CHAPTER 1
INTRODUCTION

1.1 Background

Indonesia, an archipelago of islands, lies between the Indian Ocean and the Pacific Ocean. Located at 6°N to 11°08'S and 95°E - 141°45'E, Indonesia's territory extends 3.977 miles between the Indian Ocean, located at the west and south of Indonesia, and the Pacific Ocean located on the East side. Indonesia has a land border with Malaysia in the north, New Guinea in the east, and Timor Leste in the south. Indonesia also shares a marine boundary across narrow straits with Malaysia, Singapore, and the Philippines to the north.

Indonesia's land area is 1,922,570 km², making it the world’s 16th largest country in terms of land mass, and its waters span 3,257,483 km². Indonesia consists of 17,508 islands, of which approximately 6,000 are inhabited. Indonesia has 5 large islands, namely: Papua Island, Borneo or Kalimantan Island, Sumatera Island, Celebes or Sulawesi Island, and Java Island. A map of Indonesia in Figure 1.1 shows these islands and the important cities.

Indonesia is the 4th most populated country in the world following China, India, and the USA. According to the Indonesian Central Statistics Bureau and Statistics Indonesia, in 2010 the national population was 237 million (BPS 2010). Approximately 136 million people live on Java Island; making it the world's most populous island. There are around 300 native ethnicities in Indonesia with 742 different languages and dialects spoken. The largest ethnic group is the Javanese who represent about 42% of Indonesian inhabitants, and other large ethnic groups include the Sundanese, Malays, and the Madurese. The population growth rate is 1.136% and age demographics are as follows: 0-14 years at 28.1%, 15-64 years at 66%, and 65 years and over at 6%.
Hanung Harimba Rahman, Head of Data and Information Centre of Indonesian Investment Coordinating Board (BKPM), states that by having a Gross Domestic Product (GDP) size of more than USD 700 billion in 2010, Indonesia is the third fastest growing economic in Asia, and the largest economy in Southeast Asia. Indonesia’s economy grew by 6.1% in 2010 and is forecast to climb to 6.5 to 6.9% in 2012. In actual fiscal and monetary conditions, Indonesia is better than European countries as Indonesia fiscal burden lighter. In monetary policy for example, Indonesia needs to raise SBI only once while China, Singapore and India need to raise central banks rates 7-9 times in the past 19 months (Rahman 2011).

Indonesia has a very potential national resource. Indonesia is a major player in the global coal market. By Producing of around 275 million tons in 2010 and 5,529 million tons proved reserves of coal, Indonesia become the world’s second largest thermal coal exporting country and third largest exporter of steaming coal. With 108.4 trillion cubic feet of proven natural gas at the end of 2010, Indonesia is the single largest holder of proven natural gas reserves in the Asia Pacific region. Indonesia also have
4.23 billion barrels stock tank of proven oil reserves at the end of 2010 and holds 40% of the world’s geothermal resources, equivalent to 28.1 Giga Watt of power generation potential. Others primary commodities are crude palm oil, tin, rubber, cocoa, copper, nickel and gold with the rank in the world are 1st, 2nd, 2nd, 2nd, 5th, 2nd, and 7th respectively (Rahman 2011). Those resources spread over the islands of Indonesia archipelago like shown in Table 1.1 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Commodity</th>
<th>Production</th>
<th>Location</th>
<th>World rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude Palm Oil</td>
<td>20.8 million tons (2010)</td>
<td>Sumatera, Kalimantan, Sulawesi, Papua</td>
<td>1st</td>
</tr>
<tr>
<td>2</td>
<td>Tin</td>
<td>105 thousand metric tons (2009)</td>
<td>Sumatera</td>
<td>2nd</td>
</tr>
<tr>
<td>3</td>
<td>Rubber</td>
<td>2.4 million tons (2010)</td>
<td>Kalimantan</td>
<td>2nd</td>
</tr>
<tr>
<td>4</td>
<td>Cocoa</td>
<td>792 thousand tons (2008)</td>
<td>Sumatera, Sulawesi, Java, Kalimantan, Nusa Tenggara</td>
<td>2nd</td>
</tr>
<tr>
<td>5</td>
<td>Copper</td>
<td>868 thousand metric tons (2009)</td>
<td>Maluku, Nusa Tenggara, Papua</td>
<td>5th</td>
</tr>
<tr>
<td>6</td>
<td>Nickel</td>
<td>189 thousand metric tons (2009)</td>
<td>Sulawesi, Sumatera, Maluku, Papua</td>
<td>2nd</td>
</tr>
<tr>
<td>7</td>
<td>Gold</td>
<td>105 metric tons (2009)</td>
<td>Kalimantan, Sumatera, Maluku, Papua</td>
<td>7th</td>
</tr>
</tbody>
</table>

(source: www.ekon.go.id/media/filemanager/2011/11/19/c/o/compressed-bkpm.pdf)

However, in addition to having abundant natural resources, Indonesia also has weaknesses. Due to an imbalance in population distribution, followed by an uneven economic development in many sectors, Indonesia's transportation system has mainly focused on populous centers such as Java Island home to 200 million residents living in highly concentrated living conditions. A railway system, which is dedicated to transporting bulk commodities and long distance passenger traffic, is well serviced in this island only. Not unlike the railway systems, the marine transport system is also running well across the populated island. There are significant port cities along the marine border between the major islands. There are also inland waterways in areas of
Eastern Sumatra and Kalimantan. Almost all big cities in Indonesia are accessible by air
transport systems. Even many remote cities located in mining areas and serve an
important function can also be reached by small commercial plane. Of all systems
across Indonesia, road transport is the most dominant, with a wide variety of single
passenger vehicles on the road, and public bus service available in most areas which are
connected with a primary road network. Transportation options are readily available
between major cities, especially on Sumatra, Java, and Bali. In remote areas with
narrow road access, and between smaller towns, most services are provided with
minibuses or minivans and buses and vans are also the primary form of transportation
within cities. Many cities and towns have some form of private transportation for hire,
such as taxis, motorcycles, and motorized auto rickshaws (bajaj). There are also
traditional cycle rickshaws called becaks which are common in many cities and provide
an inexpensive form of in-town transportation. Due to the increasing purchasing power
of Indonesians, private cars are gaining popularity, especially in major cities. As a result
of this growth and lack of infrastructure to accommodate increased number of vehicles,
traffic jams are a common sight in large parts of the major cities such, especially in
Jakarta and Surabaya and along the highways as well.

In the education sector, Indonesia still struggles with quality and inequity
(World Bank 2009). However, recent vigorous efforts have been made to advance
education and reduce illiteracy. In 1971, overall literacy was estimated to be about 58%,
ranging from 77% in the cities to only 52% in rural areas. By the year 2008, adult
illiteracy rates were estimated at 7.8% (males, 6%; females, 9.6%). Under the
constitution, education must be nondiscriminatory, and six years of primary education
are free and compulsory. The school system includes a six-year primary school, a three-
year secondary school, a three-year high school, and options for higher education in
universities, faculties, teacher training colleges, and academies. The vocational schools
have been brought into line with the (brought into line with the standards of high schools?) high schools. Secondary schools are referred to as SMP, or Sekolah Menengah Pertama, while High schools have the abbreviation SMA, or Sekolah Menengah Atas, Vocational schools are known as SMK, or Sekolah Menengah Kejuruan.

Besides Jakarta as the national capital, there are primary cities spread over Indonesia's provinces. There are Surabaya as East Java province and the second largest harbor. Bandung, is the capital of West Java province and also known as the technology education centre of Indonesia. Medan, is the capital of North Sumatera province and the economic centre of Sumatera Island. Yogyakarta, the former royal palace and become the education and cultural centre. Semarang, is the capital of Central Java province. Makassar, is the capital of South Sulawesi province and the largest city in Sulawesi Island. And Denpasar, is the capital of Bali province and the most famous Indonesia tourist destination. Surabaya is the study area of this research.

Surabaya is the capital city of East Java Province. East Java Province is located on Java Island beside Special Capital Region of Jakarta (DKI Jakarta), Banten, West Java, Central Java, and Special Region Yogyakarta. East Java Province, lies at 7°12’S to 8°48’S and 111°E to 114°4’E, and shares a border in the north with Kalimantn Island, and south with the Indonesian ocean, west with Central Java Province, and east with Bali Island. East Java Province has 38 cities spread across its 46,428km² area. Figure 1.2 show East Java province and its surrounding area. Surabaya is a city with a border on the west side of Madura Island and is located at 7° 21’S and 112° 36’ to 112° 54’E. As a port city, Surabaya is situated approximately 3 - 6 meters above sea level, except on the south regions, and there are two slope mountains 25-50 meters high above sea level.
Surabaya is the second biggest city in Indonesia with an area of 33,306 km². There are approximately 3 million residents spread across 31 districts called Kecamatan and 163 sub districts called Kelurahan. While most of Surabaya’s citizens are original from Native Surabaya and or of Madura descent, Surabaya is a city rich in ethnic representation and cultural diversity. For example, there are Malays, Chinese, Indians, Arabs, and Europeans as well as Indonesian archipelago ethnics including Madura, Sundanese, Batak, Kalimantan, Balinese, Sulawesi and others who mix with native Surabaya citizens to establish cultural pluralism.

Based on the data recorded by the Civil Department at the end of 2007, the population of Surabaya residents (who registered in family card) was 2,861,928 consisting of 755,914 families. The composition is 1,437,682 (50.23%) male residents and 1,424,246 (49.77%) female residents. The breakdown of age groups shows that the largest proportion is in the 36-45 years age group (524,829 inhabitants) followed by 46-59 years old (464,205 inhabitants). Based on profession, the majority of inhabitants...
were private employees representing 684,581 people followed by housewives at 527,343 and students at 448,551. The demographic information was based on education level, the largest proportion being high-school level (772,133) followed by elementary (769,728 inhabitants) and unschooled (616,240).

1.2 Statement of Problem

Surabaya is one of the most education sector-focused cities in Indonesia as suggested in its education budget which exceeds 30%. This emphasis on education is consistent with the vision of the city: Smart and Caring and with one of the city missions: “Increase the education quality and in turn increase the global perception of a quality city which takes care of its people and prepares the young to manage progress and challenges of the day”. The goals to be realized through this mission include: Increased education quality in accordance with science and technology development, improved education distribution and expansion of educational services for citizens, and increased quality of early education and sport prestige.

Surabaya has 492,495 school aged citizens with 270,076 citizens at the elementary school age, 114,733 at secondary school age, and 107,686 at high school age. There are 1,622 schools in elementary level, consisting of 564 public schools, and 1,058 private schools. At the secondary level, there are 42 public schools and 300 private for a total of 342 schools. At the high school level, there are 257 schools of which 33 are public and 224 are private. Because of the higher proportion of elementary school students, about five times of secondary school and seven times of high school, there are more schools built to accommodate these levels. Due to this fact, there exists a scarcity of educational institutions at the higher levels, making it common for students to travel much longer distances as they move to higher levels.
The city government forms the committee for public secondary and high school student acceptance. Public schools are grouped according to areas: center, north, south, west, and east. Students attending elementary school in one area are encouraged to continue to secondary school in the same district. They still can move to another locale but numbers are limited. This policy applies equally to secondary schools and high schools. The purpose of this division is to obtain smooth distribution across school regions and for consistency. Also, this policy aids in reducing the traffic across the city. The division of the school areas is shown in Figure 1.3.

![School group area](image)

**Figure 1.3.** Grouping of secondary school area

The government has calculated (Surabaya, City Mayor 2008) the participation rate at each level of education. Participation rates indicate a comparison between the numbers of students in a certain grade (or school) level with the number of citizens whose ages correspond with that level. In early 2008 for example, the elementary school level participation rate is 92.92%, secondary school level is 79.85%, and high school
level is 83.53%. We can conclude from this information that there are more than 19 thousand citizens not attending school at elementary school ages, more than 23 thousand at secondary school ages, and more than 17 thousand at high school ages. The prime reason for vast numbers of unschooled citizens is that they cannot pay schooling costs because they live in needy families.

Empowering People Department of Surabaya (Surabaya, Development Planning Department 2008) states that the number of needy families is 113,747, comprised of 525,609 people in the total. Within this number, there is a need for education at school ages for 108,428 people (sum of the schooled and unschooled people). 54,964 residents are seeking education at the elementary school ages, 26,945 at secondary school ages, and 26,519 at high school ages. Distribution for these numbers in each district is shown in Figure 1.4 below.

![Comparison of needy in 3 school level](image)

Figure 1.4. Distribution of needy students at the third level of school.

Surabaya city government has taken some action for helping needy families in the education sector. The most prominent action is removing the school cost in many
public schools. In early 2008, there were 544 elementary schools and 58 secondary schools that did not collect admission costs and monthly costs from their students. The remaining schools that still collect cost from their students can be also make education free and accessible for those who require it by showing the “needy notes” or proof of need from their district government. The government has not yet made all high schools free because they are still focusing on the national education target, with its mandate “the nine years study compulsory”. Specifically, what this means is that the priority is to have all Indonesian people study a minimum of nine years at elementary and secondary levels.

Despite this free admission, and also free monthly cost, there are still a lot people who cannot go to school. It because they have no extra money to buy uniforms, shoes, books, and other student supplies. In mid 2009, the government set aside a budget (Surabaya, Financial Department 2009) of about 183 million rupiahs for helping needy students for this reason. They allocated 145 million for elementary and secondary level needy students, and 38 million for those at high school ages. This initiative helped to ease the problem of paying school fees and equipment which many students encountered. Now the government is expanding its budget and putting greater focus on addressing transportation costs.

The transportation problem is mainly found in the secondary and high school levels. At the elementary level for example, the distance to travel between home and school is not significant because an elementary school exists in almost every sub district. Schools can be reached by walking or riding a bicycle. However, travel to secondary and high schools poses a problem to many, as the distances can be significant. It is impossible to reach many schools by walking and it would be truly exhausting if commuting by bicycle. Some students travel to school undaunted and taking chances by first walking then picking up a ride by a passing car, then walking the
remaining distance or taking another ride until they reach the school or their house. Surabaya has a bus and lyn for public transportation that usually used by students. Buses resemble those normally found around the world with a capacity of about 60 people. A lyn is a typical car whose seats have been modified and rearranged to accommodate about 15 people. For example, its seats are placed in the right and left of the body so passengers can face each other. Lyn vehicles and buses have the same cost; it is 2,000 rupiahs for student. However, even though the cost is reasonable, it still beyond reach for the needy student.

One of the alternatives the government has considered is to run the school bus just like in the other big cities around the world. They have several unused buses, and they can add other buses in the next budget year, if it can be proven that there is a true benefit and will make a substantial difference in helping the needy student. By providing valid and compelling evidence, this study will try to open a discussion around the topic of much needed transportation development in Surabaya to meet the growing needs of many students and their families.

1.3 Goal and Objectives of Study

The main aim of this study is to develop a GIS model that can be used to design an optimal bus route which serves the needs of poor school children. In achieving this goal the following objectives have been identified

(i) discover the specific school bus service needs of needy school children in Surabaya
(ii) investigate appropriate method in finding bus routes with limited data
(iii) determine an appropriate analyst method to measure how well the proposed routes perform.
(iv) find out an acceptable analyst method to show the effect of proposed route to the existing transportation system

(v) construct a model that will use to generate an optimal bus route to serve needy student

1.4 Research Methodology

In order to conduct the research, information at several areas will be gathered and applied. This research is a combination of transportation and geographic information system. Figure 1.4 shows the big picture of this research methodology.

A literature study about transportation environment, such as routing and accessibility, need to be conducted before investigating the spatial techniques for applying it. All literature will be reviewed, and several candidate techniques will be defined. After intensive literature study, a data collecting process will be conducted. Data to be gathered consists of spatial data and tabular data. Data may need to refined, extracted, or filtered. Some field survey has to be conducted for complementing the existing data.

Figure 1.5 Schema of the research methodology in this research
The chosen techniques will then be applied to the collected data. This step may result in having to acquire more data. Some assumptions may have to be made at this step. After all needed parameters have been completed, the research continues with building several sub models in specific functions but interconnected with each other. There are 3 crucial processes that have to be modeled. First is the model for preparing and refining data. Second is the model for the routing process, and the third is the model for analyzing the routing process output. The last step is determining the proposed solution to get the most feasible and reliable one. This process also needs a field checking by tracking the routes and comparing the result.

1.5 Scope of Study

This study tends to build a model that can be used by Surabaya city government. The ideal model is using the whole Surabaya city area. However, due to the time constraint in this study, we will use a portion of whole Surabaya area. Since the government has divided Surabaya into several groups of school areas, we will use one of these groups. We will use the north group area which represents the largest number of needy students, It will also be the scope of all spatial and tabular data used in this study.

The model will use the spatial data that is commonly used in geographic information system (GIS). There are time constraints with this study, and so some concerns need to be addressed. Since the focus of Indonesian education development in “the nine years study compulsory” is to make all Indonesian people obtain a minimum elementary school and secondary school education level, and the transportation problem is happening at the secondary school and high school levels, the study will use only secondary school needy student data. It also means we will use the secondary school location for the school location data.
Although this study uses a circumscribed data, the developed model will not depend on this limitation. It means that with the same model, if the other spatial areas in Surabaya have been surveyed or similar “needy” high school areas need to be included, the model will still be applicable and running well.

1.6 Organization of Study

This study report is organized into 6 chapters. Chapter 1 is an Introduction chapter. This chapter provides the background why this study needs to be conducted, and specifications that relate to the whole chapters. It contains an Introduction, Statement of Problem, Goals and Objectives of study, Research Methodology, Scope of Study, and Organization of Study.

Chapter 2 will record about Studies in Bus Routing and Network Analysis. This chapter provides some vehicle routing problem and bus school research. Some of the spatial techniques that will be used in the whole process in this study, and network analyst for the routing process, will also be explained here.

Chapter 3 will explain all about methodology. This chapter provides all information related to the concept of how the route will be founded and how the founded route will be analyzed. This chapter will provide all processes needed to follow, how to conduct the study while using data, processing data until getting the output, and how to assess the output to get the optimal one. This chapter also explains how to enhance the output after getting the optimal route. The geospatial technology that will be used in this research also explained here.

Chapter 4 will explains about Data development and GIS development. This chapter also explains about what data to be used and to be processed. Also explain how data be processed in all steps in the methodology in the previous chapter.
Chapter 5 will show the Result. This chapter explains about the final result of all process that has been described in methodology chapter. The result will assessed in several points and continue with ranking the output to obtain the best one. This chapter also explains the result after the chosen route is enhanced with the analyst processes.

Chapter 6 will show the Conclusion and Recommendation. There are overview of the whole process here, and continue with explaining the research finding and recommendation to the next research.