta including students, to Reach Public Modes Facility.
6. Based on figure 5.1, the sixth Quality Characteristic is Quality of Liveability with TIR 737,46 and weight 11,84%. Some indicators included in Quality of Liveability are Safety and Security, also Convenient Level, then the decisions below are made:
   a. Provide Physical Protection Policy for Ride-Sharing

      Based on expert discussion, as explained before in this stage related to the ride-sharing as the proposed framework. Since among others indicator of the Quality of Liveability, one of them is Safety and Security. Then decision is to provide physical protection policy for Ride-Sharing in order to protect between the user and the volunteer. In the implementation of this program it is necessary to specialize policies between men and women in a separate way, this aims to reduce the risk of sexual harassment that often occurs in public transportation, even though that is "open space". Meanwhile the need for a policy of limiting the scope of users only within a community in the course of this program also helps reduce the risk of crime so that the volunteer and the user tend to recognize each other. The limitation of this community is for example at one particular university community so that

the volunteer and the user also come from the same scope, or can also be more specifically at a university in a particular faculty, so that only those faculties are used. This can help the process of complaints and identification become easier if there is a crime committed, in other words it is able to reduce the risk of crime.

b. Expand Comfort Pedestrian and Cycling Area

Based on expert judgement, the convenient level of the public transportation and infrastructure is one of the indicators of Quality Liveability. As well as the existence of the pedestrian and cycling infrastructure are tended to be in only a few areas such as in only tourist attraction, meanwhile the population that contribute to the traffic density not only based on that area but also within the area near to the University. Then possible decision is to expand the pedestrian and cycling area not only provided in certain area, but also distribute evenly to all area in DI. Yogyakarta. In order to increase the opportunities of walkability and cycling for people, which is also as an indicator Quality of Liveability.

7. Based on figure 5.1, the seventh Quality Characteristic is Community Travel Behaviour with TIR 635,59 and weight 10,20%. One of the indicators in Community Travel Behaviour is Mobility Culture also Efficient Mobility Regulation and Auto Ownership, then the decisions below are made:

a. Provide Influencer to Promote ST Lifestyle

According to the result of discussion with the expert. The factor to less appreciate public transportation that triggered less interested for using it, because the perception of public transportation is not "prestige thing". Public transport users are described as low economic people that don't have capability to afford private vehicle. Then decision that needed is to influence people with a campaign that shows that public transportation users are promoted as the intellectual individual person which is deeply educated and able to understand what ST is, along with the benefit and negative impact. Using the social media through the influencer, as well as known the recent condition of the millennial era. Influencer has a big impact to influence and convince people especially youngster, this means student. On the other hand, imaging from VIPs, such as governors or local officials to

promote the use of public transportation can also attract the interest of many audiences, especially for those who tend to be in the upper age group. In order increase the rating of public transportation prestige and encourage people to create sustainable mobility culture.

b. Limitation Street Parking Area of Private Vehicle

Based on expert judgment on this stage, the recent condition of DI. Yogyakarta transportation indicate one of the hinder factor ST can't be achieved it is because rampant street parking activity. Then the response taken here is connected to the decision made at the previous point, such as City Bus Network Expansion, Ride-Sharing program, etc. The expert explained that before disincentive action is carried out, it is necessary to have "mutualistic" programs whose benefits can be directly felt by people, in other words acting as incentives. The reason because if disincentive action is taken immediately, in this context the policy related to the limitation private vehicle street parking. Without prioritizing offered the alternative solutions to meet mobility needs, the impact won't be significant but tends to be burdensome. Therefore, after several programs that were proposed in this framework which is explained in the previous. The possible next step is to set the limitation on the parking area for private vehicle users.

8. Based on figure 5.1, the eighth Quality Characteristic is Individual Community Education and Awareness with TIR 294,61 and weight 4,73%. Since Community Development Program and Sustainable Modes Appreciation Level are the indicators of the ST, then the decisions below are made:

a. Provide Education Program (Seminar) at school or Campus Regarding to the Importance of Appreciating Public Transportation

According to discussion with the expert, in order to increase the appreciation level of ST factor of education also become a key of successes to run the ST program. Holding a seminar in community such as in University or even School as a Community Development Program is the reasonable decision to support the ST program.

b. Subsidize Public Facilities to Those Who have Given a Ride-Sharing: Such as Restaurant, Laundry, and other Facilities

Based on the expert judgement, several previous programs were explained especially for Ride-Sharing Program. In order to support this program related the unique payment method by reward points, then need to arrange what kind of subsidize that will get as a reward after the volunteer party contribute, which is willing to use the own private vehicle for the program. Therefore, the decision is to give subsidize via reward points that able to use as payment method in public facilities for daily needs such as Restaurant, Laundry, and others public. To create this program, the local authorities and University must cooperate alongside with the merchant provider.

9. Based on figure 5.1, the nineth Quality Characteristic is Climate Change Prevention and Mitigation with TIR 568,97 and weight 9,13%. The Reduction Greenhouse Gas Emission and Environmental Preventive Regulation Availability are the indicator of the Climate Change Prevention and Mitigation, then the decisions below are made :
   a. Subsidize Public Transportation System Facilities

      Based on expert judgement, as the previous explanation in this stage before conducting the disincentive, then it is necessary to provide subsidize which is act as alternative solution. Therefore, subsidizing public transportation facilities in order to encourage people to use mass mode while also able to assist the successes of ST program. whether for the users or even the infrastructure developer so can get involve to support the program, this is the most reasonable action to reduce emissions caused by the transportation system.

   b. Limiting Possibility to Access Private Vehicle

      Referring to expert judgment, based on several programs that have been explained as a proposed framework in the previous point at this stage where has a role as an action to provide subsidies. Then the actions that should be taken are to provide disincentives, in this case in the form of restrictions in accessing the possibility of using private vehicles. The restriction can be in the form of the application of even odd number plates on the highway, or it can also be a policy of limiting private vehicle parking infrastructure in certain areas or facilities such as in office areas, school, or even universities

and etc. Making it difficult for private vehicle users to be able to access their vehicles with the expectation able to lead them using public transportation which tends to be more convenient and easier to access. In order able to provide environmental preventive regulation.

10. Based on figure 5.1, the tenth Quality Characteristic is Zero Pollutant with TIR 331,97 and weight 5,33%. Clean Air Standardization and Management Plan is one of the indicators of Zero Pollutant, then the decisions below are made:
    a. Subsidize Modes that Utilized Alternative Energy for Public (Tax and Price)

       One of the clean air standardization management efforts for the ST program is by providing subsidies for vehicle users with alternative energy. This subsidy can be in the form of cheaper price for vehicle with alternative energy and the tax imposed by the state is much lower. In principle, vehicle ownership is still not prohibited but controlled with the aim of this matter can encourage people to switch toward environmentally friendly vehicles such as electric powered cars, hydrogen fuel cells, and others. In order able to reduce the level of Particulate Matter (PM) as the main cause of air pollution which is the impact of the transportation sector.
    b. Unsubsidized Conventional Modes (Tax and Price)

       According to expert judgement, the possible action that might be taken after applied subsidization is to make policy to unsubsidized the user of conventional modes such as higher price for the conventional vehicle and etc. Compared to the vehicle using alternative modes, in order to reduce the utilization of conventional modes that could triggered hight potential risk of air pollution.
11. Based on figure 5.1, the eleventh Quality Characteristic is Biodiversity Protection with TIR 251,73 and weight 4,04%. Ecosystem Preservation is the one of the Biodiversity Protection indicators, then the decisions below are made:
    a. Provide Environmental Impact Analysis on Transportation System and its Infrastructure

Based on expert judgement, the capability to analyse the cost of environment impact is a tool to minimize the risk that might occur for the environment from transportation sector alongside with the purpose to preserve the ecosystem.

12. Based on figure 5.1, the twelfth Quality Characteristic is Availability and Energy Reserve with TIR 521,44 and weight 8,37%. Alternatives Energy Availability, Utilization of Alternative Energy, and Energy Saving Regulation are the indicators of the Availability and Energy. There a lot of action possibility that can be decide, below is one of the possible actions that can be done:
    a. Subsidize Alternative Energy Use Facilities I.e. Prices of Fuel and Fuel Station (Charging Station)

       After giving the subsidies on the price of alternative fuel vehicles, other supporting factors are needed. According to the expert judgement, one of the supporting factors is the availability of alternative fuels for public that can be accessed from all walks of life and backgrounds in the sense that the price on the market must not be burdensome to the user by means of a policy of subsidizing. In line with the provision of subsidies for those who want to access various facilities related to alternative energy. For example, subsidies are given to every developer who tries to build alternative energy fuelling stations. One obstacle that causes the use of alternative-powered cars is still rare in addition to the high price of vehicles in the market is the difficulty of finding alternative fuelling stations. This certainly has other related factors, one of which is the high cost required to access alternative fuel facilities, namely the construction of alternative fuel stations. So, it is decided to conduct these subsidies for the proposed recommendation framework relate with the indicators mentioned above so that the overall sustainable program could run as expected.

CHAPTER V

DISCUSSION

5.1. Sustainable Transportation

The findings obtained in this study all refer to the success of the ST program is not based on a single factor. However, there are many determining factors in it so that the multi-disciplinary role in the ST realization process is needed. One of the factors that are of major concern is the matter of planology or commonly known as urban design. In this case, urban design plays a role in planning the layout of a city, in relation to transportation, this is directly related to both economic efficiency that supports business activities, an environment that is friendly to sustainability, or sustainable travel behavior of people.

Then, it is necessary to have deeper research and involvement to integrate transportation engineering with urban design. Moreover, it is important to emphasize the city development pattern which is Transit Development Oriented (TOD) where it is an indicator of ST. So that in a city the distribution of infrastructure is generally evenly distributed in each region, this will have a very direct influence on how people travel and the mode they choose. In practical terms, urban design requires serious consideration in road design, land use, and zoning for each area.

At the same time, based on joint discussions with expert who are experienced in urban design, namely who has a role as urban planners as well as academic figures. He added that ST is often hindered due to improper use of land, as well as illegal use, as in the real case is illegal street parking or illegal buildings such as street vendors. Another unexpected thing that turned out to be quite a strong influence was the geopolitical issue on a local scale. Although it is considered far from the engineering approach, it has a big influence as a determinant of the success of ST. The politics of interest sometimes also becomes a serious problem related to the alignment of development goals that prioritize ST, facing with the demands of the interests for some unscrupulous whose structures are latent.

Apart from the above explanation, urban design has a major function in bringing together household which is resident area planning with the fulfilment of mobility for various backgrounds or professions for each individual in a city. In principle, TOD itself has the concept of designing an area that is compact, which does not mean that the city cannot be develop. Compact in this context is a city should be able to present an intense walkability performance such as mobility between residential district to business district in the city. Therefore, the reason why the transportation system supporting

infrastructure should be distributed evenly in each regional zone must be considered, so that ST can run in harmony to support the sustainability of a city.

5.2. Islamic Principle

Through the Islamic principle it is self, explained that in general the regulation baed on ushul and fiqih related about the dunya everything is halal until there are decision of Allah and His messenger to prohibited it, vice versa related with worshiping (ibadah) which is explained that everything related with worhsipping is prohibited until there are command from Allah. In line with the principle for the transportation system, as long as the process doesn't against the command of Allah then it is legitimate to conduct every supporting factor to encourage the easiest of mobility. When something doesn't describe as a prohibited action doesn't mean do not have principle to guide the process of the development.

Referring to the Syaikh Utsaimin as mention in Syarh Al-Arba'in An-Nawawiyyah in Tuasikal, (2020) which explained Islam principle it is already known there is principle named as "qawaidul fiqih". It is having a basic principle if in the process of transportation development were facing with multiple scenarios for instance, then the scheme that has to be chosen between those must be with the criteria with the lowest harm (mudharat) especially when between the options had every negative effect. "*La dharara wa la dhirar*" means that there must be no harm follow with the principle in the qawaidul fiqih that stated "*Adh-dhararu yuzaalu*" which mandate is the harm that might be appear as possible must eliminated. Therefore, Islam has guided to perceive sciencetific approach then it is necessary to discuss and conduct a research with the expert that Allah gift ability to expertise some disciplinary of science along with firman of Allah in surah Al Anbiya ayat 7 "And We sent not before you, [O Muhammad], except men to whom We revealed [the message], so ask the people of the message if you do not know". High number of experts for the future research will be better in order to increase the accuracy of the research toward ST. In other hand the expert selection process must be selected with full consideration

5.3. Theory of Constraint (TOC)

The findings obtained in the logic thinking process through 3 framework diagrams on TOC, namely, CRT, EC, and FRT. It shows another indication, that ST should support 3 main aspects, namely economic, social, and environmental all three must be co-beneficial. Undesirable factors or UDEs on CRT are then processed into a conflict that occur, such as in EV and goals to be achieved in the future at FRT. All of these have the potential to give birth to a non-constraint or other possibilities, but it also remains on the main limitation of ST which refers to the constraint.

Planology, as mentioned earlier, has more or less a very significant impact in the formation of ST both technologically, in fulfilling infrastructure, and on encouraging people's interest in using public transportation. So, in this case, the layout of a city should refer to the principles of ST. In addition, Masdar City development research is a city that can be used as a raw model for other cities. This is because the city development represents to the ST indicator guidelines. The following is the Masdar City master plan that was mentioned in Griffiths & Sovacool, (2020) research and was made by the team and various companies involved in the Masdar City project. Figure 5.1 shows the scheme of ST program in the Masdar City.

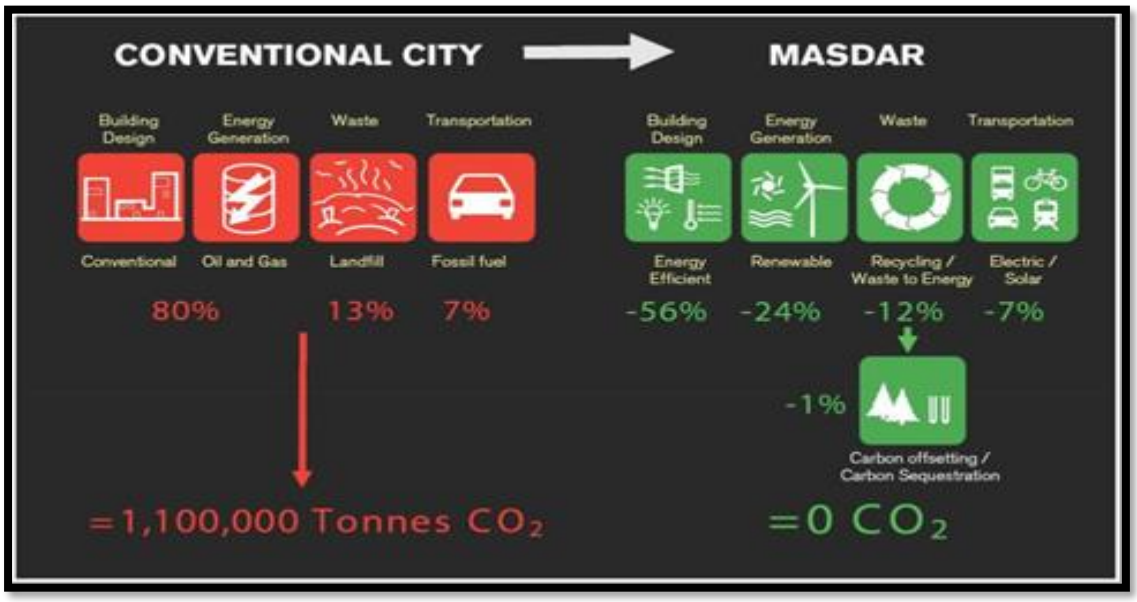

Figure 5. 1 Masdar City ST Scheme

Based on the figure illustration above Masdar City has a city structure that refers to sustainability, in practice this includes ST. This city was built with all the details that can support ST such as in the city design, buildings between one building and another tend to be close together. Refer to the figure 5.3 that shows the layout of city which in line with the TOD, the good impact obtained is that the environment feels shadier and the shades of the buildings are used by this city to create a cool atmosphere for pedestrians. In other words, simultaneously the development pays attention to the comfort of walking especially considering the location of Masdar city even though it is in an area which have climate that tends to be hot. Figure 5.3 shows ST city lay out of the Masdar City, meanwhile Figure 5.4 shows the upcoming project of the city.

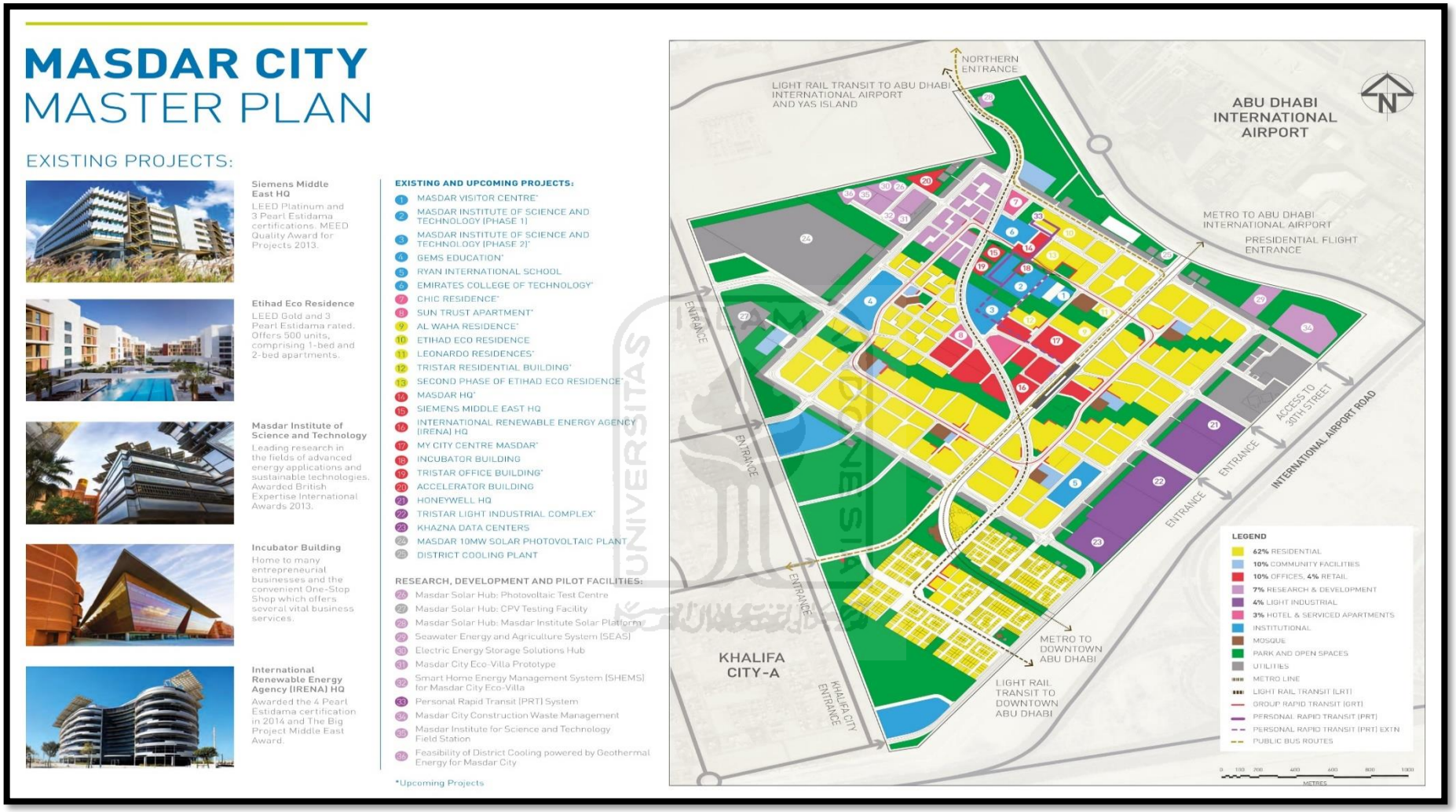

Figure 5. 2 ST City Lay Out of Masdar City

MASDAR CITY
UPCOMING PROJECTS

MASDAR CITY IS ENTERING AN EXCITING PERIOD OF GROWTH. A WIDE RANGE OF UPCOMING DEVELOPMENTS WILL ENRICH THE EXPERIENCE OF ALL WHO LIVE, WORK, LEARN AND PLAY IN MASDAR CITY. SOME OF THESE PROJECTS INCLUDE THE FOLLOWING:

Chic Residence

33,000 sq m of GFA, comprising serviced apartments with retail and other amenities including a swimming pool, spa, fitness centre, bank and children's play area.

My City Centre Masdar

A 25,000 sq m of GFA city mall in the heart of Masdar City, which will provide a quality retail offering, cafés and restaurants. Anchoring it all will be a large Hypermarket.

GEMS Education

Over 4 hectares of land, offering a premium British curriculum encompassing education from primary to year 13. Approximately 2,500 students will become the community focus for Phase 2 of Masdar City.

Tristar Residential Building

26,900 sq m of GFA dedicated to residential and 800 sq m allocated for retail outlets, restaurants & cafés. It offers glorious park views and accessibility to passive and active recreation space. Easy access to shops and a variety of schools and other community facilities.

Leonardo Residences

Comprising 170 residential units with internal amenities and basement car-parking. This development is located on one of the many linear parks at Masdar City and a short walk from the entertainment centre.

Masdar Visitor Centre (MVC)

The Masdar Visitor Center (MVC) will offer guests a unique insight into Masdar City's vision of tomorrow's cities, and MVC will operate as Masdar's key business development venue to promote Masdar's vision and achievements in sustainability and renewable energy.

Second Phase of Etihad Eco Residence

A 100,000 sq m of GFA mixed-use development comprising a 10,000 sq m office building for Masdar City, 400 units of student accommodation for Masdar Institute of Science and Technology along with 500 units of corporate accommodation. At the heart of the development will be an open plaza flanked by retail shops, restaurants and cafés.

Tristar Office Building

16,634 sq m of GFA, located at the first development phase that included Siemens HQ, the Incubator, and Masdar Institute of Science and Technology. The Metropolitan Rail Transport is within very close proximity to connect passengers to Abu Dhabi city.

Oasis Residential Complex

Comprising 612 residential units, strategically located next to Masdar City Community Mall, this residential complex will feature apartments and skyhomes overlooking Masdar's linear park.

Sun Trust Apartment

Serviced Apartment development in the heart of Masdar City, featuring retail outlets, restaurants and cafes. Ideally located at one of Masdar's principal boulevards, the development will feature an iconic facade and will have easy access.

Tristar Light Industrial Complex

With approx. 29,000sqm of GFA this Light Industrial development will host enough space to accommodate logistic space for tenants from various industries and will be designed to achieve Pearl 3 sustainability standards.

Emirates College of Technology

A 40,000 sq m of GFA college, consisting of classrooms, laboratories, workshops, study rooms, a library, an auditorium and a sports hall.

Masdar CITY

Masdar City
PO Box 54115, Abu Dhabi, UAE
800 MASDAR (627327)
masdarcity@masdar.ae
www.masdar.ae

FSC

Figure 5. 3 City Upcoming Project

Therefore, the developers and researchers involved in this study also pay attention to controlling temperature or heat in this city, in order to make mobility by walking is a fun thing. With city development that is made more compact, practically it can encourage people to make mobility activities by walking as the main choice. Meanwhile, the second option is cycling and public transportation such as trains or buses is the third option, such as the availability of Light Transit Rail (LRT) facilities. Conventional private vehicles are not an option in this city, instead as replacement this city provides Personal Rapid Transit (PRT) and all available transportation facilities in this city are fossil fuel free. The source of electrical energy that the city obtained to be able to power the entire transportation system comes entirely from geothermal energy technology and etc. Solar panels are a familiar source of energy for all facilities in this city, especially in its transportation system.

Along with the ST concept, the city design whether in terms of city layout and all technology runs in full support. In considering what the effect that can be obtained with the expected output in the form of zero carbon emissions in order to create a lifestyle that makes ST a culture in a community. At this point in time, urban infrastructure development should begin to refer to the ST guidelines. Either by making a New Purpose-Built City or by gradual development, of course, adhering to the ST principles. In other words, efforts to reduce emissions to zero carbon is not impossible. If this is accompanied by various supporting factors, which not only focusing on the technology of the vehicle but also on how the layout of a city is regulated. At the same time, the viability of life is the key to the success of ST, once again collaboration is essential in the ST application development program.

Meanwhile, the matter of planology itself capable continues to build an area without strong collaboration with transportation engineering, and mobility activities can still be carried out. However, planology itself is more focused on looking at a city from the point of view of an area which is then linked to its functions and relationships to society. It is different with transportation engineering, where they have complex considerations and measured. To understand an area not only in terms of its development but also its utilization and what impact it will have for the sustainability of a transportation system, of course, with an engineering approach. Recently, the

concept of a city with ST was often associated with the concept of a smart city which is often referred to as a Smart Sustainable City. This further encourages the many branches of discipline that need to be involved in the construction of ST.

Especially with AI which has begun to be used to predict congestion, the number of emission levels, the number of traffic accidents so that it can help the decision-making process to be more measured and accurate. This tends to look like it is not really a big deal, but if the planology stand alone in designing a city, the output obtained are as what often happens today, namely endless traffic jams to address, the addition of private vehicles from year to year that have never shown significant reduction, and incidence of health problems from the carbon effects produced by the transportation system.

5.4. Quality Function Deployment

QFD in this research is intended as a tool or method that can implement design improvements for DI. Yogyakarta in developing its transportation system. However, a factor that is much bigger than just implementing it is directly focused on planning the form of urban planning design and the mode of transportation only. Implementing ST program in this case in DI. Yogyakarta, then it should overview again to the reality condition of DI. Yogyakarta. The DI. Yogyakarta itself previously has a purpose to maximize the activity cycling, that the reason behind the scale of DI. Yogyakarta city size not quite big instead of it's pretty compact. Actually, this is good start if you want to go further for achieving sustainability of transportation system. As the ST principle itself carries TOD in one of its indicators, that a city should tend to be compact and walk-able. Optimization of land and BRT can also be additional solutions offered to design ST in stages in Yogyakarta.

In implementing ST, citizen is the most important thing that must be addressed first. Everything can be started from the strong willingness of the community which together forming an environment that refers to ST, so that together can commit to each other in making it realization succeed. Organization is matter, to create development program for the society. Besides aiming to educate citizens, but at the

same time it can attract their sympathy to realize the matter of ST for them. In practice, the expert also said that the success of this ST program also depends on co-beneficial factors that are truly sensible. So that the benefits can directly felt by the community, this is actually more effective than just focusing on infrastructure development alone. With the benefits that are directly obtained for the community, such as low mobility rates or pedestrians and shaded cycling spaces, it can tend to encourage people to be able to directly contribute to the success of the ST program.

5.4.1. Level of Importance Weighting

Below in the figure 5.1 shows the graphic chart that provides the weighting result of each variable from the questionnaire by using HOQ matrices in terms of customer demand of improvement. There are 52 variables, the highest importance level is "safety and security" with score 4,76 and weight 4,32%. Meanwhile the lowest importance level is "Consideration of Household Trips". The result of the level importance weighting process will be affecting the final result matrix calculation QFD. Through the correlation determination between Customer Demand and Quality Characteristic. Figure 5.1 shows the graphic chart of level of importance weighting score result.

There are 52 variables, the highest importance level is "safety and security" with score 4,76 and weight 4,32%. Meanwhile the lowest importance level is "Consideration of Household Trips". The irony that arises is that ST itself should be able to present a comprehensive consideration of the total mobility needs of each household or individual to be able to consider how many modes are needed, the correct operating hours, and what modes of transportation are efficient to fulfil each household so that everyone has the opportunity to use comfortable public transportation without having to use private vehicle. Meanwhile, the graph shows that the smallest demand is related to the consideration of the number of trips per household. This shows that there is still low level of public understanding and low contribution toward what ST. So that this should be a strong impetus in campaigning for ST, in order the realization process itself becomes easier and more dynamic with the involvement of the whole community.

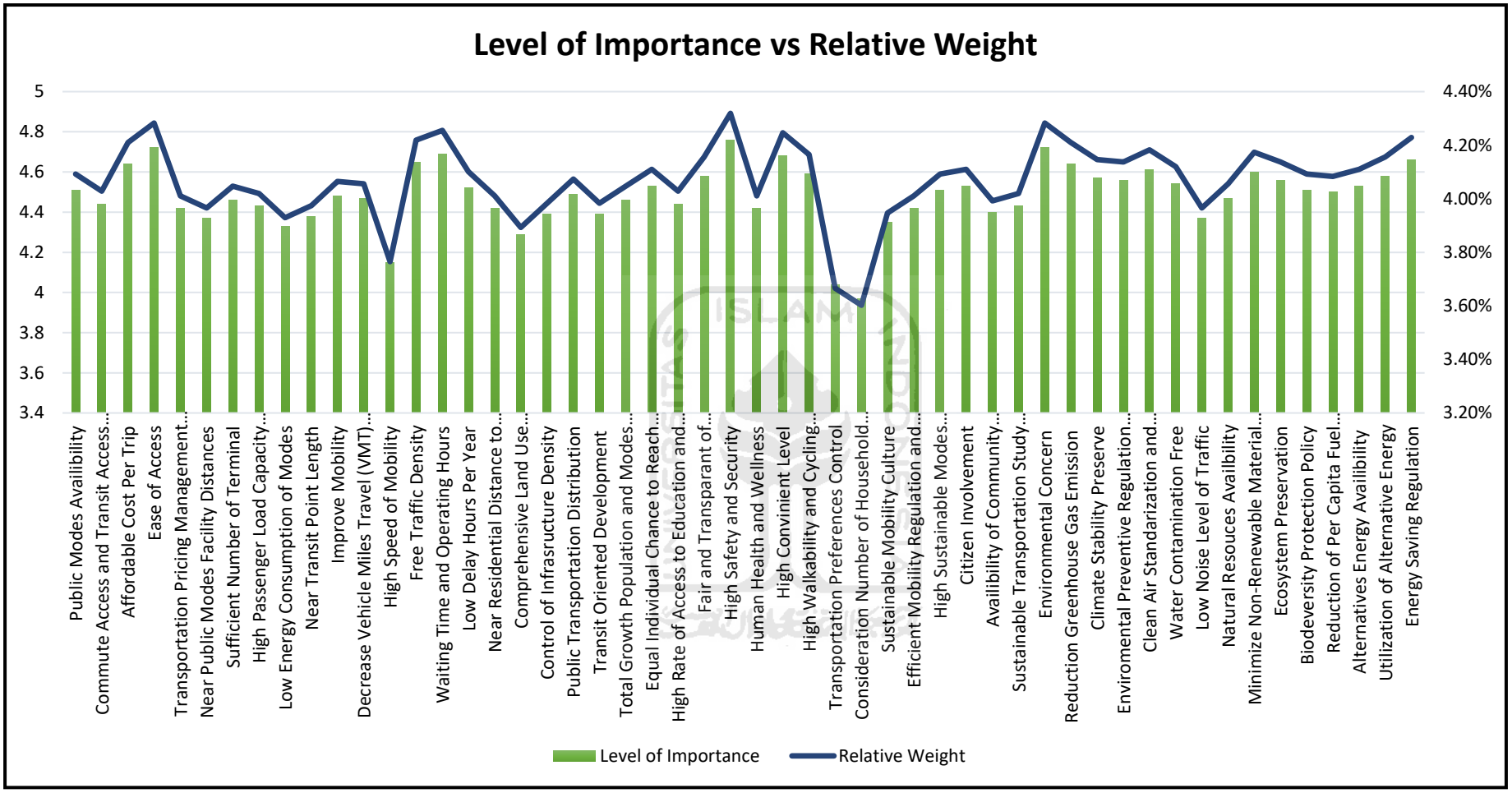

Figure 5. 4 Level of Importance Graphic

5.4.2. Correlation between Quality Characteristic

The determination of correlation has a purpose to identify, if one the quality characteristic improve whether it is also improve or decrease others "Quality Characteristic" (technical requirement) based on assumption. The assessment here was done by researcher and through discussion with the expert, as can been seen in the figure 4.14. The positive and negative relationship, or strong, it is indicating how the interaction between each indicator will affected. Positive correlation has meaning that between each technical requirement has good dependent factor. In other word, if one factor improved it will also improve the other one.

Meanwhile, if between each technical requirement has negative relationship, if one factor is improved the other can be decreased or worsening. In addition, strong or weak correlation is to show how big the impact each other technical requirement. The result of the analysis shows the relationship character nothing found in negative correlation. It is having function only to assist to be pre assessment before conducting further steps to create decision, not as judgment "right" or "wrong". In the other hand the pre assessment was indicating that every indicator was giving positive effect to each indicator means that it has a role as supporting factor between those indicators.

5.4.3. Technical Importance Rating

The Technical Importance Rating (TIR) is the result between the weight of Customer Demand with the Quality Characteristic that describe based on score that shows in figure 4.16, then result obtained from the matrix multiplication. Below Figure 5.2 shows Technical Importance Rating result.

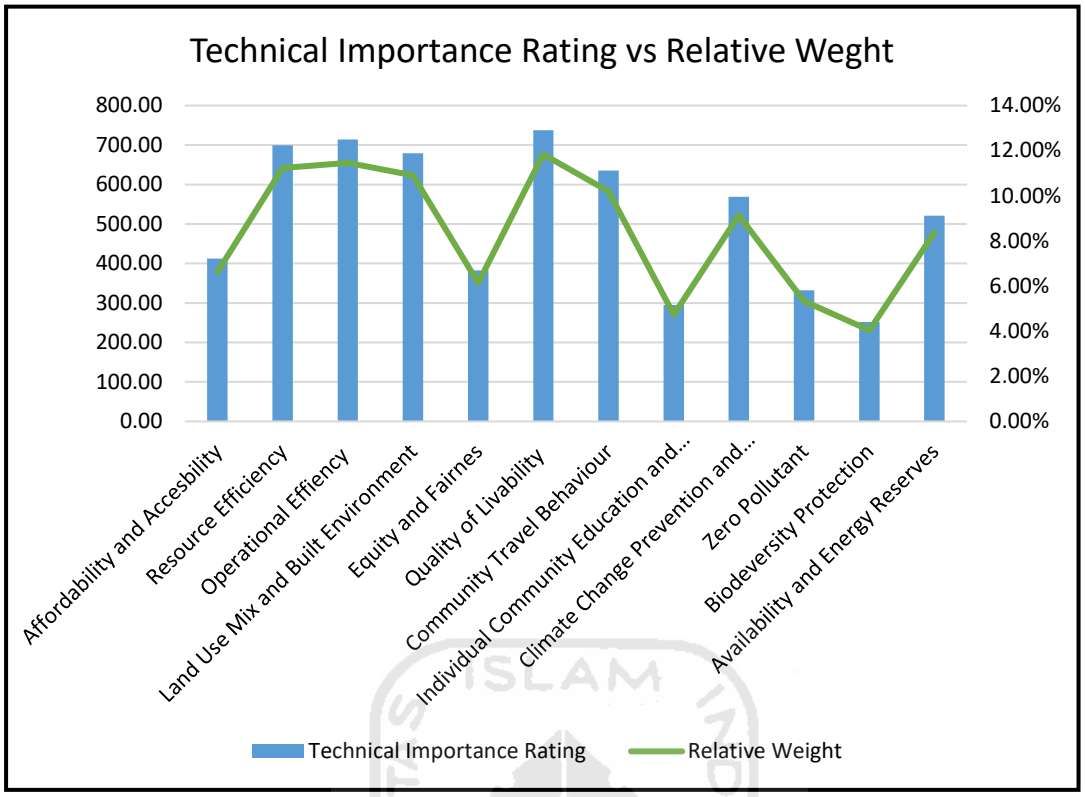

Figure 5.5 Technical Importance Rating

As the graphic shows, illustrated that the highest weighting score on the Quality of Liveability. It is indicating that people or citizen will put first the experience of comfortless in the mobility, this is why the reason Quality of Liveability is became one of the main indicators for ST. People will automatically switch their mode preference if there are a mode of transportations that is much more comfortable, more safety, and more efficient and easier to reach, and the most important the rates is cheaper than the previous one. Nowadays, the infrastructure development of transportation system should not only think about the amount of capacity that can be accommodated as much as possible in a mode, by ignoring the comfort and ease in accessing these facilities, but instead in ST is supposed to pay more attention to user's feeling and experience related to the available public transportation facilities. So that it can encourage the users to be loyal in employing public transportation.

CHAPTER VI

CONCLUSION AND RECOMMEDNATION

6.1. Conclusion

According to the previous explanation, Islamic Fundamentals are used in the TOC method as injection. This injection serves as guidance in realizing positive goals that has been determined in the TOC process. Through the TOC method is obtained a framework in the form of initial idea and guidance to assist future research process. At the same time, the ST Indicator Guidelines were obtained during the literature study research process using the TOC method which was used in the QFD method as a parameter (Quality Characteristic) and indicator (Customer Demand), to determine the ST criteria standard.

The next step in this research is collecting the voices of transportation system users through questionnaires to find out what aspects they want to be upgraded according to ST standards. Transportation system users in DI. Yogyakarta is chosen as a targeted scope with the aim of its implementation can be proven in the field by involving the direction of experts who are competent in the problems of infrastructure development and transportation systems, the final results achieved is a recommendation framework for improvement design through QFD. Below are the following conclusions:

1. The success of ST in the future is something that requires understanding in every branch of disciplines with each of its complexities. The factor that hinders success in ST is none other than the failure to understand the interaction of the transportation system with various related aspects, according to the indicator guidelines of ST. The biggest challenge in sustainable mobility is changing the behavior. The review of a transportation often tends to be seen only from the mode of transportation and the road. However, various related factors are often overlooked, a small example such as a campaign to encourage ST. Followed by inappropriate subsidies for ST facilities, which currently

tends to be expensive to access, while conventional vehicle facilities are still much cheaper. Another example is the consideration of the total mobility needs of each household and individual that is not taken seriously, the impact is that the availability of public transportation modes will not meet the portion of the total population density and the distribution of the terminals of their stops is not evenly distributed.

2. The solution needed in realizing ST is engagement at all levels, the government as the decision maker who has the courage to make public policies, manufacturers or companies that contribute for innovative solutions to the creation of communities that are oriented for low carbon solutions, and the citizen who support and involve in the society development of city for the sustainable lifestyle.
3. When planning the ST, it has a strong correlation between transportation growth with the Gross Domestic Product growth (GDP), in another sense it indicates that the transportation system must be able to create the development of each individual in each community, the development of the city, and the development of business activities but at the same time it is able to mitigate climate change and prepare for future energy availability by reducing the amount of carbon footprint. So, when it is possible to elaborate all the supporting factors of a sustainable economy, environment and social sustainability, then a transportation system can become sustainable.
4. Islam as guidance in realizing ST itself has a basic approach called qawaid fiqiyah which states "La dharar wa la dhirar" that there should be no danger and no harm Andirja, (2019). Basically, this can be used as basic guidance in ST both in planning the development of transportation system infrastructure and in mode transportation itself. In the perspective of not causing harm and harm as much as possible must be eliminated, in the case of ST, this is like the problem of carbon footprint, high number of accidents, and scarcity of natural resources due to future energy needs. So, this certainly becomes a trigger for all groups in various sectors to learn more about the impacts on a transportation system before it is conducted. In other words, not only considering the interests of a group but also what benefits can be obtained for all levels of society without injuring even a single group.

6.2. Recommendation

Based on studies conducted, researchers are well aware that this research is far from perfect and has many shortcomings in various ways. It is hoped for conducting further research related to ST as a global issue, and specifically in DI. Yogyakarta, in order to complement and enhance this research. Recommendations for researchers for future research are:

1. In this study the number of experts used in the TOC method is still limited and most of them are done through literature studies. Meanwhile, to explore the issue of the unsustainability of the transportation system on a global scale requires experts from various branches of disciplines. Given many factors that are dependent, so it needs deeper studies that learn the interaction of each of these factors. So that, more fields of science that contribute will be much better.
2. The availability of sustainable indicators is crucial, which provide direction in detailed but easily understood to the public, so that each branch of disciplines can be easily understood. To contribute to the success of the SGDs program.
3. The sample size of the population in the QFD method used in this study is still in small numbers. Larger population is required to represent the total population of DI. Yogyakarta, so it could help the accuracy of the data research.
4. For further research, similar research is needed to be conducted by using different methods to compare and evaluate the results of the analysis that has been done in this study.

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APPENDIX

RESEARCH QUESTIONNAIRE

Bismillah

Maha Suci Allah, Dzat yang menggenggam tiap tiap jiwa.

Terimakasih kepada responden yang bermurah hati untuk meluangkan waktunya dalam mengisi kuisioner, yang berguna untuk penyelesaian tugas akhir (Skripsi).

Pada kesempatan kali ini, skripsi yang berjudul:

ANALYSIS UNSUSTAINABLE TRANSPORTATION ALTERNATIVE SOLUTION USING THEORY OF CONSTRAINT WITH ISLAMIC FUNDAMENTALS COMBINING WITH QUALITY FUNCTION DEPLOYMENT METHOD

Bertujuan mengumpulkan data dari responden berupa kuisioner (daftar pertanyaan), untuk digunakan sebagai desain Improvement. Semua penilaian ini disandarkan pada suara customer atau juga bisa stakeholder yang terlibat dalam sistem transportasi Yogyakarta, disebabkan metode House of Quality (HOQ) ini sendiri merancang sebuah Kerangka desain Peningkatan (Framework Design of Improvement) berbasis Customer-Oriented.

Sehingga silahkan bagi responden untuk memberikan penilaian terhadap pertanyaaan-pertanyaan dibawah ini dengan jawaban skala yang sudah dipaparkan. Mana saja yang dirasa penting atau tidak, untuk ditingkatkan atau dilaksanakan.

Weight Description	Weight Score
Sangat Penting	5
Penting	4
Cukup Penting	3
Tidak Penting	2
Sangat Tidak Penting	1

Semakin tinggi bobot penilaian berarti semakin penting untuk ditingkatkan, dalam kata lain memiliki tingkat kepentingan yang tinggi. Semakin rendah bobot penilaian maka semakin rendah tingkat kepentingannya.

Disini tedapat 12 Technical Improvement:

1. Affordability and Accesbility
2. Resource Efficiency
3. Operational Effiency
4. Land Use Mix and Built Environment
5. Equity and Fairnes
6. Quality of Livability
7. Community Travel Behaviour
8. Individual Community Education and Awareness
9. Climate Change Prevention and Mitigation

Nama:

Jenis Kelamin:

a. Laki-laki
b. Perempuan

Usia:

a. 18-20
b. 20-22
c. 22-25
d. 30-40
e. >40

Konfirmasi anda sedang atau pernah berpengalaman dengan sistem transportasi di Yogyakarta:

a. Konfirmasi

Status di Yogyakarta:

a. Pelajar (Mahasiswa/i)
b. Pekerja
c. Wisatawan
d. Pernah Mengerjakan Proyek Transportasi di Yogyakarta

No	Affordability and Accessibility						
1	Keberadaan sarana transportasi umum, misal;(Bus tanpa hambatan, Kereta cepat dalam kota, ride-sharing)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Ketersedian fasilitas transit dan akses bolak-balik pada transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Keterjangkauan tarif pada fasilitas transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Kemudahan dalam mengakses fasilitas transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
5	Efisiensi manajemen pengelolaan tarif rata-rata moda transportasi umum, tarif parkir kendaraan pribadi, harga bahan bakar fosil dan alternatif,dll						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Resource Efficiency						
1	Jarak jangkauan sumberdaya fasilitas transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Jumlah shelter transportasi publik						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Ketersedian jumlah kursi (daya tampung) pada transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Moda transportasi umum dengan konsumsi energi yang rendah						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
5	Jarak transit poin (tempat pemberhentian) dari terminal satu ke yang lain pada transportasi publik						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Operational Efficiency						
1	Kemampuan moda transportasi umum untuk dapat meningkatkan kegiatan mobilitas						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Kecepatan moda transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Kelancaran traffic transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Jam operasional dan waktu tunggu transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
5	Transportasi umum yang cenderung bebas hambatan, (Rate delay hours per year yang rendah)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Land Mix Use and Built Environment						
1	Jarak zona kawasan residensial (hunian) ke Central Business District (Pusat bisnis : daerah perkantoran, pendidikan, dan pemerintahan)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Adanya kebijakan mendalam untuk mendukung optimalisasi penggunaan lahan *						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Pengendalian kepadatan infrastruktur						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Distribusi transportasi umum secara merata pada seluruh kawasan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
5	Infrastruktur yang berpedoman pada Transit-Oriented Development (TOD)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Equity and Fairnes						
1	Kemampuan moda transportasi umum dalam mengikuti jumlah pertumbuhan penduduk						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Kesempatan untuk setiap individu dari berbagai elemen dan latarbelakang sosial untuk dapat mengakses transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Tingkat aksebilitas ke ruang pendidikan dan peluang kerja untuk setiap individu						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Kebijakan yang adil dan transparan untuk semua strata sosial dalam mengatur sistem transportasi						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Quality of Livability						
1	Faktor tingkat keselamatan dan keamanan pada sistem transportasi						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Fasilitas umum atau sistem transportasi yang mendukung faktor kesehatan dan kebugaran jasmani serta mental						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Faktor tingkat kenyamanan fasilitas transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Performa infrastruktur kota untuk dapat memberikan pengalaman berjalan dan bersepeda yang baik (Nyaman; teduh, bersih, aman, bebas hambatan)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Community Travel Behaviour						
1	Pengendalian pemilihan moda transportasi bagi individu atau kelompok						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Pertimbangan jumlah mobilitas tiap household (rumah tangga)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Tersedianya pembetukan kultur (budaya) yang mendorong untuk menggunakan transportasi publik						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Kebijakan yang efisien dalam mengatur kegiatan mobilitas dan kepemilikan kendaraan pribadi						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Individual Community Education and Awareness						
1	Upaya menaikan rasa apresiasi terhadap penggunaan transportasi umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Peran serta keterlibatan seluruh lapisan masyarakat dalam mengkondisikan sistem transportasi yang berkelanjutan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Ketersediaan progam komunitas pengembangan (Community Development Program) dalam mengupayakan sistem transpotasi yang berkelanjutan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Peran penelitian dan pengkajian untuk sistem transportasi yang berkelanjutan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
5	Kesadaran peduli lingkungan (Environmental Concern) tiap individu						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Climate Change Prevention and Mitigation						
1	Upaya penurunan emisi gas rumah kaca						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Upaya menjaga kestabilan iklim dan pencegahannya						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Ketersedian kebijakan priventif berbasis lingkungan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Zero Pollutant						
1	Sistem transportasi yang tidak menimbulkan kebisingan suara (Polusi Suara)						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Sistem transportasi yang memiliki rencana manajemen dan standardisasi udara bersih						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Sistem transportasi yang tidak mencemari air						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Biodeversity Protection						
1	Ketersedian sumber daya alam						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Minimalisasi penggunaan bahan sumber daya alam yang tak terbarukan						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Pelestarian ekosistem						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Kebijakan perlindungan kekayaan alam						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting

No	Availability and Energy Reserves						
1	Usaha pengurangan konsumsi bahan bakar per kapita						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
2	Ketersedian energi alternatif untuk umum						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
3	Penerapan penggunaan energi alternatif pada sistem transportasi						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting
4	Kebijakan penghematan energi						
	Sangat Tidak Penting	1	2	3	4	5	Sangat Penting