

The opportunities for establishment of logistics clusters in Indonesia



Master Thesis

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*Πάντα στον νου σου νάχεις την Ιθάκη (Keep Ithaca always in your mind).
Το φθάσιμον εκεί είν' ο προορισμός σου (Arriving there is what you are destined for).*

- Konstantinos Kavafis -

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Executive Summary

This study is set out to answer the main research question of *“What are the opportunities for establishment of logistics clusters served by door-to-door multimodal transportation systems in Indonesia?”* To answer the question, it is begun by examining the logistics cluster concept, its characteristics, and critical factors for the establishment of logistics clusters. Then, the current situation of Indonesia’s socio-economic and general overview of logistics Indonesia are explored as a foundation to establish logistics clusters in Indonesia. Those concepts are explored to develop methodology to identify the opportunities of establishment logistics clusters in Indonesia that are served by multimodal freight transportation in Indonesia.

The literature study indicated the relationship between accessibility with the factors of the establishment of logistics clusters, where a region with higher accessibility is highly possible to attract logistics companies that lead to agglomeration. Then, in this study, logistics clusters are defined as the geographical concentration of logistics firms and operations, in which the emergence of this clusters depends on accessibility and quality of transportation infrastructure. The logistics clusters would be expected to establish in the region with higher accessibility that has a high concentration of logistics activities and substantial market size. In addition, there are six factors that contribute to forming the successful logistics clusters, i.e. geographical position, infrastructure, government, education and human capital, collaboration, and value-added services.

By considering a fact that Indonesia as an archipelagic country which has favorable geography and transport infrastructure, the establishment of logistics cluster is taken into account as a potential opportunity for economic development. Based on data availability, information, and finding related to logistics Indonesia, the analysis of the opportunities for establishment of logistics clusters in Indonesia conducted at the province level with multimodal transport system as the backbone of the transportation planning. The multimodal transportation system as the recommendation of LPPM-ITB has assumed as long distance and inter-islands freight shipping with two modes transport, i.e. roadway and sea modes. It is assumed that “maritime highway” policy is implemented and the target of GDRP growth is assumed would be realized in 2019.

Multimodal freight accessibility measures are conducted to analyze the geographical position and infrastructure factors. The region which results in the highest accessibility value is reviewed as the most potential location of the establishment of logistics clusters due to the advantage of strategic location and well-developed transportation infrastructure. To measure accessibility for logistics clusters that served by multimodal freight transportation in Indonesia, the modification of potential accessibility measures is applied. Meanwhile, the SWOT analysis is performed to analyze government, education and human capital, collaboration, and value-added services of the selected province based on the analysis of geographical position and infrastructure factors.

The analysis of multimodal freight accessibility value is conducted based on three different scenarios, one base scenario which counts both of land use and transport changes in 2010 and two developed scenarios which take into account changes either transport or land-use components in

2019. All scenario provides a similar spatial pattern of distribution of accessibility measures. In western Indonesia, the opportunities for establishment of logistics clusters served by multimodal freight transportation are promising in West Java. Meanwhile, South Sulawesi is indicated as the most potential location for logistics clusters in eastern Indonesia. Both provinces have the highest accessibility value in each representative region. It is indicated that both regions have a strategic geographical position, supported by well-developed physic and “soft” infrastructure as well as economic activities to establish logistics clusters. The analysis of accessibility gain indicates that the transport components which are represented by shipping impedance have the relatively small influence to multimodal freight accessibility in Indonesia in terms of establishment of logistics clusters in Indonesia. However, the accessibility value because the land-use changes increases significantly. It shows that the land-use component has more influence than transport component.

The strengths of West Java are mainly for government commitment to improve logistics performance, the large size of the academic institution, and a number of industries that related and supporter of logistics clusters. Meantime, South Sulawesi has additional strengths in terms of various transportation infrastructures. Both of provinces experiences a lack of transportation infrastructure, low quality of education, relatively high labor cost, and poor collaboration of stakeholders. Those weaknesses mostly result from the weak of governance systems in Indonesia. The highly fragmented among different ministries and government caused the difficulties on decision-making process regarding the transport infrastructure planning. Then, it is compounded by the government reputation that close to the corruption that becomes a challenge for implementation of all national and local government planning.

In the process of establishment of logistics clusters, the role of government is crucial as a leader on the project initiation, a driver for collaboration of stakeholders, and a controller of the planning implementation. Considering the MP3EI as a window of opportunity, South Sulawesi might have more opportunities to develop logistics clusters than West Java. Finally, it suggested that to start the pilot project for establishing logistics clusters in South Sulawesi that is expected to attract anchor industries and foreign direct investments (FDIs) as well as encourage the growth of small and medium enterprises (SMEs) that leads to increase innovation and boost the regional economic.

Lastly, this study develops modified potential accessibility measures for the establishment of logistics clusters that could be applied to the measurement of multi-modal freight accessibility generally and particularly for Indonesia. Some adaptation has been made considering the current situation of transportation and logistics in Indonesia, such as the type of freight shipping and recommended modes. Furthermore, this study develops a framework of potential logistics clusters in selected provinces, West Java and South Sulawesi, and presented it as a foundation for development planning in the future.

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1

Introduction

Outline

This chapter serves as the introduction part of the study; it principally presents the line of reasoning and the point of departure of the study. Section 1.1 provides the background for researching the situation to formulate the research problem. Section 1.2 presents the theoretical background of the research. In sections 1.3 and 1.4, the research objective and question are elaborated, respectively. Section 1.5 briefly describes the research approach to answer research question. Next, Section 1.6 elaborates the data requirement for this research. Finally, Section 1.7 provides an overview of the whole thesis and expected outcomes.

1.1 Logistics clusters: opportunities for Indonesia

The components of logistics are more than warehouse and transportation. Logistics is defined as the part of the supply chain process that plans, implements, and control the efficient, effective flow and storage of goods, service, and related information to meet the customers' requirement (Stock, 2001). It has integrated transportation, inventory management, warehouse management, storage and material handling, packaging, and facility location. The development of e-business and the use of advanced technologies, such as Radio Technology Identification (RFID) contribute to the growth of logistics industry. Furthermore, the global supply chain also caused changes in some development of logistics trends like nearshoring, in which increasing number of manufacturing are being brought closer to market or the end user. Those phenomena promote the growing of logistics clusters, the agglomeration of logistics activities in one location.

Logistics clusters literature makes a clear suggestion that logistics clusters are growing (e.g. (Rivera et al., 2014), (Baranowski et al., 2015), (Keller et al., 2015), (Sheffi, 2012)), (Van den Heuvel et al., 2013). Governments around the world are providing capital for the development of new and existing logistics clusters. Sheffi (2012) emphasizes the investment of Plataforma Logistica-Zaragoza (PLAZA) as the biggest logistics clusters in Europe by the Aragonese Government and the establishment of logistics clusters around the Panama Canal as proof how governments thought seriously about the establishment of logistics clusters. Meanwhile, new logistics clusters are being developed; existing clusters are expanding, including the major one such as Chicago and Dallas (Rivera et al., 2014), Singapore (Sheffi, 2012), Rotterdam (Langen, 2004), and Santos-Brazil (Silva et al., 2014).

The growth of logistics industry creates more demand for freight transportation. A reliable and efficient transportation infrastructure is a necessary condition for the efficient logistics operation because transportation cost is related to the retail price (Xu & Hancock, 2004). For the company, effective their transportation cost means higher of profit margin. Hooi Lean et al. (2014) found a well- developed transportation systems has a significant effect on China regional economic development since the improvement of transport infrastructure elevates economic growth by saving travel time and cost. For this reason, the accessibility of location become an important factor in the location decision of logistics companies. Better accessibility reduces transportation cost and time to the markets (Limao & Venables, 2001), which impact directly to the companies' performance. Berechman (1994) highlighted more efficient accessibility drives logistics companies to change their locations relatively closer to each other. Transportation accessibility is also one of the significant elements of location decision of foreign logistics companies (Hong, 2007). Therefore, logistics clusters is expected to be located in the areas that are highly accessible due to strategic location and well-developed infrastructure, such as the logistics clusters in Chicago that are mainly developed around to the major airports and seaports (Rivera et al., 2014) and the development of logistics agglomeration in three Provinces in Netherlands relocate relatively close to intermodal terminals (Van den Heuvel et al., 2013).

Besides the strategic location and supporting infrastructure, the establishment of logistics clusters is influenced by other factors. The research in (Mufnoz & Rivera, 2010) found that the successful of establishment of logistics clusters in Singapore is impacted by government and economy stability; tax policy and anchor of companies; zero corruption; human capital; research and development (R&D); support from industry; and continuous improvement in public and private sectors. Meanwhile, the factor that led to Dubai logistics clusters are success government stability; human capital; competition environment; a free trade zone and the establishment of industry clusters. Thus, Sheffi (2012) concluded there are four more factors that important on developing logistics clusters, e.i. government stability, high level of human resource, and industry support on developing the logistics clusters, and the collaboration between stakeholders.

Indonesia, as a developing country shows significant economic development in the recent years (The World Bank, 2016b). In 2015, Indonesia GDP grew 4.8%, which is a respectable growth rate (The World Bank, 2016a). However, it is not sufficient to absorb the market growth into the necessity of employment for labor force and to improve the trend of slower poverty reduction. To accelerate the growth, Indonesia needs to improve their competitiveness. As an archipelagic country, logistics activity is one of the major points of the economic growth system. Thus, the creation of logistics clusters is one of the ways to increase the efficiency of logistics activities in Indonesia. This study aims to determine opportunities for establishment of logistics clusters in Indonesia by analyzing accessibility level to select the potential location and by exploring the possible critical factors which impact the establishment of logistics clusters in selected location.

1.2 Theoretical background

A transport planning should be based on accessibility since an efficient accessibility will influence time and funds that people and business must devote to transportation (Litman, 2012). Accessibility related to the performance of transport systems, the interplay of the transportation system and land-use pattern. Thus, accessibility measures should be capable of assessing feedback between transport infrastructure and modal participation, and urban form and the spatial distribution of activities (Scheurer & Curtis, 2007). Several researchers presented the review of accessibility measures. They often focused more on individual accessibility, location accessibility, or economic benefits of accessibility. For an application, accessibility measures are examined for evaluations of land-use and transport strategies and developments (Geurs & van Wee, 2004). Yet, the current theories of accessibility measures do not specifically explain how accessibility measures relate to the establishment of logistics clusters, specifically to Indonesia, as an archipelago country where the multimodal transportation system becomes crucial to transport both goods and passenger more efficiently.

The outcome of this research will address this gap by assessing the accessibility of regions in Indonesia served by the multimodal transportation system. Several kinds of literature point out that there is a relationship between accessibility and regional economic. Alstadt et al. (2012) argue regarding the relationship of transportation access and connectivity to local economic outcomes. Using statistical analysis, they studied how various transportation projects can have different

impacts on business concentration and productivity. Furthermore, they also explained that there is a positive relationship between accessibility characteristics of local areas and relative level of business productivity, job concentration, and export base. Geurs & van Wee (2004) also remark that accessibility could be used as economic indicators of local areas directly or indirectly since travel cost saving are typically the most important category for an infrastructure project.

1.3 Research objective

Based on the above problem, the objective of this study is to contribute to the development of theory about how multimodal freight accessibility measures relate to the establishment of logistics clusters in Indonesia and how the accessibility level could be used in selecting the potential location of logistics clusters. This study will also provide opportunities for establishing logistics clusters in Indonesia by analyzing the critical factors of the establishment of logistics clusters by taking into account the social-economic situation in Indonesia. The outcome of this study, which is the accessibility map of regions in Indonesia, can also be used as economic and social indicators to study further about the spatial pattern of economic connectivity in Indonesia. Furthermore, this study is expected to offer analysis the potential location for establishing logistics clusters in Indonesia to logistics firms that intend to expand their business, either local companies or even foreign logistics firms.

1.4 Research Questions

The main research question regarding the objective of this study is *“What are the opportunities for establishment of logistics clusters served by door-to-door multimodal transportation systems in Indonesia?”*

The research question covers two significant aspects: (1) the establishment of logistics clusters, and (2) issues related to the development of social economic in Indonesia. In order to answer the main research question, several sub-questions are explored as follow.

1. “What are the critical factors to analyze the opportunities for establishment of logistics clusters?”
2. “What are substantial inputs to be considered to analyze the opportunities for establishment of logistics clusters based on the current situation of socio-economic and logistics in Indonesia?”
3. “How to analyze the critical factor for establishment of logistics clusters served by multimodal freight transportation in Indonesia?”

1.5 Research Methodologies

Specific research methods that will be adopted for answering each research questions are listed in Table 1. Along with these methods, following theories will also be used while performing the study: 1) theory of accessibility measures, 2) theory of logistics clusters.

Table 1 Methods to be adopted for research

Sub-question	Research Method
1	Literature review – studying the concept and characteristics of logistics clusters to determine the important factor for the establishment of logistics clusters.
2	Literature review – studying the current situation of socio-economic and logistics in Indonesia
3	GIS approach for accessibility analysis, data analysis, and SWOT analysis

Desk research

For sub-questions 1 and 2, the qualitative research design in general and desk research, specifically literature review was chosen. Desk research was selected because, in this research, data is collected by others (Verschuren & Doorewaard, 2010). Data can be found through the Indonesian government, including Ministry of National Development Planning, Ministry of Transportation, and Statistics Indonesia. A literature review was chosen as it is the best source of information on the research question and the context. Bryman (2012) explains since each sub-question guaranteed a research about “what is already known about the topic” (or) “what concepts and theories have been applied to the topic” (or) “what research methods have been applied to the topic”, a literature is the most suitable method for answering them either partly or entirely every sub-question.

The most significant advantage of desk research is a capability to collect data and information in the relatively short time and a large amount (Bryman, 2012). The other benefits are related to accessibility and generating new insights in the context of research. In the digital era, the internet has been revolutionary for accessing data and information. However, the validity of data becomes a problem for secondary data that retrieved from the web. Furthermore, secondary research could inspire for new insights since by analyzing the same data, the different relevant conclusion can come up or simply confirm the previous results. Verschuren & Doorewaard (2010) point out that secondary research has disadvantages related to actual practice which research design requires changes regarding nature and the quantity of material available. Moreover, the fact that secondary data is not gathered directly, it can say that a researcher has no direct contact with research units. In the perspective of individual behavior, this means missing opportunities in all types of non-verbal information. The inappropriateness of data is also one disadvantage of secondary data. Secondary data may provide an enormous amount of information however quantity is not

synonymous of appropriateness. Inappropriateness may refer to time because data was gathered a long time ago or data relates to the fact that research is for a whole country while one purpose to study a particular region or the opposite, one purpose to explore an entire country but information is given in a region-wide.

Geographic Information System (GIS) approach and SWOT analysis

Sub-question 3 aims to analyze the critical factor of the establishment of logistics clusters, GIS approach and SWOT analysis are considered to be best suited. According to Rodrigue et al. (2011), GIS is an information system designed for input, storage, manipulation, analysis and report of geographical information. The topographic information (roads, rivers, rails) can be represented on maps easily using GIS. Furthermore, the geographical information can be combined with numerical data for spatial analysis to deliver information that enables relationships and patterns to be visually recognized. Moreover, GIS allows a multitude of different spatial statistical analyses to be performed (Waters, 1999). These advantages of GIS stimulate institutions to use spatial data to provide strategic for transport and regional planning. The analysis of spatial and regional statistics data can be used to measure accessibility as social and economic indicators. However, it should be noticed that GIS requires an enormous of data inputs to be practical for some research in order to get certain results.

Application of GIS can be used in a very broad range of scientific fields, including evaluating the accessibility level of establishment of logistics clusters. In this study, QGIS software package will be applied to develop accessibility map. QGIS is an open source desktop GIS software package that provides capabilities to edit, visualize, analyze, and publish geospatial information. Basically, this application has a similar function to other software provided by GIS systems that allow users to create maps with many layers. Furthermore, maps can be assembled for different uses in a different format. This research uses QGIS due to simplicity to obtain information for the application and to connect with QGIS community for further discussion as this software is an open-source platform. In addition, QGIS integrates with other open-source GIS software packages, such as GRASS and MapServer to extend QGIS's capabilities.

Meanwhile, SWOT analysis is a framework for analyzing the region's internal strengths and weaknesses, as well as its external opportunities and threats. The SWOT analysis will be conducted in order to define what the current strength, weaknesses, opportunities, and threats of selected location.

1.6 Data collection

Data and information require in this study are mainly categorized as inputs for GIS approach. Also, some data and information are used to determine the opportunities for establishing logistics clusters in the selected location. Table 2 shows the list of data and information that required for this research.

Most all of data and information could be gathered from Statistics Indonesia (*Badan Pusat Statistik*, BPS), Indonesian Ministry of National Development Planning (*Badan Perencanaan dan Pembangunan Nasional*, Bappenas) and Ministry of Transportation. Nevertheless, data on travel costs are specifically collected from a sample online application tool for the shipping rates. The main problem in data collection is not the access to the data sources, but uncertainty for data existences and completeness. Detail data and information especially about origin-destination demand and transport cost are still uncertain whether they have already been recorded completely and appropriately or not. If this problem occurs, some adjustment and assumption will be applied to get a reliable and credible result.

Table 2 Data Collection

Data and Information Requirements	Possible Data Resources
General information and background: Indonesia's socio-economic performance, logistics' performance	Ministry of National Development Planning, Ministry of Transportation, Statistics Indonesia, World Bank, United National Development Program (UNDP), Asian Development Bank (ADB)
Population data and number of employees per main sector industry per provinces	Statistics Indonesia
Origin-destination (OD) demand, personal consumption expenditure, purchases of commodities from manufacturing industry, purchases of services from logistics industry	Ministry of National Development Planning, Statistics Indonesia
GDRP realization and future official target from public document	Ministry of National Development Planning, Statistics Indonesia
Detail transportation infrastructure in Indonesia	Ministry of Transportation
Travel costs in Indonesia	www.searates.com

1.7 Thesis structure

This thesis is started with the introduction of the study conducted, including the research objective in which research question and sub-questions are discussed. Chapter 2 examines the notion of logistics clusters concept and critical factors of the establishment of logistics clusters as well as the accessibility measures. Chapter 3 aims to understand the current situation of Indonesia's socio-economic, logistics performance, and the future logistics in Indonesia to determine some information as substantial input for analyzing establishment of logistics clusters in Indonesia. Chapter 4 presents the methodology that was performed during the study. Chapter 5 analyzes the result of accessibility measurement using GIS approach for some possible scenario.

Chapter 6 aims at finding opportunities and challenges of the establishment of logistics clusters by SWOT analysis. This thesis is then concluded in Chapter 7 which discusses conclusion, contributions, limitations, areas for future research, and reflections.

The expected final outcomes of this research are 1) an accessibility map of Indonesia that can be used to identify the most potential location for the establishment of logistics clusters in Indonesia, 2) opportunities for establishing logistics clusters in Indonesia to optimize the economy potential as an archipelagic country.

2

Logistics cluster: concept and characteristics

Outline

Review of literatures study on logistics clusters is presented in this chapter. The discussion of logistics clusters in this chapter is addressed to give principle understanding on concept and characteristics of logistics clusters for developing the methodology to answer the research question. Section 2.1 begins with an explanation of logistics clusters and its characteristics compare to another type of economic clusters. Section 2.2 then presents the factors that affect to the establishment of logistics clusters. In section 2.3, related to one of the critical factors of the establishment of logistics clusters, various accessibility measures will be scrutinized to determine the accessibility measures that fit for selecting the most potential location of the establishment of logistics clusters. This chapter concluded by developing the framework of logistics clusters and the structure of critical factors for establishment of logistics clusters in section 2.4

2.1 Logistics cluster

To realize economic of scale while minimizing transport costs, producers incline to locate in the region with larger demand, which forms a geographic concentration of industry (Krugman, 1991). The geographic concentration of interconnected companies and institutions in a particular field is later known as clusters. Several well-known examples of clusters include the agglomeration of information technology firms in Silicon Valley, biotechnology firms in Cambridge Massachusetts, fashion and design in Northern Italy, and computer products in Taipei. The British economist Alfred Marshall was originally observed this phenomenon where the agglomeration of firms draw economic advantage from geographic proximity to others in the similar industry (Marshall, 1920). He hypothesized the agglomeration of firms implies the existence of positive externalities of co-location, mainly due to three main forces, i.e. knowledge spillover among co-located companies, development of specialized suppliers, and development of specialized local labors.

M. E. Porter (2008) and M. E. Porter (2010) expand Marshall's hypothesis by providing analysis that clusters often extend downstream to the channel, customer, and laterally to the manufacturer of complementary products and companies in industries related to common inputs, so clusters impact the competition for economy geography. This competition forms in three broad ways: 1) by increasing the productivity of companies in the area, 2) by driving the trajectory of innovation which impacts the future productivity growth, 3) by stimulating the formation of the new business. Thus, to advance economic growth, clusters are one of economic market opportunities where business is increasingly expanding in a variety of industry segments.

The inter-firm relationship of clusters can be defined to be both vertical and horizontal. The vertical relationship mainly occurs between trading partners (Sheffi, 2010). Presently, all companies depend on the suppliers and then after adding their own values; those companies sell their product or service to the end customers. Thus, there are two interactions; the first interaction is between the procurement sides with suppliers and second is the interaction between sales sides with distributors and customers. The management of these relationships are foremost, thus being close to one of their main customers is one of the major pressures that pushed firms to co-locate near to their customers, while their suppliers also co-locate around their firms. The well-known example of this type of clusters is the BMW plant in Greer, South Carolina and the cluster of aviation suppliers for Boeing in Everett, Washington.

The horizontal relationship is links between firms at the same stage relationship (Sheffi, 2010). The model of this cluster includes automobile manufacturing plants in Detroit (Michigan) and advertising industry in New York City. This relationship forces companies to compete with each other and cooperate along aspects that benefit them. Therefore, they can create joint ventures to enter the difficult markets and also collaborate on lobbying the government related to regulation that might affect the entire cluster or basic infrastructure. In this type of cluster model, the economic advantage is mainly driven by trusts and association, which help firms to trade knowledge and learn from each other. However, inherently most clusters implement both types of relationship.

For example, clusters in Detroit consists of not only automotive plants but also many suppliers and sub-suppliers plants. (M. E. Porter, 1990)

The focus of this study is on industrial clusters that are focused on the production and handling of physical products, including the movement, storage, and convergence of goods. The reason is this type of clusters enables the participants to savor the operational logistics advantages. Particularly, this research will focus on a cluster of companies with logistics-intensive operations or widely known as logistics clusters (Sheffi, 2010). This type of cluster includes mainly two types of company: (i) logistics service companies, such as third-party logistics providers (3PLs), forwarders, warehousemen, transportation carriers, customs, IT provider, and specialized consulting, and (ii) firms with logistics-intensive operations, such as distributors and firms that compete based on their logistics skills (Sheffi, 2010).

Furthermore, refers to the classification by Porter (2003), logistics clusters would be developed over geography which provides the types of dependent resource industry. The employments are located particularly in the region that has needed a natural resource. According to Sheffi (2012), logistics clusters are defined as regions with very high concentrations of local activities about the local economy. These clusters include logistics service companies, the logistics operations of industry companies, and the operations of companies from whom logistics is primarily part of their cost operation. A study by Van den Heuvel et al. (2013) about the dispersion of logistics industry in three provinces in Netherlands, also treated logistics clusters as the geographical concentration of logistics activities.

Different from aforementioned concept, Baranowski et al. (2015) criticized the limitation of logistics clusters concept to the transport and logistics activities. They have defined logistics clusters based on the principle of “triple helix” (the interaction of government, industry, and university). In their view, logistics clusters is a specially organized logistics systems, organizational, and analytical improvement of logistics activities.

Logistics clusters exhibit the same characteristics to the other type of industry cluster: increasing productivity companies; the presence of the transfer knowledge and tacit knowledge; availability of highly specialized labor force, university research, research centers, and innovation centers; and high levels of trust and social capital. Therefore, similarly with other industrial clusters, logistics clusters also allow each member firm to operate independently, while still enjoying the advantages of the power of the cooperation between cluster members. In addition, logistics clusters proffer additional specific advantages to the member besides that the advantages obtainable to members of any industrial clusters. These advantages include efficient warehousing and transportation based on the capability to share resources so that the clusters could handle effectively the demand variability. Then, the logistics clusters provide many advantages of industrial clusters, even in some cases offer more benefits to regional economics. Particularly, in increasing the number of jobs created, in the astonishing sophistication of the industry in terms of use of information technology, and global financial services (Sheffi, 2010).

However, logistics clusters have some characteristics that make them different in terms of the establishment of clusters. The main factors of the establishment are geographical position because the necessity to the effective transportation of goods. The forming of logistics clusters also depends on the quality of transportation of service in the region (Hong, 2007). Thus, naturally many logistics clusters would develop around transportations hubs like seaports and airports. The logistics clusters in Singapore, Rotterdam, Hong Kong, and Shanghai are a model of logistics clusters that developed around the large ports. Likewise, several large cargo airports developed into logistics clusters, such as Seoul's Incheon, London's Heathrow, and Frankfurt. In addition, there are logistics clusters which developed around both significant seaports and large airports, such as in Dubai and Los Angeles. Therefore, firms that support international trade, as forwarders, customs broker is allowing to serve both of seaports and airports. Besides that, the logistics clusters are also often developed in central geographical locations, such as in Chicago, and Kansas City in the U.S. This is possible because port locations are served by railroads.

Last but not least, the role of government is emphasized as crucial in driving the establishment of logistics clusters. The majority of the development of these clusters is driving by the government, such as the Plataforma Logistics de Zaragoza (PLAZA). The government encourages the establishment of logistics clusters because two reasons. First, the industrial clusters are traditionally focused on clusters of goods production. Then, transport and logistics industry determine economic growth. In the next section, factors that affect the establishment of logistics clusters would be scrutinized further to determine the definition of logistics clusters that used in this study.

2.2 Factors affecting the establishment of logistics clusters

According to M. E. Porter (2008), there are three types of cluster based on a different kind of knowledge. First, techno cluster, which consists of firms that highly technologically oriented, well-adjusted to the knowledge economy, and typically located around universities and research centers, such as Silicon Valley. Next, industry clusters based on historic know-how, where they keep the traditional activities that maintain their benefit on know-how over time, for example, Manhattan as a financial center. Third, factor endowment clusters are developed because of the availability of a comparative advantage linked to a geographical position like logistics clusters. The notion of comparative advantages linked to geographical position means that one firm can produce a product with the highest efficiency relative to all other product because of the geographic position of this firm.

M. E. Porter (2008) presented the clusters map structure that represents the effect of location on competition as shown in Figure 1. The elements of this framework involve factor input conditions, the context for firm strategy and rivalry, the demand conditions, and the related and supporting industries. Factor input conditions include tangible assets (such as physical infrastructure), information, research institutes, and the legal system. The context for firm strategy and rivalry refers to the rules that control the type and intensity of the local rivalry. This element can be divided into two main dimensions, first is the climate for investment and second is the local

policies affecting rivalry itself. The demand conditions which refers to firms' capability to move from similar and low-quality products or services to competing on differentiation. Meanwhile, the related and supporting industries refer to the existence of both capable, locally-based suppliers and competitive related industries. Thus, based on the clusters map structure in Figure 1, the logistics cluster could be structured into four components, i.e. 1) the logistics cluster core consist of logistics services, transportation services, and logistics operators, 2) related industries, 3) supporting industries, and 4) key organization which crucial on enhances the development of a logistics clusters.

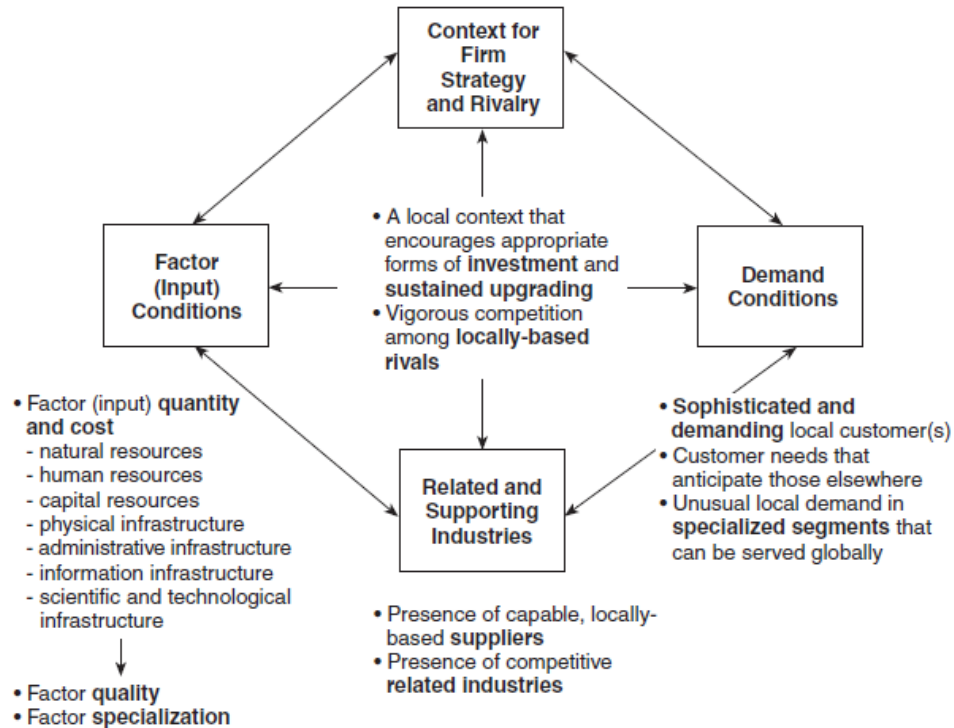


Figure 1 Sources of locational competitive advantage (M. E. Porter, 2008)

M. E. Porter (2008) argued that in many cases the birth of logistics clusters is driven by the strategic location of the region. Besides the geographical position, the establishment of logistics clusters might be caused by various factors as well. Three particular factors that are argued by M. E. Porter (2008) as important factors: intensity local competition which drives rapid improvement and entrepreneurship, the location's entrepreneurship climate, and the effectiveness of organizational and relationship-building mechanisms for bringing clusters members together.

Sheffi (2012) extended the factors that affect the establishment of logistics clusters into six factors. Some of them are natural attributes while others relate to existing conditions in the region and the level of development of the society involved. These six attributes include geographical position, infrastructure, government, education and human capital, collaboration, and value-added services.

Geography of logistics clusters

Geography matters more to logistics clusters than other types of industrial or knowledge clusters. Moreover, the technology and economics of transportation support that. The origins and destinations of goods follow geographic patterns to form population centers, industrial clusters, and indeed logistics clusters. Consequently, physical necessity accommodates the development of clusters. Thus, logistics clusters often form at land-ocean interfaces (such as Shanghai and Rotterdam) or nearby midpoints (such as Singapore and PLAZA). One important thing that logistics clusters require is massive, inexpensive land areas; if there are situations where the land in/near a port is expensive, some clusters may dislocate to inland ports to create new land. Land availability considers region's capability to expand horizontally.

Infrastructure

Logistics clusters should be as good as the transport infrastructure including the local infrastructure within clusters and network connectivity to other clusters, to industry, and to population centers. These utilities require much investment, not only in physical infrastructures but also in maintaining them for a long time. Furthermore, logistics clusters need access to the "soft" infrastructures, such as financial services as well as information and communication technology (ICT) services. These "soft" infrastructure elements are some of the factors that are required at only some basic level of establishment of logistics clusters to support a cluster which starts growing.

Government

Many types of economic clusters and logistics clusters are highly dependent on supportive government. This dependency is due to the government being the main provider of public infrastructure, often also paying to maintain and regulate the use of the major infrastructure assets, such as ports, airports, and roads. Logistics also depends on the cooperative regulation of land-use, infrastructure use, freight operations, and trade. Moreover, competition between logistics clusters to attract tenant and distribution activities means that governments should favor tax regimes. Furthermore, general government characteristics are critical for increasing attractiveness because the features of supporting overall government lead to the social and political stability of a country.

Education and human capital

Expectation to create jobs is a reason government supports economic clusters. Logistics clusters specifically provide a full skills-range job function from warehouse operation, such as picking and packing to work involving expensive equipment and advanced software tools to managerial and executive position. Therefore, successful logistics clusters develop local training programs and support academic institutions in the creation of a qualified worker. However, academic institutions usually follow the establishment of logistics clusters and then support their growth. Most academic institutions are developed through partnerships between local government and industry. In most cases, the type of academic institution that develops in logistics clusters is research and innovation

centers, such as Dinalog in the Netherlands. Higher education and research centers are sources of innovation and technology that result in advanced logistics processes and smarter supply chain concepts. Such innovation and technology then deploy through knowledge spillover mechanisms. Hence, by realizing the advantages of academic institutions, the government should include such institutions in their initial plan rather than develop them first.

Collaboration

Once the factors to cooperate are found in logistics clusters, all stakeholders will create collaboration. While collaboration is essential for any large projects, a significant transportation infrastructure development requires cooperation between the local, regional, and national government in relation to planners, real estate developers, and chambers of commerce. As explained above, the development of educational institutions depends on government funding. Yet, a collaboration between education institutions and private companies is also required. Private companies require adequate workforces, so they can help to define the relevant curricula and to provide living-laboratory data for research. In locations like Fort Worth, Singapore, and Netherlands, there is an excellent collaboration between governments at all levels, academia, industry, and other institutions.

The interaction between stakeholders could be explained by innovation system concept. According to Edquist (2001), the innovation system is defined as all important economic, social, political, organizational, and other factors that influence development, diffusion, and use of the innovation. The establishment of logistics clusters was a result of the active participation of stakeholders in the innovation systems, i.e. government, university, and industry. A framework of the triple helix as mention in paper Etzkowitz & Leydesdorff (2000) is explaining the relations among university, industry, and government. Henceforward, to understand the relationship of the stakeholders on forming the collaboration in logistics clusters, the triple helix model is used. Figure 2 displays the triple helix model that used in this study.

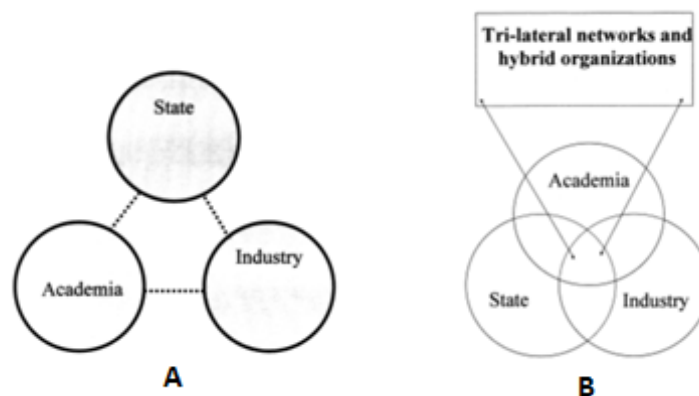


Figure 2 Triple Helix II (A “laissez-faire” model) & B. Triple Helix III model of government/state, industry, and university/academia relations (Etzkowitz & Leydesdorff, 2000)

A. Triple Helix II model consists of separate institutional spheres with strong borders dividing them and highly restrict among them. In this model, the stakeholders worked independently. Meanwhile, B. Triple Helix III model, the relationship amongst institutions in the innovation system of logistics clusters is overlapping, with each taking the role of others in order to realize the same objectives. To promote the rapid establishment of logistics clusters, B. Triple Helix III model is recommended.

Value-added services

Success in attracting value-added services includes transforming, modifying, tagging, sequencing, and repairing goods increases the competitive level of logistics clusters. Thus, it makes it more difficult for tenants of clusters to change locations. Besides providing the core infrastructure and services that support many industries, logistics clusters can also lead to form other types of economic clusters. For example, the logistics clusters in Memphis started around Memphis airport and then attracted life science companies, clean-tech energy, and information technology enterprises. Thus, this element should be planned by the government, but it should not act on (regarding recruiting companies) before the logistics clusters start to operate since value-added service and attractiveness feeds the positive growth of logistics clusters in next level.

In addition to Sheffi's argument, Rivera (2014) suggested that logistics clusters provide specific benefits for companies mostly from opportunities for collaboration and for offering value-added service. Furthermore, the logistics clusters also open more opportunity for employees' mobility and more jobs at a different level. Therefore, to achieve these benefits, many companies considering to locate or relocate with the assumption that logistics clusters provide better infrastructure, accommodative policy, knowledge spillover, and higher efficiency and competitiveness towards the other companies. Thus, companies could reduce their distribution costs and increase customer satisfaction.

Related to geographical position and infrastructure factors, the logistics clusters are indicated to have a relationship to the accessibility. Several kinds of literature regarding the relationship between transport infrastructure investment and spatial economy have been studied. Rietveld (1994) presented that the investment can lead to both negative and positive impacts. The positive impact is acknowledged towards the growth of population and income (GDP). Meanwhile, the negative consequence is regarding environmental degradation. Transport infrastructure investment positively impacts to the spatial development because the improvement of the infrastructure induces companies to change their locations relatively near to each other (Berechman, 1994). More effective accessibility due to reducing congestion as the impact of improvement of transport infrastructure drives the agglomeration firms to maintain the profit level (Berechman, 1994). However, it should be noted that most infrastructure investment would impact the accessibility of the system, which sometimes a distinction is made within the system or with other systems, where there is an important change in the system-wide accessibility, e.g. a new link connecting beforehand disconnect networks (Banister & Berechman, 2001).

Accessibility influences the location decision of companies generally and logistics companies particularly. The location decision of foreign logistics companies in China tends to be determined by the transportation accessibility to the particular region (Hong, 2007). De Bok (2009) underlines how on the location preference of companies, accessibility, and infrastructure quality are significant factors. In the United States, it is shown better accessibility as one of the most important factors on leading companies to make the location decision (M. Porter & Rivkin, 2012). In addition, accessibility also plays a major role in choosing location warehouse, as part of logistics services. Bowen (2008) analyzes that air and highway accessibility has strongly impacted on location decision of warehouse establishment. Better accessibility to a strategic point allows companies to have less stock in their warehouse in order to achieve cost saving in their inventory (Allen et al., 2012). In the logistics industry, better accessibility translates to lower transportation cost and shorter time to the end user (Limao & Venables, 2001).

There is a positive relation between the accessibility and population (Thomas et al. 2003). Population growth in rural is influenced significantly by the improvement of airport and highway accessibility (Chi, 2012). Though, in an urban area, the transport infrastructure development does not result in the significant population changes (Chi, 2012). The region with higher accessibility also attracts more logistics employment that impacts the region population (Van den Heuvel et al., 2014).

The aforementioned literature shows the relationship between accessibility with the factors of the establishment of logistics clusters. Thus, a region with higher accessibility is highly possible to attract logistics companies that lead to agglomeration. **In this study, logistics clusters are defined as the geographical concentration of logistics firms and operations, in which the emergence of this clusters depends on accessibility and quality of transportation infrastructure. The logistics clusters would be expected to develop in the region with higher accessibility that has a high concentration of logistics activities and substantial market size.** This definition serves as the foundation to develop the accessibility measures for the establishment of logistics clusters.

2.3 Accessibility measures for establishment of logistics clusters

This section presents the explanation regarding the accessibility measures generally and which type of accessibility measures will be chosen for the purpose of accessibility measures.

In transportation planning, accessibility is a significant factor on expressing the mobility of passenger, freight, or information (Rodrigue et al., 2011). Well-developed and an efficient transportation system provides a high level of accessibility, and less-developed ones have lower levels of accessibility. Papaioannou & Martinez (2015) defined accessibility as the potential for a user to perform his activities, closely related to land-use location. Meanwhile, Burns (1979) emphasized accessibility as the freedom of individual to decide to participate or not in different activities. In other words, accessibility can be defined and operationalized in several ways. Therefore, several components of accessibility can be identified from the different definitions and practical accessibility measures.

According to Geurs & van Wee (2004), there are four types of components of accessibility: land-use, transportation, temporal, and individual. The land-use component reflects the land-use system, consisting of the distribution opportunities, the demand for these opportunities, and the confrontation of supply and demand for opportunities at each location. For example, jobs, shops, health, and social. The transport component describes the transport system, expressed as disutility for an individual to cover a certain distance using a certain transport mode. It includes the amount of time (travel, waiting, and parking), cost (fixed and variable) and effort. The temporal component reflects the temporal constraints, such as the time available for an individual to participate in particular activities. The individual component refers to the needs (depending on age, income, and educational level), abilities (depending on individual's physical condition and availability of transport modes) and opportunities (depending on individual's income and educational level).

Geurs & van Wee (2004) suggested that accessibility measures should take all of four components from a theoretical point of view. However, in practice, accessibility measures focus on one or more components of accessibility. Several researchers review of accessibility measures yet focusing on certain perspectives, such as location accessibility (Handy & Niemeier, 1997), individual accessibility (Kwan, 1998), or economic benefits of accessibility (Koenig, 1980). There are four basic perspectives on measuring accessibility, including infrastructure-based measures, location-based measures, person-based measures, and utility-based measures.

Infrastructure-based measures analyze the performance level of transport infrastructure, such as 'level of congestion' and 'average travel speed on the road network' and usually used in developing transport planning (Geurs & van Wee, 2004). This kind of measures plays an important role in transport policy related to accessibility because they provide valuable information on the level of services of infrastructure in a region. However, these measures do not consider the land-use component in the region and the impacts of an improved level of services of infrastructure. The location-based measures have the advantages to reflect the efficiency of both land-use and transportation components.

Location-based measures analyze accessibility of location, typically on a macro level, such as 'the number of jobs within 50 minutes travel time from origin locations' (Geurs & van Wee, 2004). Several types of these measures are used in accessibility studies; including distance measures, cumulative opportunities measures, and potential measures. Distance measures are the simplest class of location-based accessibility measures, measuring a distance from one location to different locations. According to Makri & Folkesson (1999), it can be measured as average distance or weighted area distance. Accessibility measures use average distance estimating the average distance to one destination from all origin points in the area or the average distance to all destinations from one origin point. Meanwhile, weighted average distance arranges to include the attractiveness of destination on measuring.

If more than two possible destinations are analyzed, cumulative opportunities could be derived. Cumulative opportunities measures count the number of opportunities that can be reached within a fixed travel time or distance (Geurs & Ritsema van Eck, 2001). The main

disadvantage of these measures is the arbitrary selection of the cut-off value used for a given travel time or distance. Consequently, this method results in the fuzzy outcomes. The potential accessibility measures are used to avoid arbitrary spatial boundary, which uses travel time to weight the opportunities in another region.

The potential accessibility measures (also called gravity-based measures) concept is aimed to describe accessibility to opportunities. These measures define accessibility as the potential opportunities for interaction. On its development, these measures are used in the form of market potential in location analysis (Geurs & Ritsema van Eck, 2001). The potential accessibility measures take into account the accessibility of a given region as a sum of generalized travel costs between origin and destination point, weighted by an attraction term representing the region's opportunities. The weights (W_j) are typically considered the agglomeration effects, whereas the impedance function ($f(c_{ij})$) typically take into account the assumption that the attraction of a destination increases with size and declines with distances or travel time or cost (Papa & Coppola, 2012). By doing so, the potential accessibility measures could include both of the component of accessibility, transportation system captured by the impedance function ($f(c_{ij})$) and the land-use component captured by the weighted (W_j).

The increased computational power of Geographic Information System (GIS) causes the accessibility measurement for individual's travel behavior, such as person-based measures and utility-based measures are proposed. Person-based measures analyze accessibility at the individual levels, such as 'the activities in which an individual can participate at a certain time' (Geurs & van Wee, 2004). Person-based measures are related to space-time measures. Space-time measures are reviewed by Geurs & Ritsema van Eck (2001) focus specifically on time budgets or space path of transport users. Space-time measures examine whether and how users' activities can be performed when the given time restriction is used to describe the travel patterns in space and time.

Utility-based measures analyze the (economic) benefit that individually derives from access to the spatially distributed activities (Geurs & van Wee, 2004). This type of measures is designed to seize the advantages to users from accessibility to opportunities. They can capture these benefits in monetized form as a measure of economic utility (Geurs & Ritsema van Eck, 2001). In addition, utility based-measures should be measures at the individual level, and the computation of individual accessibility should account for user's characteristics, such as income and demographic variables in addition to link transport characteristics, such as speed and travel costs (Banister & Berechman, 2000). A measure is derived from assumptions that individual tend to maximize their utility which means that individual gives each destination a utility value then ranks destinations and chooses the best destination based on utility value. The utility function reflects the attribute of each choice, the attractiveness of the destination, the travel impedance, and socio-economic characteristics (Makri & Folkesson, 1999).

The purpose of accessibility measures in this research is to determine the most optimal accessibility for potential logistic clusters establishment. By considering this purpose, the accessibility measures that used in this study should fit three criteria. First, the accessibility

measures have a consistent spatial boundary and consider both of the component of accessibility, transportation system and the land-use component. Thus, the distance measures and cumulative opportunities measures are not fit to first criteria. Second, the analysis is place-based, which means the measurement is certain to measure the accessibility of a certain location, not of individual people. Third, the accessibility measures are relevant to firms, not individual people. Because person-based measures and utility-based measures are specifically focused on the participation of individual people in certain activities, hence those measures could not be applied in this study. Thereby, this study would apply potential accessibility measures, which assumes that all alternative are available for all individuals and consider not only the transportation component but also a land-use component. This measure has been widely used for analysis of accessibility to different destinations, including as market potential with income or Gross Domestic Regional Product (GDRP) as the destination variable. Potential accessibility measure related to logistics clusters could analyze economic potential to measure region's attractiveness for logistics clusters by taking local income, transport infrastructures, travel cost, and population as a destination variable.

2.4 Chapter conclusion

Literature reviews suggest that logistics clusters are the geographical concentration of logistics activities. The concept of logistics cluster is related close to industry or other economy clusters. They have the same characteristics, including increasing firms' productivity, stimulate the transfer knowledge and tacit knowledge, the presence of institution for developing the quality of human resources, and high level of trust and social capital. However, logistics clusters have different characteristics in terms of the establishment of clusters. The establishment of logistic clusters is mainly depending on geographical position and quality of transportation of service in the region. Thus, the role of government is crucial in driving the initiation of clusters as the quality of transportation depends on government's investment to develop infrastructures.

Taking into account the effect of location on competition, the logistics clusters could be structured into four components, 1) cluster core consist of logistics service, transportation service, and logistics operators, 2) related industries, 3) supporting industries, 4) key organizations which significantly accelerate the deployment of logistics clusters. The logistics cluster-structured based on cluster map structure in (M. E. Porter, 2008) as mentioned in Section 2.2 could be depicted in Figure 3. This framework would be applied in analyzing the potential logistics cluster components in the selected regions. This structure integrates four components of logistics clusters.

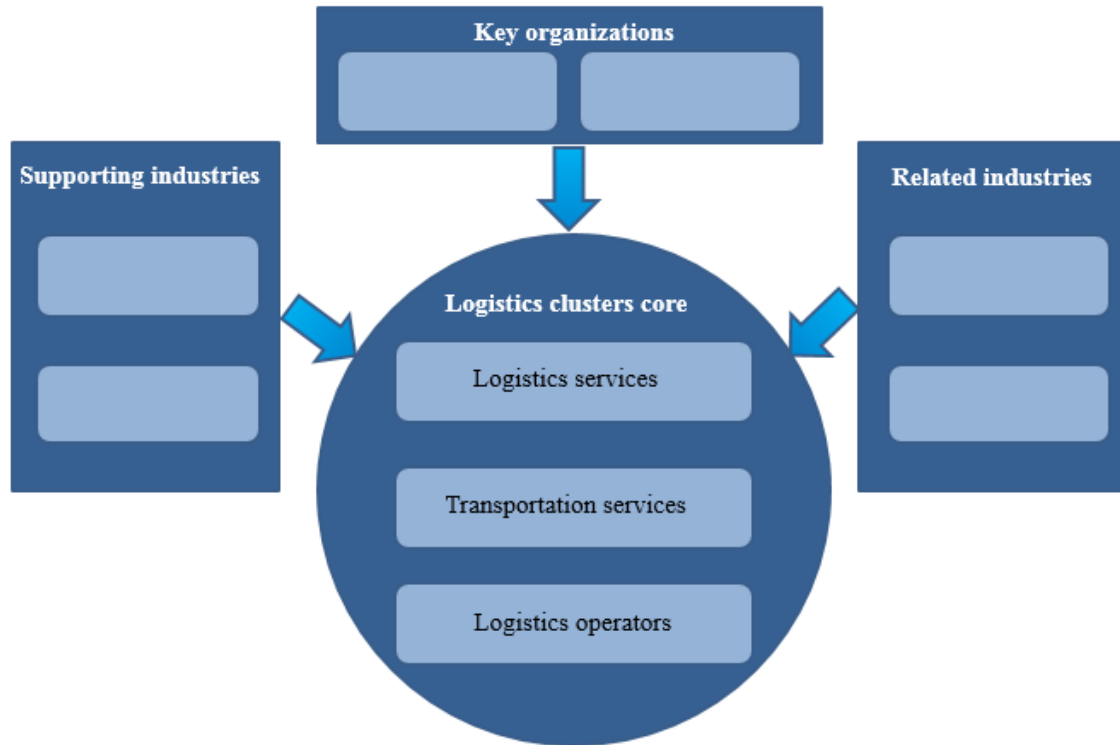


Figure 3 Framework of logistics clusters

There are six factors that contribute establishing the successful logistics clusters, i.e. geographical position; infrastructure; government; education and human capital; collaboration; value-added services. Those critical factors would be used to analyze the most potential location for establishing logistics clusters in Indonesia. Specifically for the first and second factor, i.e. geographical position and infrastructure, the potential accessibility measures would be applied to determine the strategic location. The potential accessibility measures were selected because these measures have a certain spatial boundary, consider both of transport and land-use component, and assume the alternative are available for all individuals. Since this study defines logistics clusters as the geographical concentration of logistics firms and operations, in which the emergence of this clusters depends on accessibility and quality of transportation infrastructure. The logistics clusters would be expected to establish in the region with higher accessibility that has a high concentration of logistics activities and substantial market size.

Therefore, the way the logistics cluster should be established could be prioritized. Figure 4 presents the structure of critical factors for the establishing of a logistics clusters. The structure is divided into three parts:

1. The foundation constructed by location and government commitment, which represents the precondition for establishing a logistics cluster.
2. The pillars conceiving human resources (education, research, and innovation), infrastructure, and collaboration of stakeholder, which represent compulsory processes.

3. The capstone formed by the ability to provide value-added services, which represent affirmation factors that guarantee the successful establishment of the logistics clusters.

The top in Figure 4 represents the successful establishment of a logistics clusters.

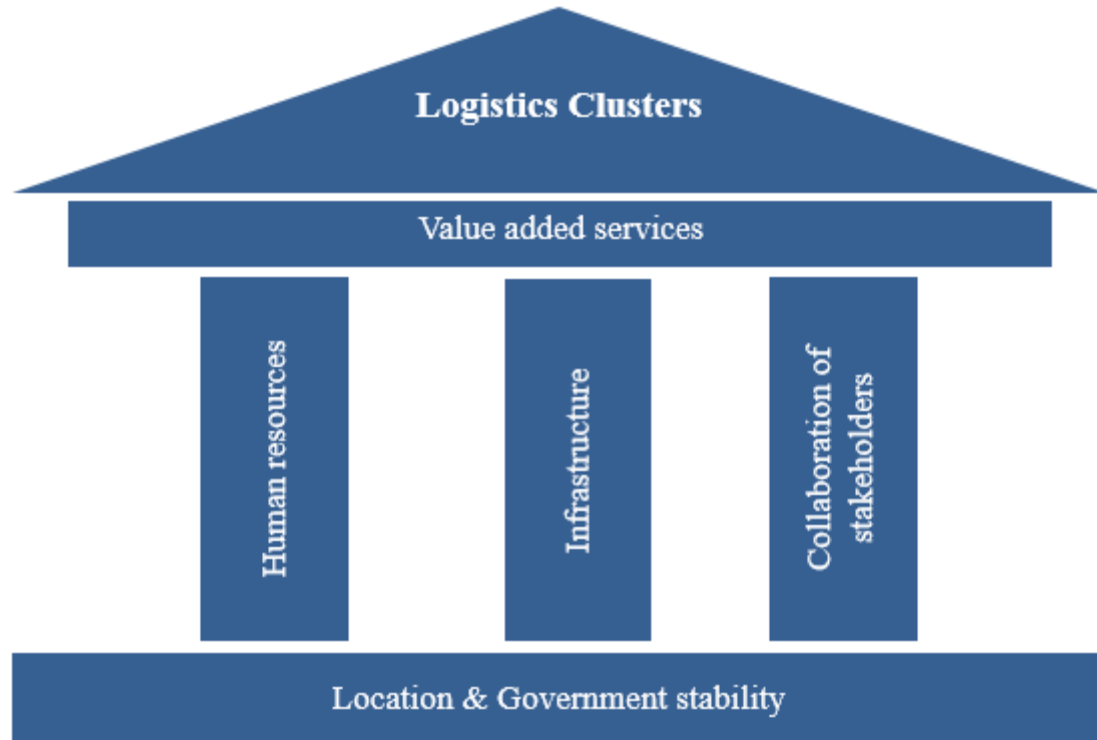


Figure 4 The structure of critical factors for establishing of a logistics clusters (Mufnoz & Rivera, 2010), adjusted)

3

Logistics Indonesia: an overview

Outline

The purpose of this chapter is to analyze the current situation of Indonesia's socio-economic and general overview of logistics Indonesia as substantial inputs to analyze the opportunities for establishment of logistics clusters in Indonesia. Then, it could be considered in the scenario of the accessibility measure. Section 3.1 discusses Indonesia's socio-economic development, which describes the potential economic and the problem that Indonesia faces presently regarding imbalance development progress between western and eastern Indonesia. Then Section 3.2 presents the current state of logistics Indonesia include the logistics performance compared to another country in the world, the condition of transportation infrastructure, and then current strategy on multimodal transport by the government to create efficiency transportation system in Indonesia. Section 3.3 introduces the future planning of the Indonesian government to improve the economic performance generally and the logistics performance specifically by implementing the "maritime highway" policy which is expected to create the balance of using different transportation modes. Therefore, it could improve the multimodal transportation network. Finally, Section 3.4 concludes the important factor in developing methodology and assumption were used in this research.

3.1 Indonesia's socio-economic development

In the last five years, Indonesia's economic grew moderately by average GDP growth rate 5.5%, showing a positive trend of GDP growth. However, overall 2015 GDP growth declined to 4.8%, from 5.0% in 2014, affected by external conditions, such as persistently low commodity prices globally, and weaker purchasing weighed on global trade (The World Bank, 2016a). Table 3 shows the overall Indonesia's socio-economic development period 2011-2015 as reported by various sources.

Table 3 Indonesia's socio-economic development performance

Key Indicators	Units	2011	2012	2013	2014	2015
Population	Millions	244.8	248.0	251.3	254.5	255.5 ¹
Population growth rate	%	1.3	1.3	1.3	1.3	1.4 ²
GDP growth rate	%	6.2	6.0	5.6	5.0	4.8
Unemployment rate	%	7.5	6.1	6.2	5.9	6.2
Poverty headcount ratio at national poverty lines	% of population	12.5	12.0	11.4	11.3	11.2
Human development index	HDI	67.09	67.70	68.31	68.90	69.55

Sources: (BPS, 2016), (The World Bank, 2016b), (ADB, 2016), (UNDP, 2015)

Based on the population projection of 2015, the number of population is about 255 million, with average population growth rate 1.3%. In 2015, the estimation by Statistics Indonesia (*Badan Pusat Statistik*, BPS) showed poverty rates of 11.2%, 0.1 percentage points lower than a year earlier. Since 2011, the incidence of poverty has decreased by an average of 0.3% per year. The slowing poverty reduction could be attributed to moderate economic growth and impacts to slower job creation. It showed an increase of 0.3 unemployment rate in 2015, compared to rate 5.9 in 2014. The HDI (an indicator of basic human development achievement) indicates stable in the last three years by around 68.

Indonesia has approximately 17,504 islands. The total land area is 1,910,931 km² and the total ocean area is 3,257,483 km². Indonesia has 5 biggest islands: Java (129,438 km²), Sumatera (480,793 km²), Kalimantan (544,150 km²), Sulawesi (188,522 km²), and Papua (416,060 km²) (BPS, 2016); with Daerah Khusus Ibukota (DKI) Jakarta is a capital city of Indonesia. Since April 2013, Indonesia was divided into 34 provinces, with Kalimantan Utara has been established as the newest provinces. However, in this study, because the data limitation, only 33 provinces would be analyzed, with Kalimantan Utara treated as part of Kalimantan Timur. The important thing is Indonesia lies in a strategic position between Indian and Pacific oceans and between Asia and Australia continents. Therefore, it is appropriate if Indonesia is labeled as the biggest archipelagic country which has

¹ Indonesia's population projection

² The result of Indonesia's population projection in 2010-2035 (in the middle of year/June)

favorable geography for their economic development and also inevitably presents certain logistics and economic development challenges.

Even though the GDP growth rate can be considered to be positive, Indonesia is still facing a problem in imbalance development progress. National development which centralized in the capital city, Jakarta, and regions in Java islands has caused slow development growth in areas outside Java. The centralized of economic activities in Java also drives inevitably fast growing population number in Java. Java has 57% of the population with only 7% of total area. Uneven distribution of the population directly affects the infrastructure and household demand. The high demand in Java impacts to better development infrastructure in Java regions. Furthermore, the development in Java has positive effects on the development of infrastructure in areas around Java. The development in the west region of Indonesia, including Sumatera, Kalimantan, and Bali islands has better progress than east regions, including Sulawesi, Papua, Maluku, and Nusa Tenggara.

The imbalance development progress is also shown by Gross Domestic Regional Product (GDRP) and poverty level. The distribution of poverty level in Indonesia indicates that the percentage of inhabitants in the east region who live under the poverty line is more than the percentage in the west region. On the other hand, the GDRP of provinces in Java Islands is much higher than in other regions. However, it should be noted that there are some provinces outside Java Island that have high GDRP per capita (more than GDRP per capita for overall Indonesia), such as Riau, Kepulauan Riau, Kalimantan Timur, and Papua Barat. These regions have bigger GDRP per capita since they have the competitive advantages to another region, including natural resources (e.g. oil, gas, and coal), oil-palm and tourism to drive their regional income. Table 4 shows the list of provinces in Indonesia and each socio-economic performance in 2014.

The unique geographical nature of Indonesia and the disproportionate distribution of population and economic activities put a significant challenge in developing infrastructure and resolving the regional disparities. Insufficiency of infrastructure has hampered the development of national and regional economic potentials. The efficient logistics system is a crucial factor in the socio-economic development of Indonesia. Developing an efficient logistics system would increase export, reduce regional discrepancy, provide better access to the commodities on the domestic market, and then lead to enhance the competitiveness of Indonesia's internal and external trade.

Table 4 Provinces in Indonesia and their socio-economic performances 2014

No	Province	Population density (people/km ²)	Dist. of Poverty Level (%)	GDRP (Billion Rp)	GDRP per capita (Thousand Rp)
1	Aceh	85	19.57	113,836	23,199
2	Sumatera Utara	189	11.33	419,649	30,483
3	Sumatera Barat	122	9.04	133,240	25,963
4	Riau	71	8.47	447,616	72,331
5	Jambi	67	8.65	120,696	36,089
6	Sumatera Selatan	87	14.24	243,229	30,628
7	Bengkulu	93	17.50	36,216	19,631
8	Lampung	232	16.93	189,809	23,649
9	Kep. Babel	82	5.75	44,172	32,869
10	Kep. Riau	234	7.40	147,168	76,753
11	DKI Jakarta	15,173	3.75	1,374,349	136,408
12	Jawa Barat	1,301	10.65	1,148,949	24,961
13	Banten	1,211	6.32	766,272	29,962
14	Jawa Tengah	1,022	15.78	79,557	22,858
15	DI Yogyakarta	1,161	16.06	1,262,700	21,874
16	Jawa Timur	808	14.23	350,700	32,704
17	Bali	710	4.20	121,778	29,666
18	NTB	257	19.73	73,285	15,352
19	NTT	103	21.23	54,108	10,742
20	Kalimantan Barat	32	8.60	107,092	22,708
21	Kalimantan Tengah	16	6.56	73,735	30,221
22	Kalimantan Selatan	101	5.29	106,821	27,231
23	Kalimantan Timur	20	6.77	492,178	120,970
24	Sulawesi Utara	172	8.51	66,359	27,805
25	Sulawesi Tengah	46	15.83	71,678	25,316
26	Sulawesi Selatan	180	10.29	234,084	27,761
27	Sulawesi Tenggara	64	14.56	68,299	27,899
28	Gorontalo	99	18.75	20,781	18,627
29	Sulawesi Barat	75	13.89	24,169	19,211
30	Maluku	35	23.00	23,585	14,230
31	Maluku Utara	36	9.18	19,212	16,872
32	Papua Barat	9	31.92	50,272	59,157
33	Papua	10	31.98	120,217	38,892
	INDONESIA	132	12.49	8,605,810	34,128

Source: (BPS, 2016)

3.2 Current state of Logistics Indonesia

3.2.1 Logistics performance

The World Bank's Logistics Performance Index (LPI) as shown in **Error! Reference source not found.** revealed that Indonesia is ranked 53rd out of 160 countries. The Indonesia ranked increased from rank 59th in 2012. However, it was lower than some SEA (South East Asia) countries, i.e. Singapore, Malaysia, Thailand, and Vietnam. LPI scored by logistics indicator of 2014 are presented in Table 5 shows that port sectors, including custom, infrastructure, and international shipment have the biggest contribution on lower LPI in 2014 as their score was much lower that average rating of SEA countries.

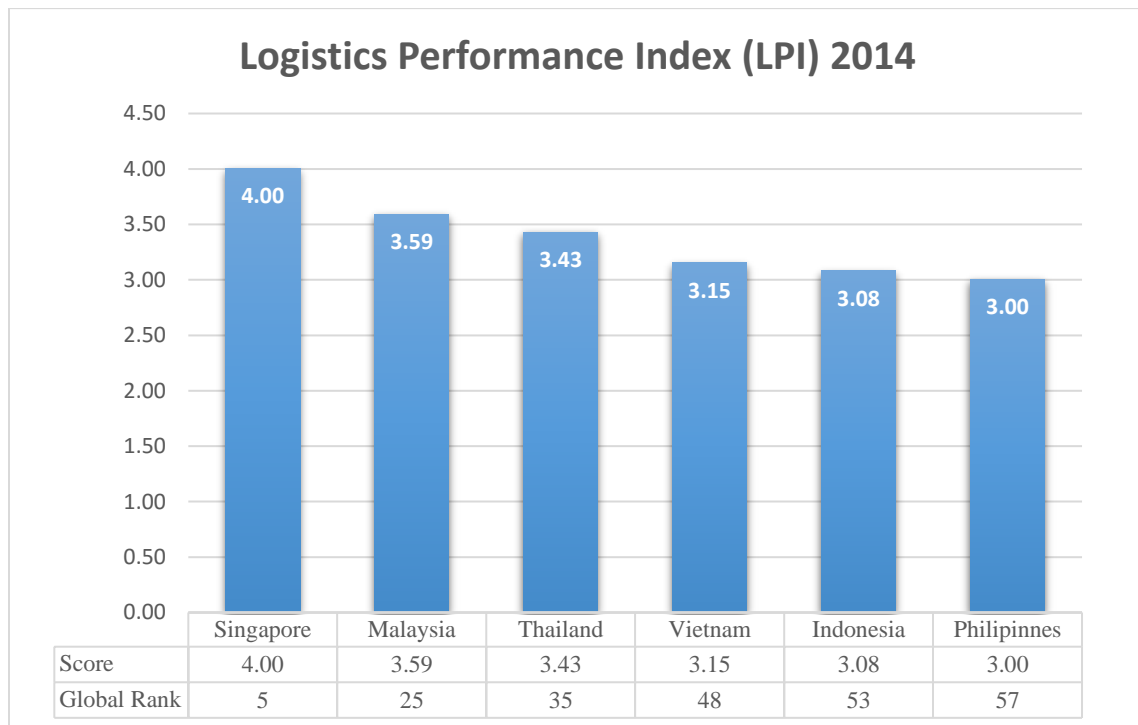


Figure 5 Indonesia's Logistics Performance Index (LPI) 2014 (The World Bank, 2016c)

Table 5 Indonesia's LPI by logistics indicator 2014

Logistics indicator	Score	Global rank	vs. SEA average
Custom	2.87	55	-0.34
Infrastructure	2.92	56	-0.39
International shipment	2.87	74	-0.47
Logistics quality and competence	3.21	41	-0.12
Tracking and tracing	3.11	58	-0.26
Timeliness	3.53	50	-0.17

Source: (The World Bank, 2016c)

It was revealed that the high logistics costs are considered to be one of the main factors behind Indonesia's ranking surveyed by World Bank LPI. According to report "State of Logistics 2015" by World Bank, Indonesia's logistics costs in 2014 were 23.5% of GDP (van der Baan et al., 2015). Compared to another country, logistics cost in Indonesia in 2013, at 27% of GDP is higher than regional peers, Vietnam (25% of GDP), Thailand (20% of GDP), and Malaysia (13% of GDP) (Meeuws et al., 2013). Eventually, the numbers for the United States and Singapore were far lower, at 8% and 9.9%, respectively (Meeuws et al., 2013).

Recent World Bank survey of logistics cost in manufacturing companies in five big cities in Indonesia, i.e. Jakarta, Surabaya, Semarang, Palembang, and Makassar, suggested that the average total logistics cost is 20% of sales can be broken down as follows: 17% logistics administration, 26% inventory, 17% warehousing, and 40% percent transport and cargo handling (The World Bank, 2016a). In the period of 2007-2011, transportation costs also regarded as the biggest contributor (12% of GDP) to the national logistics costs. The logistics administration contributes the lowest by 4% of GDP. The estimation of Indonesia's logistics costs is rather stable along period 2007-2011 around 24% - 25% as shown in Table 6.

Table 6 Estimation of Indonesia's logistics costs 2007-2011

	2007	2008	2009	2010	2011
GDP (Billion Rupiahs)	3,950,893	4,948,688	5,606,203	6,436,270	7,427,086
Logistics costs (Billion Rupiahs)	1,016,611	1,238,410	1,397,267	1,543,793	1,829,669
Logistics costs (%)	25.73	25.03	24.92	23.99	24.64

Source: (Meeuws et al., 2013)

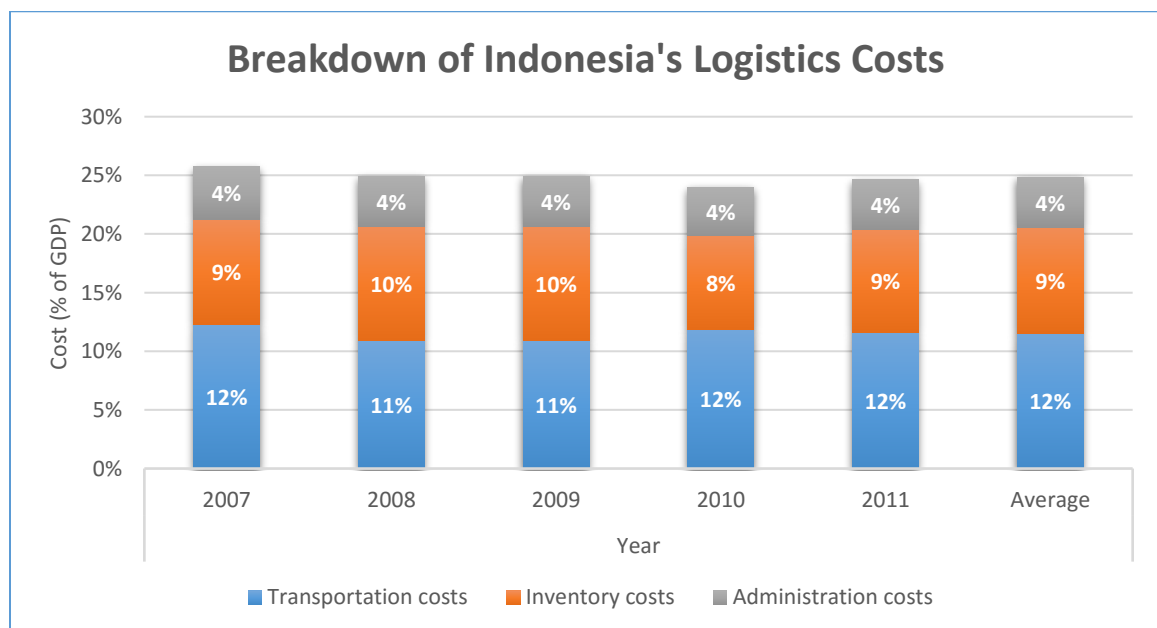


Figure 6 Breakdown of Indonesia's logistics cost for each component (Meeuws et al., 2013)

High logistics costs in Indonesia reflects the uncertainty in the supply chain. Manufacturers simply could not forecast when their input or output products will arrive due to uncertainty in port handling, road transport, and paperwork. This uncertainty forces manufacturers to keep inventories high to avoid production delays and out-of-stock that can reduce their sales. High inventories lead to increase overall logistics costs. Low productivity of assets correlates to high logistics in Indonesia. Most logistics assets, such as truck, warehouses, inventory are deficient utilize and hence unproductive.

Poor utilization of logistics assets is aggravated by long and fragmented supply chain to eastern Indonesia. A shipment from Java to eastern Indonesia makes stops at two ports, and the goods are at least three times unloaded and loaded before arriving at the destination (The World Bank, 2016a). In Indonesia's supply chain, there is also the imbalance in using different transportation modes. The transportation costs were dominated by hinterland transportation cost (72.99%). For shipment to eastern Indonesia, these transportation modes are inefficient in terms of handling, time, and warranting goods arrive in good condition, further increasing costs. Furthermore, such fragmented supply chain to eastern Indonesia makes it challenging for backhaul problem, where 70% containers are empty in returning to Java or Sumatera (The World Bank, 2016a). It makes it harder to provide cost efficient logistics. Thus, it is no surprise that the commodities prices in eastern Indonesia are much higher compared to western Indonesia. The price disparities in Indonesia and higher freight transportation costs become a higher priority for the Indonesian government.

Table 7 Breakdown of transportation cost

Year	Land	Water	Air	Rail	Services
2007	75.63%	16.99%	0.85%	0.43%	6.11%
2008	78.13%	14.81%	1.58%	0.41%	5.07%
2009	69.51%	22.59%	1.78%	0.58%	5.54%
2010	70.96%	22.01%	2.31%	0.46%	4.26%
2011	70.70%	22.04%	2.70%	0.51%	4.06%
Average	72.99%	19.69%	1.84%	0.48%	5.01%

Source: (Meeuws et al., 2013)

Trucking is one of land transport modes which is the preferred mode for transportation within Java and between Java and Sumatera, which is multi modes with ferryboat to pass through Sunda Strait, given the fact that roadway mode is cheaper to 30-40%. The companies consider the criteria of both flexibility and lead time in choosing their modes of transportation. As a comparison within the Java, the ratio of price in transporting a 20ft container was 1 (sea): 1.71 (railway): 2.14 (roadway)³. Although the sea and railway mode is cheaper than the road, trucking has a much

³ Based on the price (Rupiah) per TEU in 2010, 3.500.000 for sea mode and 7.500.000 for roadway mode (Sinaga, 2010), After the adjustment with inflation, the price (Rupiah) per TEU for railway in 2010 is 6.000.000 (Nurhayat, 2014)

better lead time for 1-2 days, compare to 3-4 days for railway and 7-8 days for sea mode (Sinaga, 2010). Moreover, the capacity of trucking is nearly unlimited. The capacity is only restricted by road congestion near the port, and their service is very frequent and flexible. Meanwhile, the railway and sea mode have constrained both capacity and service frequency. In the rail case, the rail within Java is serving for both passenger and freight. However, the passenger has higher priority. Transport service of rail is more regular to service of sea mode. There is 2-5 freight carrying trains every day. In the sea mode case, feeder service between the two biggest ports in Java (Tanjung Perak and Tanjung Priok) is limited. Then, the service is infrequent in both of ports.

The high dependency of logistics sectors on land transport causes high road charges and infrastructure-related costs. Infrastructure costs are high due to the condition of secondary, arterial roads. With only 57% of the total road length is paved, driving up the maintenance costs for vehicles, particularly trucks carrying high loads (BPS, 2016). Compared to peer regional, 98.5% of Thai roads are paved, and 80.8% of Malaysian road are paved (Sudjana & Hergesell, 2008). Then, it leads also to high logistics costs. It should be noted as well, based on a finding by The Asia Foundation (Sudjana & Hergesell, 2008), the transportation costs in Indonesia also significantly influenced by the cost of illegal and legal charges. On the moving goods process, drivers are liable for various types of payments, such as local user fees, legal and illegal charges at weight bridges, and payments to police or *preman* (criminal organizations) (Sudjana & Hergesell, 2008).

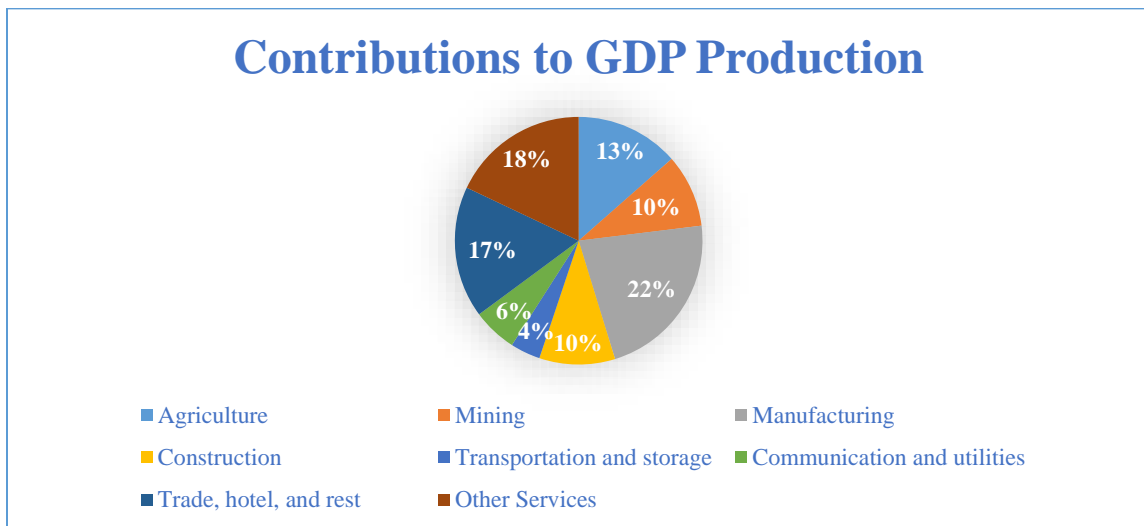


Figure 7 Contribution main sector industry to GDP 2014 (BPS, 2016)

At the same time, transportation and logistics sector in Indonesia continue to expand. As retail becomes more organized and e-commerce is developing significantly as lifestyles change and per capita income increase, the logistics industry is possible to grow. In 2014, the logistics sectors contributed 4% of Indonesia's GDP and expected to continue to grow as the impact of higher trade growth, lower oil and gas price, and infrastructure development by Indonesian Government. Despite the bottlenecks, Frost & Sullivan (2015) expected the transport and logistics market to growth by compound annual growth rate (CAGR) of 15.2% in 2015. The total freight is expected

over 1.1 Billion tons by 2015 with CAGR of 5.4% between 2010 and 2015 while sea freight is projected to grow 5.1% by end 2015 (Frost & Sullivan, 2015).

Furthermore, Indonesian Government is taking seriously the position of logistics system as a strategic role in synchronizing and harmonizing economic progress across sectors and regions in order to realize the inclusive economic growth. Therefore, to achieve the goal of GDP per capita at 14,250-15,500 USD in 2025, National Logistics System (*Sistem Logistik Nasional, Sislognas*) is expected to play an important role to support the implementation of Masterplan Economic Development Acceleration and Expansion of Indonesia (*Masterplan Percepatan and Perluasan Pembangunan Ekonomi Indonesia, MP3EI*) 2011-2025 as stated in Presidential Regulation No.32/2011 (KP3EI, 2016).

3.2.2 Transport infrastructures

All transport modes play a role in Indonesian transportation system and are complementary rather than competitive. Road transport is the predominant mode, dominating about 70% of freight ton-km. Although Indonesia has five biggest islands, however, railway network is only available in Java and Sumatera islands. There are four unconnected railway networks in both of islands which are dedicated substantially to transport bulk commodities and long-distance passenger freight. As a maritime country, sea transport is significantly necessary for integration and foreign (export and import) and domestic trade. In contrast, maritime transport in Indonesia is well developed. Each of the major islands has, at least, one important seaport city. Considering inland waterways in Indonesia's transportation, the role of them is relatively minor and is limited to specific areas of Kalimantan and Eastern Sumatera. These were originally used for long-haul transport, and most of the terminals in inland waterway system are operated and owned by private sectors. Finally, air transport is essential, especially when land or water transport is deficient and well-established ("Transport in Indonesia," 2016). The detail of transport infrastructure in Indonesia presents in Table 8.

Table 8 Transport Infrastructures in Indonesia

Transport Infrastructure	Overview
Roadway	The total length of roads in 2014 is about 517,663 km, out of which, 7% is under the state responsibility, 10% under the provincial responsibility and the rest 80% under district responsibility. Of the total road length, 57% is paved. The national road network is in good condition with 95% paved and 81% in good and fair condition. The provincial road network is also in right or fair condition.
Railway	Indonesia has four independent railways system, one in Java and three in Sumatera. The total length of track railways is 5,040 km of which Java is 3,700 km. The rail network is made of 1,067 mm gauge and mostly single tracked type. The electric rail network is only in some section in the Jakarta metropolitan. The total fleet consists of 468 locomotives and due to insufficient maintenance and lack spare parts, the availability and reliability performance is low.
Inland Waterway	There is more than 10,000 km of navigable waterways among 50 river systems, mostly are in Sumatera and Kalimantan. Some infrastructure improvements have been carried out, such as the construction of new harbors. However, because of the high seasonal variation in the water level, without further investments, the role of inland waterways is still relatively minor.
Sea mode	Indonesia has 300 open ports deployed over the archipelago, consist of 43 international port, and the rest are a feeder and serving inter-island. There are 15 larger ports. Four of them (Jakarta, Surabaya, Belawan, and Ujung Pandang) handle most of the foreign trade.
Air mode	Air transport is significantly increasing, particularly for the passenger. There were 23 scheduled airlines operating and 37 permits issued in 2004. Air transports are growing rapidly because air travel is the quickest way to get the country's thousands of islands.

Sources: ("Transport in Indonesia," 2016), (BPS, 2016)

There are two types of inter-islands shipping services: ferry and shipping services. Ferry are serviced for a relatively short distance and use a vessel that transfers a mix of the passenger, car, and trucks. In 2010, Indonesia had 172 of quays of ferry transport (Indonesia Ministry of Transportation, 2011). Meanwhile, shipping services are offered on long distance trip and are mostly dedicated to cargo services.

The Directorate of Sea Transportation divides the port into two types: public ports and special ports. Public ports are defined as ports that offer services to passenger and freight transport. This kind of ports is owned by the central government and state-owned companies (*Badan Usaha Milik Negara*, BUMN), which is under the management of Indonesia Port Corporation (*Pelabuhan*

Indonesia, Pelindo) I-IV. The central government handles the local port and not transit ports, whereas Pelindo I-IV manages the administration of the commercial and privatized ports. The existing data reveals that the total of public ports are 473, and the total of special ports are 87 (Indonesia Ministry of Transportation, 2011). Table 9 shows the current composition of the seaport ownership

Table 9 Composition of the seaport ownership

Seaport's Operator	Seaport Class						Non-Class	Total
	Primary	I	II	III	IV	V		
Pelindo I	1	1	1	3	4	11	5	26
Pelindo II	1	5	1	3	1	8	10	29
Pelindo III	1	5	6	3	3	0	19	37
Pelindo IV	1	5	5	5	4	7	3	30
Directorate of Sea Transportation	0	1	0	6	20	161	346	534

Source: (Indonesia Ministry of Transportation, 2011)

Airports functions as the interconnection and as transfer points for both of passenger and goods intra and inter-modes. Even in the recent days, airports have functioned not only as a terminal but also as integrated business centers to the international scope. The airports are classified into five classes. The current data of Directorate of Air Transportation shows 297 airports are consisting of 24 first-class airports, 19 second-class airports, 118 third-class airports, 2 fourth-class airports, and 1 fifth-class airport (Directorate General of Civil Aviation, 2016).

3.2.3 Strategy on multimodal transport

Inefficiency in distribution transportation modes causes a high cost and operating time in the transportation system. The dominated road modes are mostly serving route inside Java and Sumatera. The strong economic growth of the two islands drives highly concentrated goods movement in both regions. Meanwhile, for inter-islands movement, sea modes contribute a little share of transportation. The transportation cost for sea modes at one-fourth of land transportation costs. Moreover, the increase free trade areas, which indicated by the development of WTO and AFTA, demands an efficient national logistics system. Multimodal transport is the answer to keeping the transportation cost at a minimum rate without sacrificing the service level.

Multimodal transport in Indonesia is a strategy to improve the competitiveness of Indonesia's trade in the global market and to function as an instrument for national integration. Transportation systems with various modes can be viewed from two different conceptual perspectives, i.e. intermodal transportation network and multimodal transportation network. According to Rodrigue et al. (2011), the intermodal network is a logistics system which is connected to two or more modes, and each mode has a service characteristic which enables cargo to move to another existing mode in one trip point-to-point connection. Whereas multimodal network is a set of transport modes which provide a point-to-point connection. For the efficiency of the national

transportation, the multimodal transportation network would be developed based on the intermodal transport.

Strengthening of national connectivity is one of the main pillar strategies of the acceleration and expansion of Indonesia's economic development. National connectivity is the integration of four elements of national policy, including national logistics system (Sislognas), the national transportation system (Sistranas), the development of region (RJPMN), and information and communication technology (ICT). National connectivity is a part of global connectivity. Thus, the manifestation of the strengthening of national connectivity must consider the connectedness Indonesia with the regional and global economic center. According to Sistranas, multimodal transportation is defined as transportation of passengers and/or goods using more than one mode of transport in one continuous journey to create one-stop services, single ticket for passenger transport and singles seamless service (3S): single operator, single tariff, and single document for freight transport (Indonesia Ministry of Transportation, 2015).

In the Sistranas, multimodal transportation plays a role as the main driver of all logistics activities and freight in Indonesia to ensure the availability of goods at the affordable prices and stables as well as low discrepancy among region throughout Indonesia. However, according to finding of research and development body of Indonesia Ministry of Transportation, the integration of the transport network infrastructure, such as port, terminal, airport, and schedule setting and services network in Indonesia is still not satisfactory (Indonesia Ministry of Transportation, 2015). Evaluation of the current implementation of multimodal transportation indicates that the development of service network tends to be unimodal and the integration of routes to create 3S is not optimal.

Based on the result of a study by the Institute for Research and Community Services of Bandung Institute of Technology (LPPM-ITB) (Lubis et al., 2005), the recommendation of the multimodal transportation system, which is based on the modes' comparative advantages is shown in Table 10 and Table 11. The strategy of development of freight transportation suggested based on the goods characteristics, the modes characteristics, and the distance. The railways are better for a large capacity container and long distance trip. Meanwhile, airplanes are superior in speed; thus, are recommended for the transportation of perishables goods. In this study, by taking into account the recommendation for freight transport of a small container, large container, and dry bulk, the multimodal transport that considers on the study of the establishment of logistics clusters in Indonesia is roadway mode and sea mode for the long-distance and inter-islands trip.

Table 10 Idealization for the intra-islands freight transportation network

	Roadway	Railway	Air mode
Short-distance trip			
Postal and goods with small loads	+++	+	+
Fresh goods	+++	+	+++
Small container	+++	+++	+
Large container	++	++++	+
Dry bulk	+	++++	+
Medium-distance trip			
Postal and goods with small loads	++	+++	+++
Fresh goods	+++	++	++++
Small container	+++	+++	+
Large container	+++	++++	+
Dry bulk	+	++++	+

Note: ++++ highly recommended, +++ recommended, ++ less recommended, + not recommended

Source: (Lubis et al., 2005)

Table 11 Idealization for the intra-islands long distance and inter-islands freight transportation network

	Roadway	Railway	Air mode	Sea mode
Postal and goods with small loads	+	+++	++++	+
Fresh goods	+	+	++++	+
Small container	++	++++	+	+++
Large container	+	++++	+	+++
Dry bulk	+	++++	+	+++

Note: ++++ highly recommended, +++ recommended, ++ less recommended, + not recommended

Source: (Lubis et al., 2005)

3.3 Logistics Indonesia in the future

Based on data from Indonesia Ministry of Planning, National GDP is projected to grow 7% in average for the period of 2015-2019. It is mainly supported by manufacturing industry which predicts to rise by 7.4% in average for the same period (Indonesia Ministry of National Development Planning, 2014). Table 12 shows the projection for GDP growth and industrial growth for a period of 2015-2019. The growth projection would be achieved under the assumption that the government completes the implementation of infrastructure development planning, including increase capacity of transportation facilities and infrastructure and integration of multimodal transport system to reduce backlog and bottleneck of facility and infrastructure capacity. Indonesian government allocated USD 55.4 Billion to develop 24 commercial ports, over 1,481 non-commercial ports and the procurement between 2015-2019 as part of a modern transport

system, known as “maritime highways” (van der Baan et al., 2015). This new freight transport system is expected to create the balance of using different transportation modes. Therefore, it could improve the multimodal transportation network. Furthermore, the Indonesian government also tries to accelerate the economic growth in eastern Indonesia by this infrastructure expansion.

Table 12 Projection Indonesia's national GDP and industrial sector growth for period 2015-2019

Growth	Projection for 2015-2019					
	2015	2016	2017	2018	2019	Average
National GDP	5.8	6.6	7.1	7.5	8	7
Industrial sector (non-oil and gas)	6.1	6.9	7.4	8.1	8.6	7.4

Source: (Indonesia Ministry of National Development Planning, 2014)

The national mid-term development plan (*Rencana Pembangunan Jangka Menengah Nasional*, RPJMN 2015-2019) is targeted to reduce logistics costs at 19.2% of the GDP in 2019 by the integrated program of the Indonesian government. The integration of transportation master plan, including transportation acts (Act no.33/2004 on road, Act no. 22/2009 on traffic and road transport, Act no. 23/2008 on railways, Act no.17/2009 on shipping, Act no. 1/2009 on aviation), spatial acts (national, islands, province, and district spatial plan), transportation level (national, regional, and local transportation level), transportation modes (blue print of roads, railways, shipping, and aviation), and institution is needed for the improvement multimodal. The improvement of logistics performance is expected to be the solution for higher freight transportation costs and price disparities in Indonesia.

3.3.1 Maritime Highway Policy

Maritime highway policy is defined as an effective maritime connectivity with routine and scheduled ship from west to east Indonesia and vice versa (Indonesia Ministry of Development Planning, 2015). This policy covers planning to improve maritime connectivity for both people and freight transportation. In regards to freight transportation, the ministry (Indonesia Ministry of Development Planning, 2015) broken down “maritime highway” policy into five main elements: (1) reliable ports, (2) sufficient load from west to east and vice versa, (3) effectiveness of supporting inland transportation, (4) routing and schedule freight shipping, and (5) sufficient number of shipping industry.

The main objective of “maritime highway” policy is to ensure the presence of maritime network which serves the main route to connect hub ports in west and east Indonesia continuously as well as to reduce freight transportation costs and price disparities in Indonesia (Indonesia Ministry of Development Planning, 2015). In this planning, the main route is developed as pendulum route, where there is a central market in main routes. The hub ports will be located at the main routes, and there are feeder routes that connect the hub port to another feeder ports. In the initial plan, 24 ports have been analyzed and identified as strategic ports. Furthermore, 50 new ships procurement, 83 commercial small ports, and 1,481 non-commercial ports are also included in “maritime highway” policy. The detail location and role of 24 strategies ports are denoted in Table 13.

Table 13 The 24 strategic ports in Indonesia's "maritime highway" policy

Ports	City	Provinces	Role
Malahayati	Banda Aceh	Aceh	Feeder
Belawan	Medan	Sumatera Utara	Hub
Kuala Tanjung	Kuala Tanjung	Sumatera Utara	Hub (international)
Teluk Bayur	Padang	Sumatera Barat	Feeder
Batu Ampar	Batam	Kepulauan Riau	Feeder
Jambi	Jambi	Jambi	Feeder
Palembang	Palembang	Sumatera Selatan	Feeder
Panjang	Bandar Lampung	Lampung	Feeder
Tanjung Priok	Jakarta	DKI Jakarta	Hub
Tanjung Emas	Semarang	Jawa Tengah	Feeder
Tanjung Perak	Surabaya	Jawa Timur	Hub
Pontianak	Pontianak	Kalimantan Barat	Feeder
Sampit	Palangkaraya	Kalimantan Tengah	Feeder
Kariangau	Balikpapan	Kalimantan Timur	Feeder
Palaran	Samarinda	Kalimantan Timur	Feeder
Tenau Kupang	Kupang	NTT	Feeder
Makassar	Makassar	Sulawesi Selatan	Hub
Pantoloan	Palu	Sulawesi Tengah	Feeder
Bitung	Manado	Sulawesi Utara	Hub (international)
Kendari	Kendari	Sulawesi Tenggara	Feeder
Ambon	Ambon	Maluku	Feeder
Ternate	Ternate	North Maluku	Feeder
Sorong	Sorong	West Papua	Hub/Feeder
Jayapura	Jayapura	Papua	Feeder

Source: (Indonesia Ministry of Development Planning, 2015)

The location of 24 strategic ports, both of hub and feeder port is shown in Figure 8. The hub ports are marked by red cycle, and the feeder ports are marked by a yellow circle. There are 5 hub ports: Belawan, Tanjung Priok, Tanjung Perak, Makassar, and Bitung while the other 19 ports are expected to play a role as feeder ports. However, based on the latest planning from Indonesia Ministry of Development Planning (2015), Sorong is considered as an additional hub port to cover eastern Indonesia together with Bitung port. Therefore, there is four alternatives of main routes from west to east Indonesia:

1. Belawan-Tanjung Priok-Makassar-Bitung
2. Belawan-Tanjung Priok-Makassar-Sorong
3. Belawan-Tanjung Perak-Makassar-Bitung
4. Belawan-Tanjung Perak-Makassar-Sorong

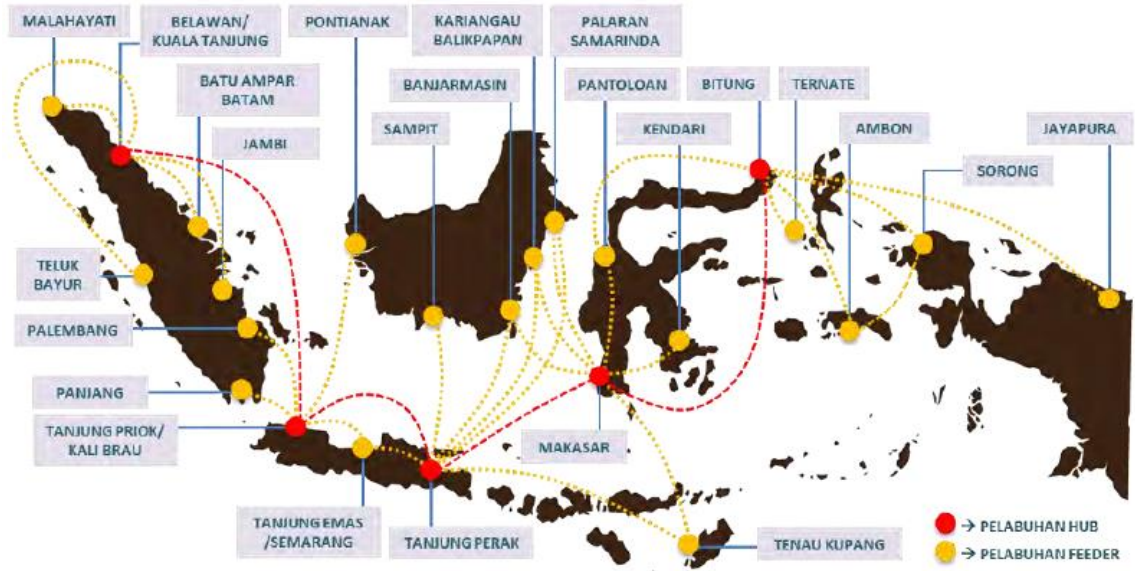


Figure 8 Ports map and main line in Indonesia's "maritime highway" policy (Indonesia Ministry of Development Planning, 2015)

In Figure 8 also shows that each hub ports is affiliated to several feeder ports to cover certain region. The affiliation between hub ports and feeder ports is summarized in Table 14.

Table 14 Affiliation between hub ports and feeder ports

Hub Ports	Hub Ports Coverage Regions	Affiliated Feeder Ports	Feeder Ports Coverage Areas
Belawan/Kuala Tanjung	Sumatera Utara	Malahayati	Aceh
		Batu Ampar	Kep. Riau, Bangka Belitung, and Riau
		Jambi	Jambi
		Teluk Bayur	Sumatera Barat, north part of Bengkulu
Tanjung Priok	DKI Jakarta, Banten, and Jawa Barat	Palembang	Sumatera Selatan and south part of Bengkulu
		Panjang	Lampung
		Tanjung Emas	Jawa Tengah
		Pontianak	Kalimantan Barat
Tanjung Perak	Jawa Timur, Bali, and NTB	Tanjung Emas	Jawa Tengah
		Sampit	Kalimantan Tengah
		Banjarmasin	Kalimantan Selatan
		Palaran	Kalimantan Timur
		Kariangau	Kalimantan Timur
Tenau Kupang	NTT		

Hub Ports	Hub Ports Coverage Regions	Affiliated Feeder Ports	Feeder Ports Coverage Areas
Makassar	Sulawesi Selatan	Pantoloan	Sulawesi Tengah and Sulawesi Barat
		Kendari	Sulawesi Tenggara
		Palaran	Kalimantan Timur
		Kariangau	Kalimantan Timur
		Tenau Kupang	NTT
Bitung	Sulawesi Utara	Ternate	Maluku Utara
		Ambon	Maluku
		Sorong	Papua Barat
		Jayapura	Papua
Sorong	Papua Barat	Ternate	Maluku Utara
		Ambon	Maluku
		Jayapura	Papua

Source: (Indonesia Ministry of Development Planning, 2015)

As mentioned before, “Maritime highway” policy is a program from the Indonesian government for a period of 2014-2019 with estimation of the total budget until 2019 is IDR 700 trillion or around EUR 50 billion (Indonesia Ministry of Development Planning, 2015). Thus, the time planning and budgeting for this policy also considers being implemented for the same period (1-4 years). As the short and middle term project, the “maritime highway” policy is expected to realize in 2019 to achieve growth of GDP that government has targeted for 2019.

3.4 Chapter conclusion

Indonesia is a developing country that shows significant economic growth in the recent years. However, as an archipelagic country, Indonesia is facing a problem of imbalance development progress between western and eastern Indonesia that caused the disproportionate distribution of population and economic activities. Consequently, in relation to logistics Indonesia, the current logistics performance indicates that a significant improvement is required to chase the other countries’ logistics performance, particularly countries in SEA region. The poor logistics performance is caused by poor utilization of logistics assets and is aggravated by long and fragmented supply chain to eastern Indonesia and the high dependency of logistics sectors on land transport. Therefore, the planning to increase efficiency logistics system by the government like “maritime highway” policy is completely right on the target. Developing an efficient logistics system would increase export, reduce regional discrepancy, provide better access to the commodities on the domestic market, and then lead to enhance the competitiveness of Indonesia’s internal and external trade.

Furthermore, by considering a fact that Indonesia as an archipelagic country which has favorable geography and transport infrastructure, the establishment of logistics cluster is taken

into account as a potential opportunity for economic development. Indonesia, which lies between two oceans and two continents, has advantages for logistics services and also supported by well-developed transport infrastructures, logistics service has a chance to expand. The advanced development of manufacturing industry in Indonesia also encourages growth in logistics services. Thus, logistics clusters are expected to provide a more proper avenue for growth in logistics services and targeted more opportunities to third party providers. In addition, logistics clusters would serve a multitude manufacturers, retailers, and distributors so are not dependent on one type of industry. Therefore, they can help to facilitate unemployment by creating and sustaining jobs.

There are substantial inputs to be considered to identify the opportunities for establishment of logistics clusters in Indonesia that are determined based on data availability, information, and discussion on this chapter. First, the simulation would be conducted based on province level, which consisting of 33 provinces. Though presently Indonesia has 34 provinces, considering the data availability, it is assumed that North Kalimantan would be treated as a part of East Kalimantan. Second, by considering the priority of Indonesia government to develop eastern Indonesia because of the imbalance development progress compared to western Indonesia, the analysis of the opportunities for establishment of logistics clusters is conducted for western and eastern Indonesia separately. Third, the multimodal transport system is expecting would be the backbone of the transportation planning in Indonesia. Therefore, multimodal should be considered in the simulation. Nevertheless, based on the recommendation of multimodal transportation system by LPPM-ITB, there are three assumptions that take into account on strategy of multimodal transportation system for developing logistics clusters in this research: 1) the goods characteristic is suitable for container and dry bulk, and 2) considered the geographical characteristics of Indonesia, all freight shipping is assumed long distance trip and inter-islands, 3) thus, only two modes that recommended, i.e. roadway and sea modes. Fourth, the implementation of “maritime highway” policy is expected affect the transportation costs in the future (2019) in the routes that serve by maritime connectivity include the alternative main routes as well as the routes for the affiliation between hub ports and feeder ports. Fifth, the target of GDRP growth is assumed would be realized in 2019. Therefore, the data for period 2019 can be developed by adjusting the data based on the projection growth by Ministry of National Development Planning.

4

Methodology to identify the opportunities for establishment of logistics clusters

Outline

This chapter presents the steps of research methodology that were performed during the study. Section 4.1 describes the step by step methodology to achieve the goal setting. Followed by assumption in Section 4.2 that is needed in this study. The assumptions related to six critical factors for establishing the successful logistics clusters that identified in Chapter 2 based on the current situation of socio-economic and logistics in Indonesia. Then section 4.3 explains the accessibility measures that used for multimodal freight transportation in Indonesia. This accessibility measures were used to analyze the geographical position and infrastructure factors. Section 4.4 describes GIS approach that was applied to analyze of the cartographical presentation as the output of accessibility measure process. Finally, SWOT analysis is discussed in Section 4.5. This analysis was used to analyze the potential of selected region in regards to government, human capital, collaboration, and value-added services factors.

4.1 Methodology

In chapter 2 and 3, some important factors related to the establishment of logistics clusters in Indonesia have been identified based on current situation and literature reviews. Figure 9 presents the steps of research methodology that were used in this study and the explanation for each step of methodology.

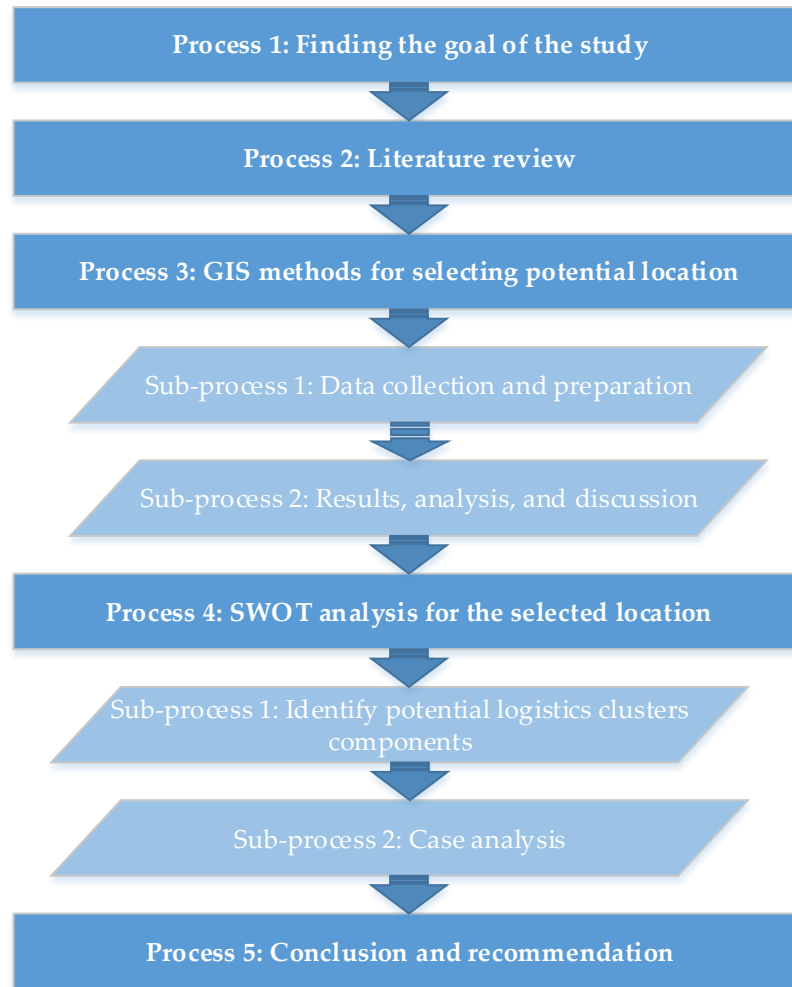


Figure 9 The methodology flow chart

Process 1: Finding the goal of the study

The first step is conducted to determine the goal, purpose, and objectives of this research have been identified as described in Chapter 1.

Process 2: Literature review

This research is initiated by an extensive literature review of the existing research regarding on logistics clusters concept as well as literature review in relation to the current situation of socio-economic and logistics in Indonesia. From the literature review of logistics clusters in Chapter 2, it

was discovered that there are six critical factors for establishing the successful logistics clusters; includes geographical position, infrastructure, government, education and human capital, a collaboration of stakeholders, and value added services. Those factors were used as a foundation to analyze the most potential location for the establishment of logistics clusters in Indonesia. Additionally, literatures review of accessibility measures suggested the potential accessibility measures to calculate accessibility value to determine the most potential location for the establishment of logistics clusters. Meanwhile, literatures review of Indonesia's current situation in Chapter 3 reveals that some assumptions are required on conduct analysis of six factors affecting the establishment of logistics clusters.

Process 3: Accessibility measures for selecting potential location

To analyze the geographical position and infrastructure factors, this study assumes that a region with the highest accessibility value has the advantage of geographical location and supported by well-developed infrastructure. This analysis presents in Chapter 5. Before that, based on the definition of logistics clusters that developed in Section 2.1 and Section 2.2, which **logistics clusters are defined as the geographical concentration of logistics firms and operations, in which the emergence of this clusters depends on accessibility and quality of transportation infrastructure and be expected to develop in the region with higher accessibility that has a high concentration of logistics activities and substantial market size**, the accessibility measures for establishment of logistics clusters is developed. The developed accessibility measures were used to calculate the accessibility value for 33 provinces in Indonesia. The calculation would be conducted in Excel and GIS approach was applied to analyze of the cartographical presentation as the output of accessibility measure process. This stage consists of two sub-processes. First is data collection and preparation for accessibility measures. Then, the analysis and discussion of the calculation results are conducted to choose the potential location that would be analyzed in the subsequent process.

Process 4: SWOT analysis for the selected location

Meanwhile, to analyze government, human capital, collaboration, and adding value factors, this study uses the framework of logistics clusters as depicted in Figure 3 in section 2.4 as a foundation to conduct the SWOT analysis for selected province. The SWOT analysis would be the basis to determine the opportunities of the selected province for establishing logistics clusters. The analysis of potential logistics clusters components delivers in Chapter 6. This stage consists of two steps. The first step is identifying potential logistics clusters components for selected province that have been narrowed down in the previous process. In the next step, case analysis is conducted using SWOT analysis methods.

Process 5: Conclusion and recommendation

From the results of analysis in process three and four, the discussion has been drawn. The discussion part concluded by offering the recommendation for the selected region in relation to the establishment of logistics clusters. Furthermore, the impact of the logistics clusters to innovation, entrepreneurship, and economic regional in selected region would be discussed as material to

consider the establishment of logistics clusters in the future. Finally, the stakeholders' analysis would be conducted to understand the opportunity to implement that recommendation.

4.2 Assumptions and identified methods for critical factors of establishment of logistics clusters in Indonesia

To analyze the six critical factors, some assumptions and identified methods are required to be applied in this study. The subsequent parts of this section discuss the assumptions and identified methods for each critical factor for establishing the successful logistics cluster as well as a further explanation in relation to the structure of critical factors as shown in Figure 4.

Geography of logistics clusters

The geographical position is the first critical factor for a logistics cluster. Location impacts the ease with which regions engage in trade. It considers the proximity to market of any region within a fixed time by a specific mode of transportation. The strategic geographical position provides high accessibility both land and sea transportations. Then, it provides an advantage to develop air connectivity. A good geographical position is a precondition required to establish logistics clusters. Furthermore, location is the basic factor in the foundation of the establishment of logistics clusters. However, it location alone is not sufficient; other factors required. In this research, it assumed that the most strategic location has the highest accessibility value.

Supportive and efficient government

The supportive and efficient government is the second foundation for the establishment of a logistics clusters since it ensures the continuity in decision process making for conducting business. To analyze this factor, the regional economic development councils were explored, especially those with logistics and transportation emphasis and the regulation for attracting investment, either local or foreign direct investment (FDI). Then, a long-term vision in both political and economic issues to understand the condition in the region whether sustained for making an investment or entering a new market was identified. However, the provincial government has a different approach in the implementation of national policies. Therefore, analysis of the local policies that related to national policies in the region could be conducted.

Human resources (education, research, and innovation)

Once a region obtains the foundation factors, they work simultaneously with three pillars in Figure 4. The first pillar is human resources. Both of quantity and quality of human resources are the most significant factor to guarantee the sustainability of logistics clusters. The education increases the efficiency of individual workers. This factor was identified by taking into account the quantity and quality of education given to the inhabitants of both regions. It could be analyzed by finding the size of people with higher education and level of human development index. In addition, the number of the academic institution, and research center also indicate the level of human resources

in the region. They are sources of innovation and technology that help companies that want to move up the value chain beyond the simple supply chain concepts.

Supporting physical and 'soft' infrastructure

Infrastructure is the second pillar for establishing logistics clusters. Supporting infrastructure is a key to ensuring the effective functioning of the economy. Logistics and transportation services require a well-developed infrastructure both physical and 'soft.' The physical infrastructure considered the condition of highways, railroads, seaports, and airports, whether the transportation infrastructure enables to support economic agents to move their goods and services to market safely and timely manner. The 'soft' infrastructure is identified by obtaining the size of financial services and information technology services, which increase overall logistics efficiency. It assumed that region with the highest accessibility value had been supported by well-developed physical and 'soft' infrastructure.

Collaboration of stakeholders

Once the aforementioned factors are found, all stakeholders should synchronously create collaboration. This is the third pillar for establishing logistics clusters. In the success logistics clusters, such as Singapore and Netherlands, there is an excellent collaboration among government, academia, and industry (Sheffi, 2012). While collaboration is important for a significant transportation infrastructure development, it is also a key on innovation system in logistics clusters. Triple helix is implemented to understand the relationship of the stakeholders on forming the collaboration in logistics clusters.

Value-added services

If those five factors are working, the logistics industry is beyond moving and storage activities and could attract anchor companies to invest in a region. They can provide value-added services that support many industries, particularly manufacturing industries. Many manufacturing clusters started with a foundation of superior transportation and logistics services in logistics clusters, such as in Memphis (Sheffi, 2012). Consequently, this factor could be identified by considering the size (by revenue and employment) of local (manufacturing industry). The last factor enhances and faster the cluster development and that is why it is represented as the capstone in Figure 4.

4.3 Multimodal freight accessibility measures for establishment of logistics clusters in Indonesia

Most of the accessibility measures are specifically dealt with passenger transport. Freight accessibility measures are found in a few of literature. Thomas et.al. (2003) investigated that the methods used for passenger transport, particularly potential accessibility measures are applicable for freight transport. They analyzed the freight accessibility by considering the major transportation modes in Belgium include roads, railways, and waterways. The potential accessibility measures weight the nodes of the transportation system by topological, population,

and economic activity. The result is the transportation system that has a positive relationship with population and topological, but economic activities are less associated with the transportation system.

Bowen (2008) and Van den Heuvel et al. (2014) defined four different accessibility measures, based on various modes of transportation. Air accessibility was measured by an ordinal value that based on the distance to the nearest airport and the air cargo tonnage handled at that airport. Maritime accessibility was measured with the same method with air accessibility, by an ordinal value that took into consideration both the distance to the nearest seaport and the number of containers handled at that seaport. Road and rail accessibility were measured by the density of road/rail per region. Even though both kinds of literature defined accessibility based on modes of transportation, they have a different method of measuring accessibility. Bowen (2008) used the density-based measures to analyze the relationship between accessibility and the number of warehouse establishment. Meanwhile, Van den Heuvel et al. (2014) applied potential accessibility measures to analyze the relationship between accessibility and logistics employment.

The previous literature measures accessibility for the different modal network separately. Lim & Thill (2008) specifically developed the accessibility measures for intermodal freight accessibility using potential accessibility measures. This measures weight the shipping cost by a measure of economic opportunities that is designed as a combination of population, employment, final demand (personal consumption expenditure), and intermediate demands (purchases) of manufacture goods.

Potential accessibility measures were modified in order to analyze the opportunities for the establishment of logistics clusters in Indonesia that take into account multimodal freight transportation. Firstly, basic potential accessibility measures as follow were used:

$$A_i = \sum_j W_j f(c_{ij}) \quad (1)$$

where A_i is the measure of accessibility at location i , W_j is the weight representing the opportunities at potential location j , c_{ij} is the generalized cost of reaching potential location j from location i , and $f(c_{ij})$ is the impedance function.

Secondly, the potential accessibility measures are weighted. In this study, by considering logistics clusters as a geographical agglomeration of logistics activities that take into account the substantial market size, both of opportunities were calculated, first the significant market size and economic power in potential location j and logistics activities of possible location j . The economic opportunities of location j is designed as combination of a final demand and intermediate demand of manufactured goods at the level provinces (Lim & Thill, 2008):

$$W_{jE} = X_j + \sum_k \frac{E_{jk}}{\sum_{ik} E_{ik}} Y_k \quad (2)$$

where W_j is the measure of economic activities/opportunities in j , X_j is the personal consumption expenditure on manufactured goods in j in 2010, E_{jk} is the number of employees in industrial sector k in j in 2010, and Y_k is the purchases of industry k from manufacturing industry in 2010. Final demand is represented by personal consumption expenditure on manufactured goods, and intermediate demands are represented by purchases of manufactured goods. But, intermediate demand is not available at a province level. Thus, these purchases were estimated by apportioning intermediate national purchases for the entire nation to each province in relation to its employment in industrial sector k . National final demand X and intermediate demands Y_k are given in Table 15. Final demand for each province is in **Appendix 1**: National final demand and purchases of commodities from the manufacturing sector in 2010.

Table 15 National final demand and purchases of commodities from the manufacturing sector in 2010

	Industry	BPS Codes	Million Rupiahs
X	Personal consumption expenditure on manufactured goods		2,128,141,401
Y1	Agriculture	Category A	77,642,251
Y2	Mining	Category B	28,011,258
Y3	Manufacturing	Category C	825,146,003
Y4	Construction	Category F	575,157,741
Y5	Transportation, storage, and communication	Category H, J	131,465,929
Y6	Utilities	Category D, E	28,858,880
Y7	Trade, hotel, and restaurant	Category G, I	268,841,240
Y8	Finance, Insurance, and real estate	Category K, L, M, N	37,634,887
Y9	Other Services	Category O, P, Q, R, S, T, U	125,906,756

Source: (BPS, 2016)

Whereas, the logistics activities in potential location j are calculated by taking into account the intermediate demand (purchases) of logistics sector at the province level as follow:

$$W_{jL} = \sum_L \frac{E_{jL}}{\sum_i iL} Y_L \tag{3}$$

where W_{jL} is the measure of logistics activities/opportunities in j , E_{jL} is the number of employees in industrial sector L in j in 2010, and Y_L is the purchases of industry L from logistics industry in 2010. Similarly, the intermediate demand is estimated by apportioning the national purchases of logistics sector to its employment in industry sector L . The national purchases of services from the logistics industry in 2010 are shown in Table 16. Final demand for each province is in **Appendix 2**: National purchases of services from logistics industry in 2010.

Table 16 National purchases of services from logistics industry in 2010

	Industry	BPS Codes	Million Rupiahs
Y1	Agriculture	Category A	1,282,875
Y2	Mining	Category B	18,723,401
Y3	Manufacturing	Category C	62,228,716
Y4	Construction	Category F	58,386,219
Y5	Transportation, storage, and communication	Category H, J	41,244,906
Y6	Utilities	Category D, E	3,824,595
Y7	Trade, hotel, and restaurant	Category G, I	41,510,747
Y8	Finance, Insurance, and real estate	Category K, L, M, N	9,641,181
Y9	Other Services	Category O, P, Q, R, S, T, U	32,071,246

Source: (BPS, 2016)

On the choosing the most potential location for the establishment of logistics clusters in Indonesia, combination of the location with the accessibility that represents the economic attractiveness and the accessibility that represent the logistics activities were identified. It is assumed that location with the high economic attractiveness, more logistics activities and better accessibility had bigger opportunities to attract companies to invest in the place and even perceive government to develop the place for the agglomeration of the logistics industry.

$$W_j = W_{jE} + W_{jL} \quad (4)$$

where W_j is total opportunities of potential location j .

Thirdly, the potential accessibility measures are analyzed for multimodal freight transportation. Differences between two recommended modes, i.e. roadway and sea modes could be expressed by generalized cost function of travel time and distance (Wegener et al., 2000):

$$c_{ijm} = v_m t_{ijm} + c_m d_{ijm} + u_m k_{ijm} \quad (5)$$

where t_{ijm} , d_{ijm} , k_{ijm} are travel time, travel distance, and convenience of travel from location i to j by mode m , respectively, and v_m , c_m , u_m are the value of time, cost per kilometer, and disutility of inconvenience of mode m , respectively. The use of generalized costs in the accessibility measures is preferable. By considering the data available, this study only considered travel costs are used as costs, done by multiplying the travel distance by a cost per kilometer.

In this study, the exponential function is used as impedance function of the travel costs. This function represents the disincentive to travel as cost increases. Although, it is also a popular impedance function for multimodal accessibility, the logsum impedance, was not considered here.

This function impedance is difficult to apply in Indonesia's case since this function is purposed to express the combined effect of alternative modes for a location (Wegener et al., 2000). While, for the archipelagic countries, such as Indonesia, multimodal transport means using more than one mode of transport in one continuous journey to create one-stop services. Using the exponential function, the 'self-potential' problem which occurs when $i = j$, $c_{ij} = 0$, since $\exp(0) = 1$, can handle completely. The exponential function is given by the following equation (Ortuzar & Willumsen, 2011):

$$f(c_{ij}) = \exp(-\beta c_{ij}) \quad (6)$$

where c_{ij} represents the generalized cost of travel by multimodal freight transport between i and j , and β is a parameter indicating the sensitivity to travel cost. It is expected that when the transport cost between two regions increases, the accessibility would decrease and vice-versa. The transport cost between the regions will have no effect if the value of β is 0. Therefore, the value of β is critical for model's behavior. Unfortunately, the empirical analysis for cost-sensitivity parameter β in Indonesia region is not available. To determine the value of β , it is assumed the choice of any destination (j) depend on the utility of the area where the utility of the region measures by the transport cost between provinces (Ortuzar & Willumsen, 2011). The following equation is used to determine the value of β :

$$\sum_i \sum_j T_{ij} c_{ij} = \sum_i O_i \sum_j c_{ij} * P_{ij} \quad (7)$$

where,

Probability,

$$P_{ij} = \frac{D_j e^{-\beta c_{ij}}}{\sum_k D_k e^{-\beta c_{ik}}} \quad (8)$$

Inbound flow,

$$O_i = \sum_j T_{ij} \quad (9)$$

Outbound flow,

$$D_j = \sum_i T_{ij} \quad (10)$$

The left side of the equation (7) is a summation of OD demand between all provinces and their respective transport costs. Whereas, the right part is the total outbound and cost parameter multiply to the probability to choose a destination. Equation (8) is the probability that is calculated by Multinomial Logit Model considering the utility of any destinations by the transport costs between the regions (Alam, 2013). By combining equation (7) and (8), the only unknown value in these equations is β .

The accessibility measures in this section were used in GIS approach to multimodal freight accessibility analysis in Indonesia. Next section presents the GIS approach that was applied to analyze of the cartographical presentation as the output of accessibility measure process.

4.4 Geographic Information System (GIS) approach to multimodal freight accessibility analysis in Indonesia

Accessibility level and changes can be associated with socio-economic data available at the province level to estimate the current accessibility levels as well as future changes in accessibility. The spatial distribution of accessibility levels and changes can be displayed in GIS environment. GIS is widely known as a useful tool for accessibility analysis, which has capabilities not only for displaying data in cartographical presentation but also deeper data analysis, such as spatial analysis and network analysis.

Adopted from the integrated GIS approach to accessibility analysis in Zhu & Liu (2004) study, a GIS approach for the multimodal freight accessibility analysis in Indonesia is developed, which is adjusted based on requirement, data availability, and type of used GIS packages. Generally, accessibility analysis involves a process to formulate the concept of accessibility, develop the appropriate accessibility measures, assess accessibility using the developed accessibility measures, and then evaluate the assessment results. An integrated GIS approach correlates with each step of accessibility analysis process, including problem definition and data collection, query and data retrieval, measure selection and specification, travel impedance measurement, calculation of accessibility measures , and visualization of accessibility value (Zhu & Liu, 2004), which is illustrated in Figure 10.

The integrated GIS approach in Zhu & Liu (2004) study was designed originally as an extension of ArcView, as one of popular GIS software package, so that all accessibility analysis processes would be done within that software. However, in this research, QGIS software packages was used, which does not provide accessibility analysis extension. Thus, the first five process of accessibility analysis in this research would be calculated outside the GIS software. QGIS software packages will be utilized in the last step to visualize the cartographical presentation and to provide the descriptive statistics of accessibility measures.

In the first process, *problem definition and data collection process* are conducted to determine the accessibility process, which is analyzing multimodal freight accessibility to choose the potential locations for establishment of logistics clusters in Indonesia, and identify data requirement to build

an accessibility map in QGIS. The output of the second process, *query and data retrieval process* is a set of data. These data is used to understand the area research situation and formulate the appropriate concept of accessibility. Next, the third process *measure selection and specification* choose appropriate accessibility measure based on the concept, which is in this study, the potential accessibility measure is the model base to conduct accessibility analysis and specifies the selected measures by carrying out spatial data manipulation. This process includes generating the data of origins and destinations (OD), calculating the opportunities of potential destinations, and choosing the appropriate general cost to estimate the parameter value of β for calibration to adjust the model base for selected area. The process *travel impedance measurement* calculates travel impedance between every pair of OD. Then, the output of process *calculation of accessibility measures* is accessibility value for every origin region based on the selected accessibility measures. The calculation of opportunities values, travels impedance, and accessibility measures conducts in Excel. The final process, *visualization of accessibility value* is processed in QGIS and then displayed as maps. Those maps can help to present a visualization of the accessibility value for each region.

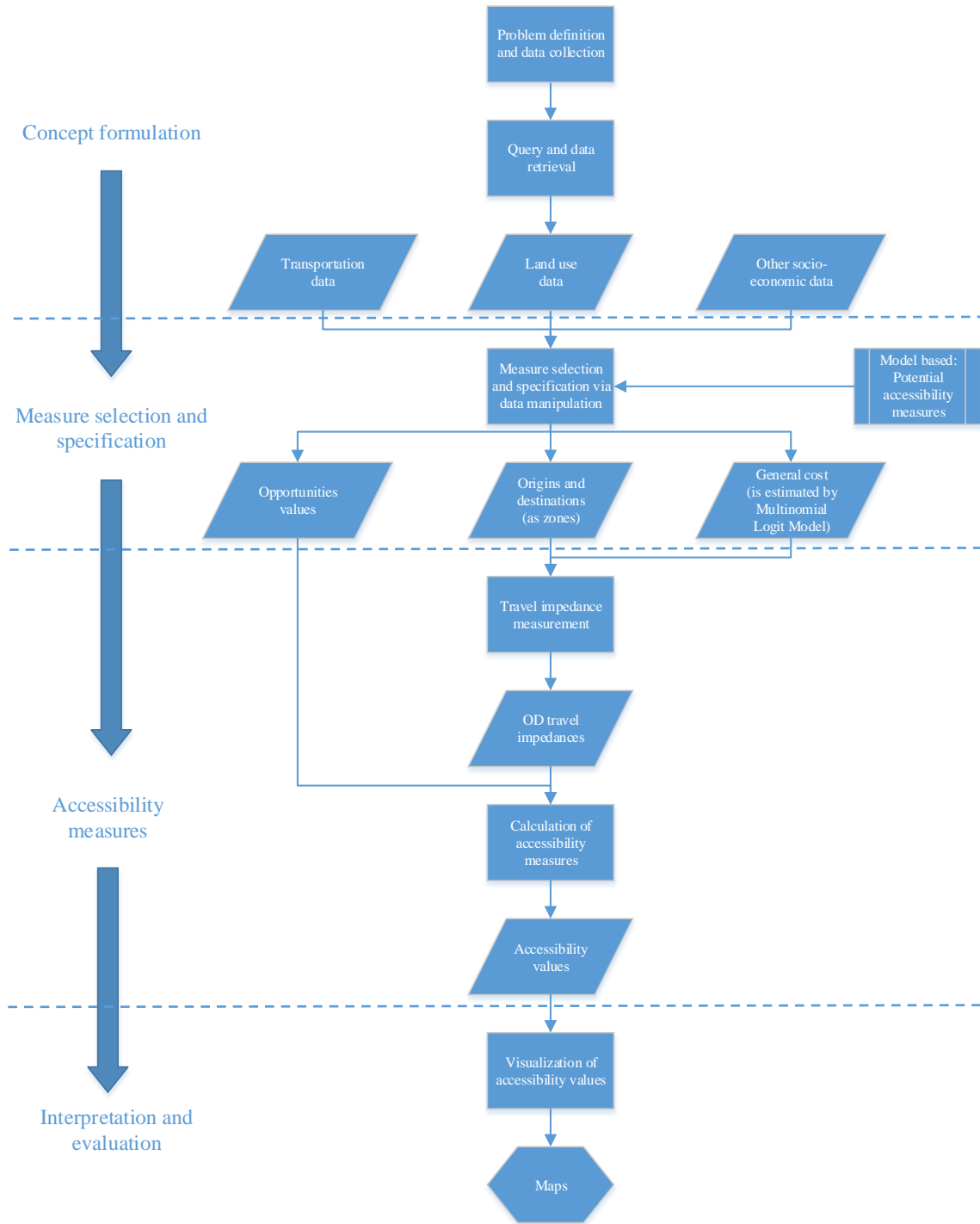


Figure 10 An integrated GIS approach from study to Indonesia's multimodal accessibility analysis (Zhu & Liu, 2004), adjusted)

4.5 SWOT analysis

The opportunities of the selected province based on accessibility measures could be explored using SWOT analysis. SWOT analysis is a framework for analyzing the region's internal strengths and weaknesses, as well as its external opportunities and threats. Here is an explanation of different factors considered for SWOT analysis.

Strengths

Strengths describe the internal characteristics on how region could gain a competitive advantage

Weaknesses

Weaknesses refer to the internal characteristic which might be considered unfavorable for the region and needs to be minimized since it hampers the region from performing at its optimum degree.

Opportunities

Opportunities refer to favorable external factors that are useful and might be used to region's advantages.

Threat

Threats refer to factors that might impact negatively to the region in the future and might be considered as potential sources of failure to the region.

Internal factors are ones that involve the internal operations and resources of the region including strengths and weaknesses inherent to the objective to establish logistics clusters. Meanwhile, external factors are related to the external environment of the region and on which the region have no influence, including opportunities and threats. Based on those factors, combining its strengths with imminent opportunities while trying to tackle weaknesses and counter threats should be done to achieve the goal of establishing logistics clusters

5

Analysis of multimodal freight accessibility level in Indonesia

Outline

Multimodal freight accessibility measures were used to analyze the geographical position and infrastructure factors. The region with the highest accessibility value is considered as the most potential location of the establishment of logistics clusters due to its advantage of strategic location and well-developed transportation infrastructure. GIS approach that was applied to analyze of the cartographical presentation as the output of accessibility measure process. In this chapter, Section 5.1 presents the scenario which was developed by considering the current situation of socio-economic and logistics in Indonesia. Followed by an explanation on how data for accessibility measures collected and calculated using the multimodal freight accessibility measures that have been developed, particularly for the establishment of logistics clusters in Indonesia in Section 5.2. Next, Section 5.3 presents some assumptions that are needed considering the data availability and complexity. The result and analysis of accessibility measures are presented in Section 5.4. And finally, Section 5.5 discusses which regions have the most potential location for the establishment of logistics clusters and some findings in the study.

5.1 Scenario definition

Literature reviews suggested the potential accessibility measures in order to select the most potential location establishment of logistics clusters. Those types of measures include accessibility components, transport, and land-use. Thus, the scenario of the establishment of logistics clusters involves the changes in land-use and transport. The reference scenario was conducted in prior to shows a continuation of current land-use and transport trends in Indonesia in relation to the establishment of logistic clusters, followed by the scenario with changes on the component accessibility. The different scenario is conducted to exhibit how the changes of component accessibility in the future (2019) due to policies could impact the regions' accessibility value, either the policies increase or decrease the accessibility value. Decreases accessibility value mean that policies affect negatively to region's economic, and vice versa; increases accessibility value offer advantages to regions. Therefore, there are three scenarios that can be conducted to analyze the multimodal freight accessibility on developing logistics cluster in Indonesia, i.e. base scenario (2010) and two scenarios in the future (2019). Besides, it discussed in Section 3.3 that infrastructure expansion aims to reduce the price disparities in Indonesia by accelerating the economy growth in eastern Indonesia. Thus, by considering the priority of Indonesian government to develop eastern Indonesia due to the imbalance development progress compared to western Indonesia, the analysis of accessibility value was conducted for western and eastern Indonesia separately. Table 17 is the summarized of provinces in western and eastern Indonesia.

Table 17 Summarized of provinces in western and eastern Indonesia

Western Indonesia	Eastern Indonesia
Aceh, Sumatera Utara, Sumatera Barat, Riau, Jambi, Sumatera Selatan, Bengkulu, Lampung, Bangka Belitung, Kepulauan Rian, DKI Jakarta, Jawa Barat, Bali, Nusa Tenggara Barat, Kalimantan Barat Banten, Jawa Tengah, DI Yogyakarta, Jawa Timur,, Kalimantan Timur, Kalimantan Selatan, Kalimantan Tengah	Nusa Tenggara Timur, Sulawesi Utara, Sulawesi Selatan, Gorontalo, Sulawesi Barat, Sulawesi Tengah, Maluku, Maluku Utara, Papua Barat, Papua

1. Accessibility measures of transport and land use for 'present' (the year 2010)

In the first scenario, the accessibility measures focus on the evaluation of transport and land use in the 'present' condition. The land use component is based on the economic opportunities which are a combination of a final demand (personal consumption expenditure) and intermediate demand (purchases) of manufactured goods, and logistics activities that are represented by purchases of logistics service. As the most updated data for calculating the attractiveness of potential location is available for the year 2010, in this study, 2010 was set as the basis year in accessibility measures for the first scenario. Furthermore, the transport component that is captured by travel impedance function is an exponential function.

2. Accessibility measures of transport changes in the future (the year 2019)

In this scenario, Indonesia's logistics and socio-economic performance are assumed to accelerate parallel with the infrastructure expansion. It is expected that the Indonesian government had established the government development planning. This infrastructure expansion is supposed to influence the transport components in the future. Transportation costs in 2019 will change, not only due to inflation but also because the implementation of "maritime highway" policy. This policy is expected to reduce transportation costs in 2019. In addition, the economic growth changes the demand positively. Thus, the OD demand matrix 2019 is assumed to increase by adjusting it with real GDRP growth from the period of 2012-2014 and 2015-2019 GDRP growth projection.

In the second scenario, only the transport component changes, keeping the number of economic and logistics activities constant at base-year level (2010). Therefore, in the second scenario, the accessibility gain for each province as an impact of transport changes was analyzed. This analysis was not conducted to choose the most potential location but to evaluate the impact of the policy on accessibility value in the future (2019). The analysis was done for western and eastern Indonesia.

3. Accessibility measures of land-use changes in the future (the year 2019)

In the last scenario, it is assumed that land use component would change as the impact of government development planning, keeping the travel cost and demand to be the same as in 2010. In this scenario, the weight of attractiveness of potential location is assumed to grow parallel with the GRDP growth. Similarly, with the second scenario, the analysis of the accessibility gain for each province as an impact of land-use was performed and conducted separately between western and eastern Indonesia.

5.2 Data collection and data calculation

Most of the required data are collected from government institutions website, in this case, is Statistics Indonesia (*BPS*). In addition, some of the data are also collected from internal public institutions, i.e. Ministry of Development Planning (*Bappenas*) and Ministry of Transportation.

Based on the problem definition and selected accessibility measures, the main data input for the multimodal freight accessibility measures are (the detail is shown in **Appendix 3**: Accessibility measures of transport and land use for 'current' (the year 2010)) : Origin-Destination (OD) demand matrix (province to province level); demographic and socio-economic data by each province; OD matrix for inter-zonal; travel costs; real GDRP growth of each provinces in 2011-2014 and 2015-2019 GRDP growth projection; real inflation in 2011-2015 and 2016-2019 inflation rate forecast; and district layers to build accessibility map in QGIS, such as zone geographic boundary files and point of major cities in Indonesia.

OD demand matrix is provided by Ministry of Transportation by means of a survey conducted every five years. The latest available data is for 2011. This matrix is province to province level for 33 provinces in Indonesia based on discussion on previous chapters. For the first scenario, the OD demand matrix of 2011 was adjusted with real GDRP growth in 2011 to get the estimation of OD demand matrix of 2010. Meanwhile, for the second and third scenario, the OD demand matrix is adjusted with real GDRP growth in 2012-2014 and GRDP growth target in 2015-2019 to calculate the estimation of OD demand matrix 2019.

Demographic and socio-economic data for each province is collected to measure the attractiveness of the potential destination. Based on the problem definition, information on personal consumption expenditures for manufactures goods in province level, national purchases from manufacturing industry, and national purchases from logistics industry are required in order to analyze the opportunities of logistics cluster development by measuring multimodal freight accessibility. Since the accessibility analysis is in province level, to get the province level of purchases from manufacturing and logistics industry, the data of the number of employees in each industrial sector is required. The latest update for all data demographic and socio-economic is for the year 2010 based on the official reported by Statistics Indonesia. The first and second scenario were developed by applying real data in 2010 to calculate the weight of attractiveness for each province. Meantime, the third scenario is adjusted with real GDRP growth in 2012-2014 and GRDP growth target in 2015-2019 to calculate the estimation of provinces' attractiveness in 2019.

OD matrix for inter-zonal travel costs is the most difficult data to gather completely in reliable and valid value. Theoretically, the travel costs consist of fixed costs (e.g. car purchase, insurance) and variable costs (e.g. maintenance, fuel). In this study, for simplicity, the OD travel costs matrix is generated from a sample online application tool for shipping rates (www.searates.com) by considering the difficulty of recapitulation data of every cost component for each OD matrix and the high possibility of illegal charges as discussed in the Section 3.2.1. This situation leads to lack of validity towards the availability data in government institutions. The shipping rates that this application suggested is the rates for door to door multimodal freight transport, i.e. road and sea modes. As discussed in section 3.2.2, railway infrastructure's Indonesia is restricted. Indonesia has only four independent railways systems, Java, South Sumatera, West Sumatera, and North Sumatera. Thus, in the current situation, it is difficult to move goods between provinces using the rail modes, even though there is a railway system that covers almost of Java Island. Nevertheless, the passenger still has higher priority. Thus, the travel costs that provides by these application tool being consistent with a hypothetical, through the realistic multimodal situation in Indonesia. The data is obtained from www.searates.com on 8th May 2016, by using the rates currency 1 USD equal to 1 USD = IDR 13350.12.

Realization of GRDP for all provinces from 2011 to 2014 is obtained from Statistics Indonesia, and GDRP growth projection for 2015-2019 is taken from the national mid-term development planning (*RPJMN*) by Ministry of Development Planning. Furthermore, the real inflation from 2011 to 2015 is obtained from official World Bank website. These data were used to adjust travel costs in the first scenario (the year 2010). The inflation rate forecast from 2016-2017 is gathered from

official Asian Development Bank (ADB) websites, and inflation rate forecast for both 2018 and 2019 is gathered by continuing ADB's inflation forecast for the year 2017. These data inflation is used to adjust the travel costs in the second scenario (transport changes in the future (the year 2019)). In addition, for the second scenario, travel costs are changed due to the impact of "maritime highway" policy. Jacoby & Hodge (2008) found that an investment in freight transportation investment would reduce the direct transportation costs by 10%. Thus as impact of "maritime highway" policy, transportation costs would be 10% lower of the adjusted travel cost by inflation in 2019. The impact on transportation costs is assumed to only affecting in regions that cover by routes of "maritime highway." Summarized data calculation based on developed multimodal accessibility measures for three scenarios of accessibility measures for the establishment of logistics clusters is presented in Table 18.

The main data to build accessibility map in QGIS is obtained from various sources. Zone geographic boundary layers are taken from Global Administrative Areas website (<http://www.gadm.org/>), transport infrastructure layers, such as ALKI line is found in Ministry of Transportation website (<http://gis.dephub.go.id/mappingf/Mapservices.aspx>). Meanwhile point of capital cities of province layer and accessibility map layer in Indonesia are own work.

Table 18 Summarized data calculation for three scenarios of accessibility measures

Scenario	Measurement	Data required	Data available	Data for adjustment
1	Travel impedance (f(C_{ij})) (Equation (6), (7), (8), (9), (10))	OD matrix (2010)	OD matrix (2011)	Real GDRP growth (2011)
		Travel costs (2010)	Travel costs (2016)	Real inflation (2011-2015)
	Travel cost (C_{ij}) (Equation (5))	Travel costs (2010)	Travel costs (2016)	Real inflation (2011-2015)
	Total opportunities (W_j) (Equation (2), (3), (4))	National final demand (2010)	National final demand (2010)	
		National Purchases of commodities from manufacturing sectors (2010)	National Purchases of commodities from manufacturing sectors (2010)	
		National purchases of services from logistics industry (2010)	National purchases of services from logistics industry (2010)	
		Number of employee per province (2010)	Number of employee per province (2010)	
Accessibility (A_i) (Equation (1))	Travel impedance (f(C _{ij}))			
	Total opportunities (W _j)			
2	Travel impedance (f(C_{ij})) (Equation (6), (7), (8), (9), (10))	OD matrix (2019)	OD matrix (2011)	Real GDRP growth (2012-2014)
				GRDP growth target (2015-2019)
		Travel costs (2019)	Travel costs (2016)	Inflation rate forecast (2016-2019)
	Travel cost (C_{ij}) (Equation (5))			Impact of "maritime highway" policy (10%)
		Travel costs (2019)	Travel costs (2016)	Inflation rate forecast (2016-2019)
				Impact of "maritime highway" policy (10%)

Scenario	Measurement	Data required	Data available	Data for adjustment
	Total opportunities (W_j) (Equation (2), (3), (4))	National final demand (2010)	National final demand (2010)	
		National Purchases of commodities from manufacturing sectors (2010)	National Purchases of commodities from manufacturing sectors (2010)	
		National purchases of services from logistics industry (2010)	National purchases of services from logistics industry (2010)	
		Number of employee per province (2010)	Number of employee per province (2010)	
	Accessibility (A_i) (Equation (1))	Travel impedance ($f(C_{ij})$)		
		Total opportunities (W_j)		
3	Travel impedance ($f(C_{ij})$) (Equation (6), (7), (8), (9), (10))	OD matrix (2010)	OD matrix (2011)	Real GDRP growth (2011)
		Travel costs (2010)	Travel costs (2016)	Real inflation (2011-2015)
	Travel cost (C_{ij}) (Equation (5))	Travel costs (2010)	Travel costs (2016)	Real inflation (2011-2015)
	Total opportunities (W_j) (Equation (2), (3), (4))	Total opportunities (W_j) (2019)	Total opportunities (W_j) (2010)	GRDP growth target (2015-2019)
	Accessibility (A_i) (Equation (1))	Travel impedance ($f(C_{ij})$)		
Total opportunities (W_j)				

5.3 Assumptions and limitations based on data availability

There are some assumptions and limitations that are required to ensure the research could be executed based on data availability and complexity, i.e.

1. The accessibility measures are calculated at the province level. Thus, each province is considered to have equal attractiveness for all districts, even though the center of economy and social activities are usually in the capital city of the province.
2. The moving goods transportation intra-islands is unimodal (152 matrix from 1089 of the total matrix, with red highlight in travel costs (2010) data in **Appendix 3: Accessibility measures of transport and land use for 'current'** (the year 2010) is multimodal and black highlight is unimodal). It is more preferably to be used because of the travel cost of unimodal is less than travel cost of multimodal for intra-islands transportation (except in Papua Islands). Multimodal is more preferably In Papua, because of the limitation of the road infrastructure.
3. The government completes the implementation of infrastructure development planning, including the increase of transportation facilities' and infrastructure's capacities as well as the integration of multimodal transport system in 2019. Thus, the second and third scenario can be executed by assuming the growth GDRP is aligned with the government's target.
4. The travel costs are pre-determined as a constant value and by assuming that all transportation cost is for the full truckload (FTL), no less truckload (LTL) is included in this study.
5. The travel costs are 10% lower of the adjusted travel costs with inflation in 2019 due to the implementation of "maritime highway" policy. The decrease of transportation costs is expected to occur in routes that are covered by hub and feeder ports as mentioned in Section 3.3.1. The yellow highlight in travel costs (2019) data shown in **Appendix 4: Accessibility measures of transport changes (the year 2019)** represents the routes affected by "maritime highway" policy implementation.

5.4 Model results and analysis

There are three scenarios used to analyze multimodal freight accessibility to develop logistics clusters in Indonesia. In this study, 33 provinces in Indonesia are considered as the level of the accessibility considered. Hence, there is 1089 OD demand matrix. Sensitivity analysis was conducted for all scenarios by changing the response of the cost sensitivity parameter (β). First, it was assumed that the travel cost to weight most heavily on multimodal freight goods between provinces, hence, the value of β is discounted 95%. Second, it was assumed that there was a reduced response of multimodal freight to an exponential function. Thus, the effect of cost sensitivity parameter is discounted 90%. It was also assumed the effect of β is discounted 75% of the final value of β for the weakest impedance decay effect on multimodal freight flows. The value of β is the difference between the left hand side (LHS) and right hand side (RHS) of equation (7). When the difference is below the lowest point that could be by Excel, the value of β was assumed for further accessibility measures. Furthermore, as the accessibility measures take into account the economic attractiveness, all accessibility value is in Billion Rupiahs.

1. Accessibility measures of transport and land use for 'current' (the year 2010)

This scenario is used as a reference scenario that focuses on the evaluation of the accessibility measures in “current”. The present accessibility value distribution is important because it helps to understand the condition of current transportation infrastructure in each province. Then, it also indicates where the present concentration of economic activities is located. By understanding the current situation, the impact of policies that explained in Chapter 3 would be observed.

In the first scenario, the accessibility measures used transport and land-use in 2010. The value of β for the first scenario is 0.0000026088. Under the different scenario of response to cost sensitivity parameter, the three parameters are 0.0000024783, 0.0000023479, and 0.0000019566 respectively. Then, by applying the potential accessibility measures, the accessibility value is obtained. The detailed data calculation is scrutinized in **Appendix 3: Accessibility measures of transport and land use for 'current' (the year 2010)**. As mentioned in Section 4.4, QGIS is capable of analyzing the spatial data. Using QGIS's analysis tool and basic statistics extension, the descriptive statistics on the multimodal freight accessibility measures at province level is obtained, as shown in Table 19. The multimodal freight accessibility measures show considerable variation across Indonesia's area. They also exhibit high sensitivity to the travel impedance parameter β . The accessibility value increases when the value of β becomes smaller. A lower cost sensitivity parameter reduces the friction of impedance on the network between a pair of OD leading to an increase in accessibility value. Therefore, when the influence of shipping impedance declined, the accessibility measures would represent the global tendency instead of local effects tied to goods movements in Indonesia's network, since the value of β is a parameter for a specific area. Moreover, as indicated by the coefficient of variation, the multimodal freight accessibility becomes less vary as the travel impedance decay falls.

Table 19 Descriptive statistics of accessibility measure of transport and land use for 'present' (the year 2010)

Response of β	β parameter	Mean	Min	Max	Standard deviation	Coefficient of variation (%)
High	0.0000024783	596759	33581	1866376	586076	98%
Medium	0.0000023479	631191	36963	1915569	601139	95%
Low	0.0000019566	775590	42851	2087409	642911	83%

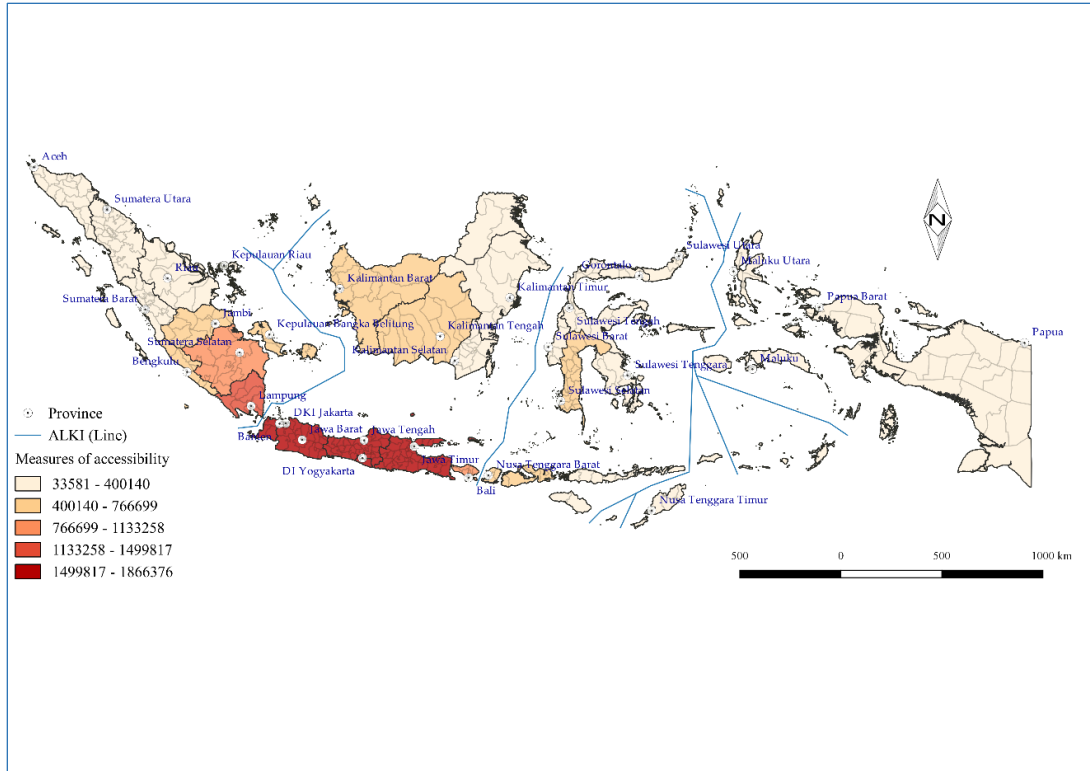


Figure 11 Measures of accessibility under high beta

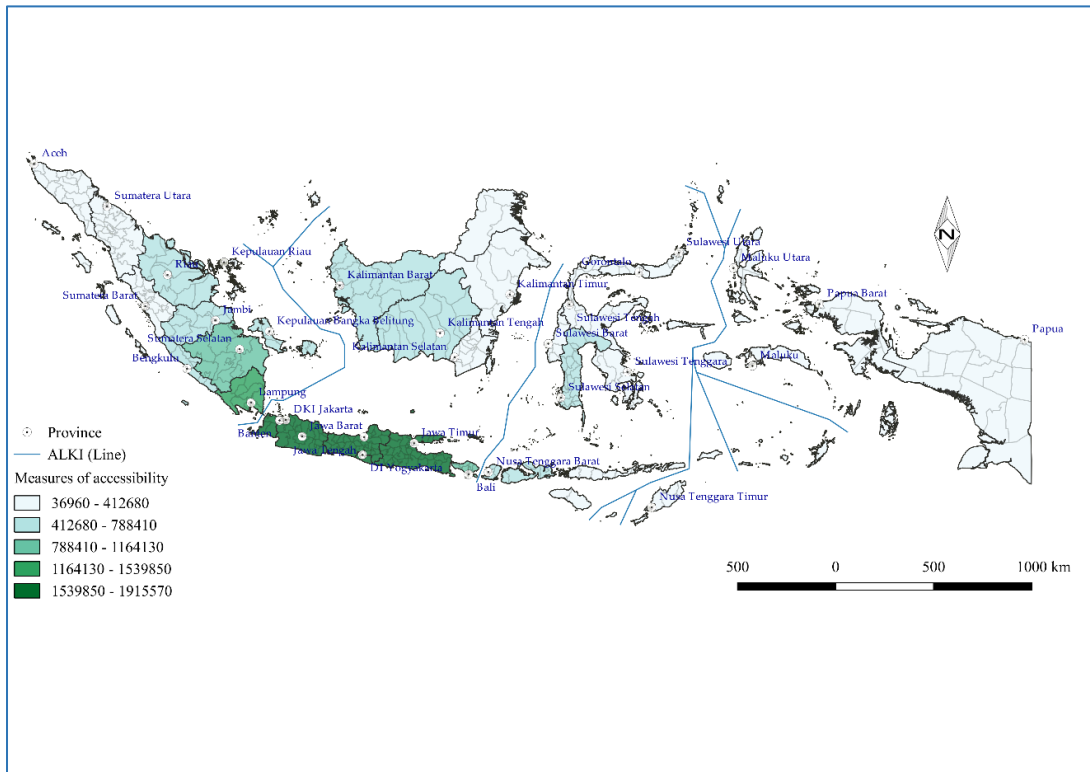


Figure 12 Measures of accessibility under medium beta

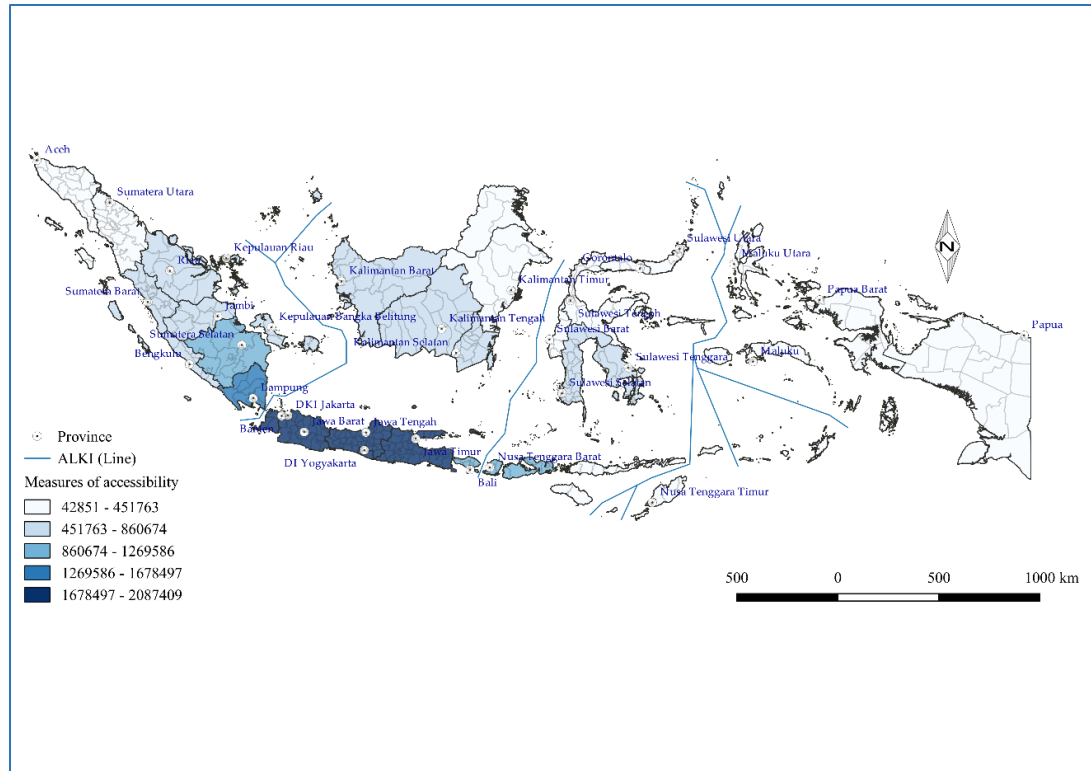


Figure 13 Measures of accessibility under low beta

The visualization of accessibility value is developed in QGIS. Figure 11, Figure 12, and Figure 13 are the output of the visualization accessibility value in QGIS. Based on those accessibility maps, it is clear that the places in the highest accessibility category are located in the center of Indonesia (Java Islands). All province in Java Islands (DKI Jakarta, Jawa Barat, Jawa Tengah, Jawa Timur, Yogyakarta, and Banten) enjoy good access to highly developed transportation infrastructure and are located relatively close proximity to the large population centers (e.g. Jakarta, as a capital city of Indonesia) and economic and logistics activities. Accessibility gradually decreases towards the western and eastern Indonesia. The highest accessibility value in western Indonesia holds in Jawa Barat. However, in order to achieve equitable development, the logistics cluster in eastern Indonesia is supposed to do similarly well in the western Indonesia. Based on the accessibility map, Sulawesi Selatan seizes the highest accessibility value in eastern Indonesia. The accessibility value of transport changes in Sulawesi Selatan is much higher compared to another province in eastern Indonesia. It shows that for the eastern region the economic and logistics activities are concentrated in Sulawesi Selatan. Sulawesi Selatan is supported by well-developed infrastructure, hence the transport costs from and to this province is lower than others. Thus, in the 'present' condition, by considering the attractiveness of the potential location, the most potential location for logistics cluster development is Jawa Barat and Sulawesi Selatan.

2. Accessibility measures of transport changes in the future (the year 2019)

Based on the finding in Section 3.4, the implementation of “maritime highway” policy is expected to influence the transportation costs in the future (2019) for the routes that serve by maritime connectivity, including the alternative main routes as well as the routes for the affiliation between hub ports and feeder ports. According to Jacoby & Hodge (2008), the investment in freight transportation infrastructure supposed to reduce the transportation costs by 10%. The improvement of transportation infrastructure offers the advantage of the new capacity. Thus the companies are able to adjust their logistics processes and supply chain in order to improve service and even reduce transportation costs. Besides, the “maritime highway” policy also creates the efficient freight flows from west to east Indonesia. The forming of hub and feeder ports network connects multiple distribution points through central operating hubs. This policy is intended to reduce transportation costs directly and decrease the price disparities between eastern and western Indonesia indirectly that leads to increasing overall demand in 2019. Thus, in this scenario, the infrastructure expansion influences the changes of transport components on accessibility measures. For the potential accessibility measures, the transport components are represented by travel impedance function with two important variables, OD demand, and travel cost. The OD demand matrix 2019 is assumed to increase by adjusting it with real GDRP growth from the period of 2012-2014 and 2015-2019 GDRP growth projection. Furthermore, the travel cost in 2019 changes by taking into account the inflation rate forecast of 2016-2019 as well as impact of “maritime highway” policy.

In the second scenario, only the transport component changes, keeping the number of economic and logistics activities constant at base-year level (2010). Thus, the cost sensitivity parameter β for this scenario changes to 0.0000017967. According to the different scenario of response to cost sensitivity parameter, i.e. high, medium, and low, the three parameters are 0.0000017069, 0.0000016171, and 0.0000013476 respectively. Table 20 consists of descriptive statistics of accessibility measures of transport changes in 2019. The β value for accessibility measure of transport changes in 2019 is smaller than parameter value in 2010. The value of β is lower than β of the base scenario and closer to zero. Therefore, depends on the scale for c_{ij} , the impact of the value of β in this accessibility measures is lower. Similarly with the first scenario, multimodal freight accessibility exhibit sizeable variations and they are very sensitive to the value of β . Smaller β reduces the influence of travel impedance to accessibility measures. Thus, for lower β values, the coefficient of variation would decline.

Table 20 Descriptive statistics of accessibility measure of transport changes in the future (the year 2019)

Response of β	β parameter	Mean	Min	Max	Standard deviation	Coefficient of variation (%)
High	0.0000017069	610742	35942	1914128	601697	98%
Medium	0.0000016171	656502	39380	1964123	607532	92%
Low	0.0000013476	775724	43192	2137605	666274	86%

All three series of accessibility maps of transport changes in 2019 exhibit a similar pattern with the first scenario. The accessibility maps for the second scenario is shown in Figure 14, Figure 15, and Figure 16. It exhibits that in 2019 if the attractiveness of potential location is taken into account and the economic and logistics activities to establish logistics clusters are not changed, thus the most potential location is Jawa Barat (located in Java) which Jawa Barat province has the highest accessibility value based on the potential accessibility measures for all different response to cost sensitivity parameter β . The accessibility value in Jawa Barat is slightly higher compared to DKI Jakarta, which is the capital city of Indonesia. It shows that Jawa Barat has the strongest neighborhood impact from capital city as the central of the population and economic activities. Meanwhile, the accessibility value of transport changes in Sulawesi Selatan is much higher compared to another province in eastern Indonesia even when the component of the weight of opportunities is not changing. It shows that the economic and logistics activities in Jawa Barat and Sulawesi Selatan are greater than other provinces. Moreover, the highest accessibility value of transport changes indicates the development of transportation infrastructure in both provinces is well-developed compared to other provinces in the “current” and future. Thus, even though there is an infrastructure expansion across Indonesia as a result of “maritime highway” policy, both regions still have the advantages of geographical position and supporting infrastructure.

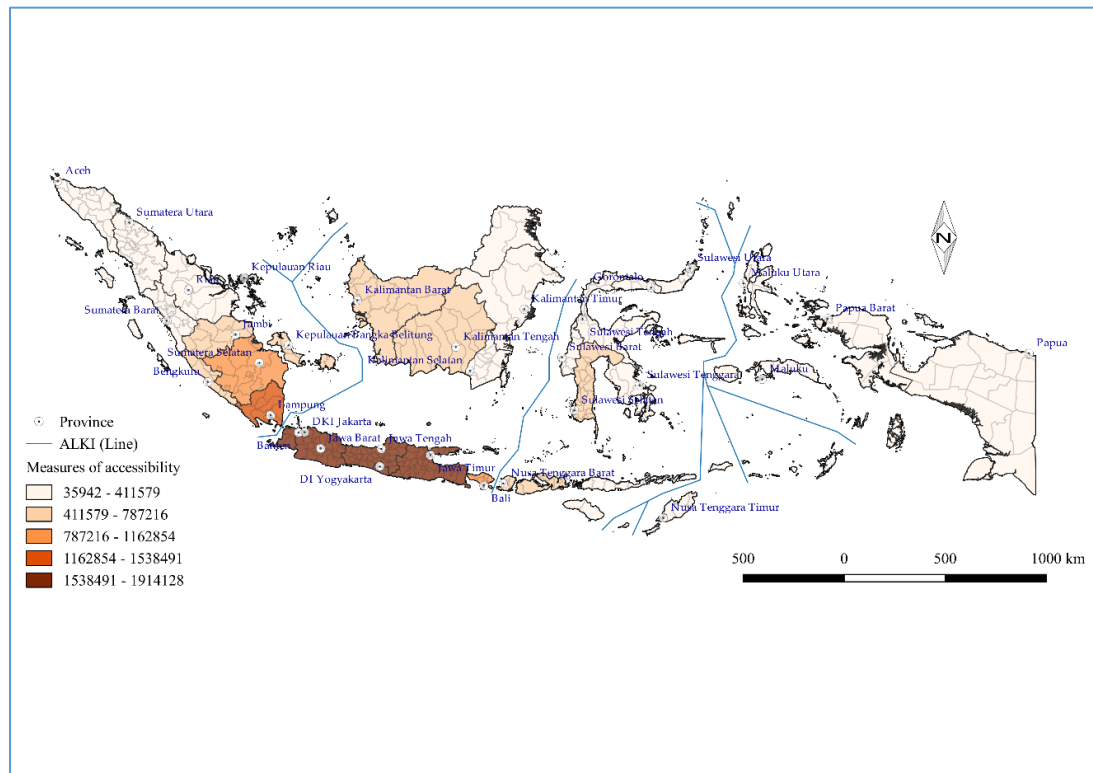


Figure 14 Measures of accessibility of transport changes under high beta

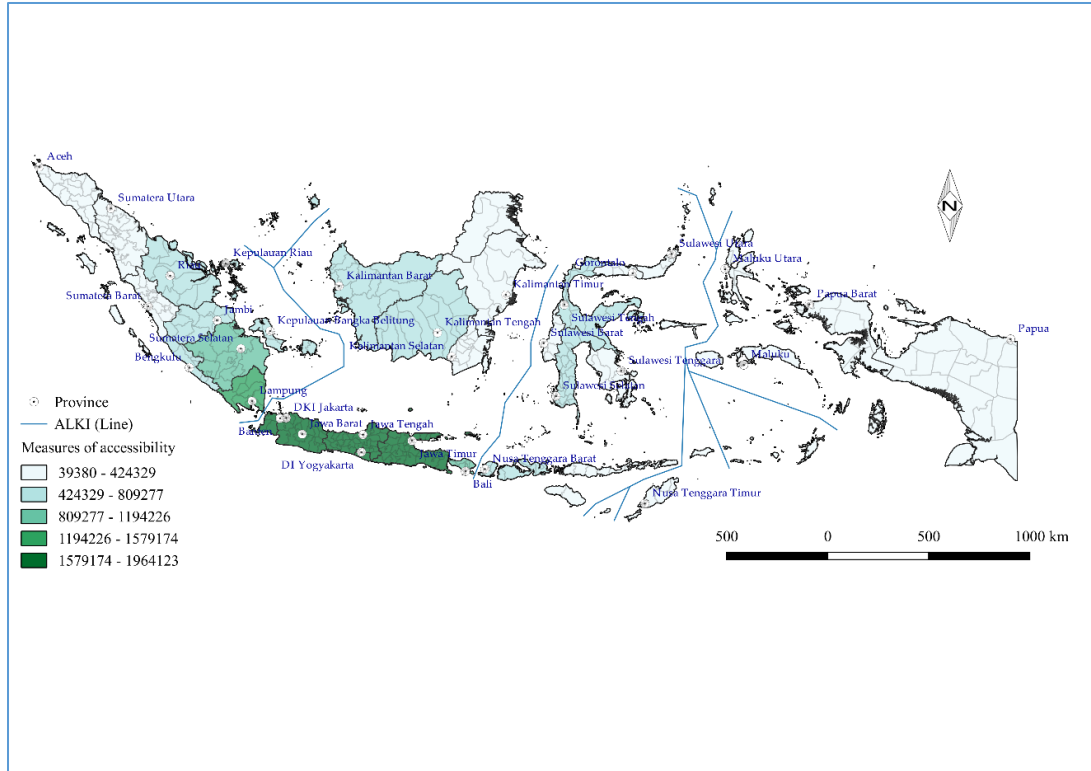


Figure 15 Measures of accessibility of transport changes under medium beta

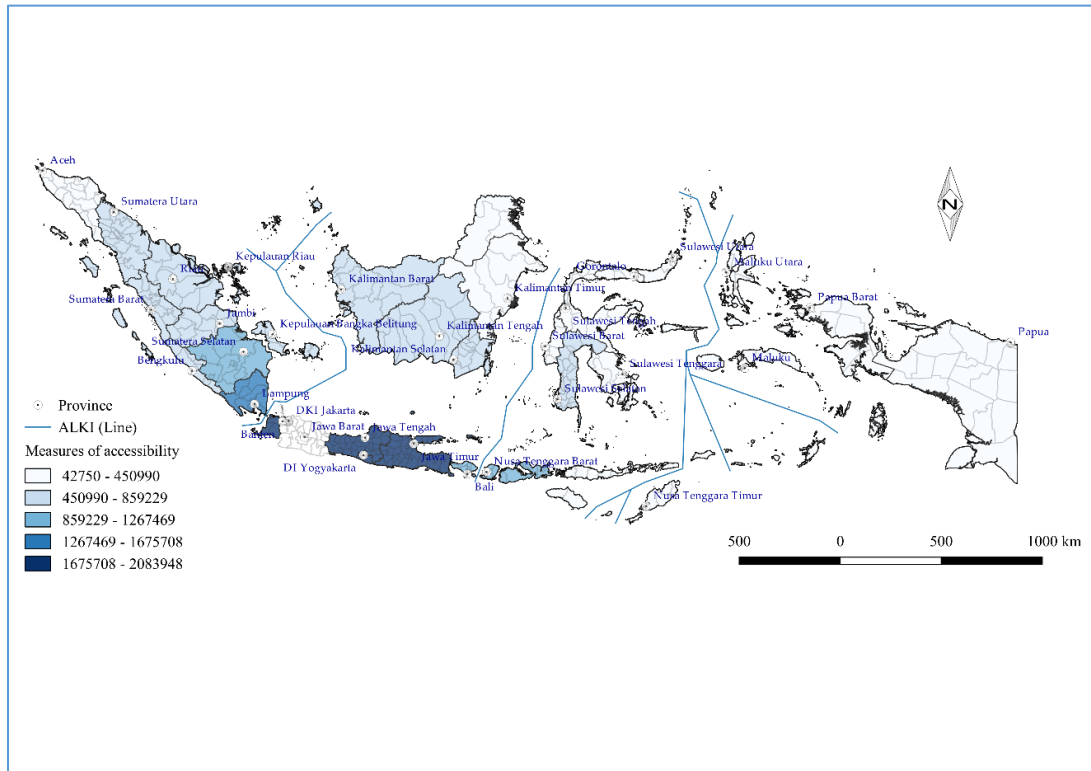


Figure 16 Measures of accessibility of transport changes under low beta

In proportion to existing multimodal freight accessibility, the accessibility gain because of transport changes in 2019 are rather small, less than 4% on average in all three responses (Table 21). The absolute gain in accessibility associated with transport components changes tend to increase as β becomes smaller. In addition, accessibility gain show a relatively high degree of variability across the nation, which indicates that the absolute gain of accessibility value is highly variant across the region. This is because the impact of lower transportation costs occurs only in the routes that served by maritime connectivity include the alternative main routes and the routes for the affiliation between hub ports and feeder ports. For those regions, the absolute gain is higher compared to regions that are not covered by “maritime highway” policy.

Table 21 Descriptive statistics of accessibility gain of transport changes in the future (the year 2019)

Response of β	β parameter	Mean	Min	Max	Standard deviation	Coefficient of variation (%)
<i>Absolute gain</i>						
High	0.0000017069	19225	169	65542	19040	99%
Medium	0.0000016171	19638	78	64123	19003	97%
Low	0.0000013476	21228	58	64314	19181	90%
<i>Percentage gain (%)</i>						
High	0.0000017069	3.18	0.19	7.42	1.95	61%
Medium	0.0000016171	3.08	0.08	7.24	1.88	61%
Low	0.0000013476	2.76	0.05	6.11	1.58	57%

The spatial pattern of absolute gain related to transport changes in Figure 17 displays that accessibility value is steady high in western Indonesia when there is a change in transport component. The highest absolute gain is also indicated in Jawa Barat. The development of Tanjung Priok port (DKI Jakarta) improve the accessibility in this province. Meanwhile, in the eastern region, absolute gain changes in Sulawesi Selatan are slightly higher than other eastern provinces. In “maritime highway” policy, Sulawesi Selatan is central for the freight flow from west to east Indonesia (vice versa). Consequently, this increases accessibility value in this region more than other regions in eastern Indonesia.

Meanwhile, the accessibility gain due to the decrease of travel costs is not significant compared to accessibility value in 2010. It confirms that the transport components which is represented by shipping impedance have the small influence to multimodal freight accessibility in Indonesia in terms of establishment of logistics clusters in Indonesia. However, Figure 18 and Figure 19 display that even though the accessibility value (taking into account the transport changes in eastern Indonesia) is relatively smaller than western, the highest percentage gain is in two provinces of eastern Indonesia, i.e. Papua Barat, Nusa Tenggara Timur (NTT). It means that the improvement infrastructure of “maritime highway”; in Tenau Kupang port (NTT) and Sorong port (Papua Barat) improves accessibility value of those regions compared to “present” condition. The highest percentage gain in western is pointed to Nusa Tenggara Barat (NTB). Though NTB does not include the infrastructure expansion, yet the neighborhood impact from Tanjung Perak port (Jawa Timur) is rather strong since most of the commodities flow from NTB passed these port.

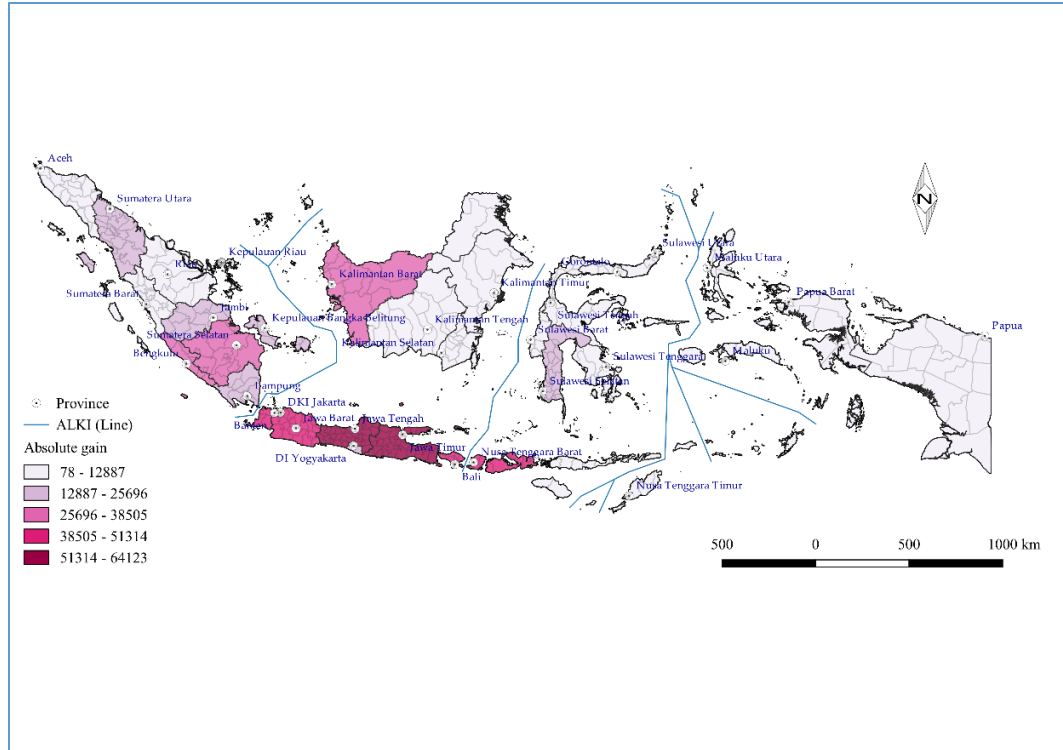


Figure 17 Absolute gain in accessibility as impact of transport changes in 2019

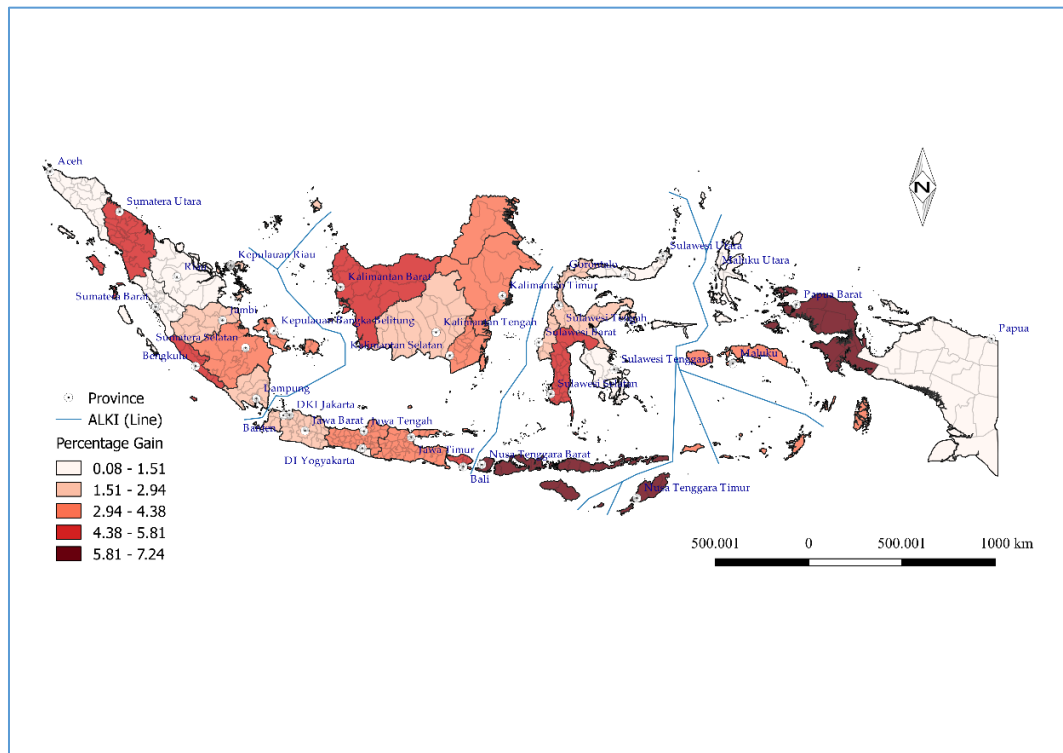


Figure 18 Percentage gain in accessibility as impact of transport changes in 2019

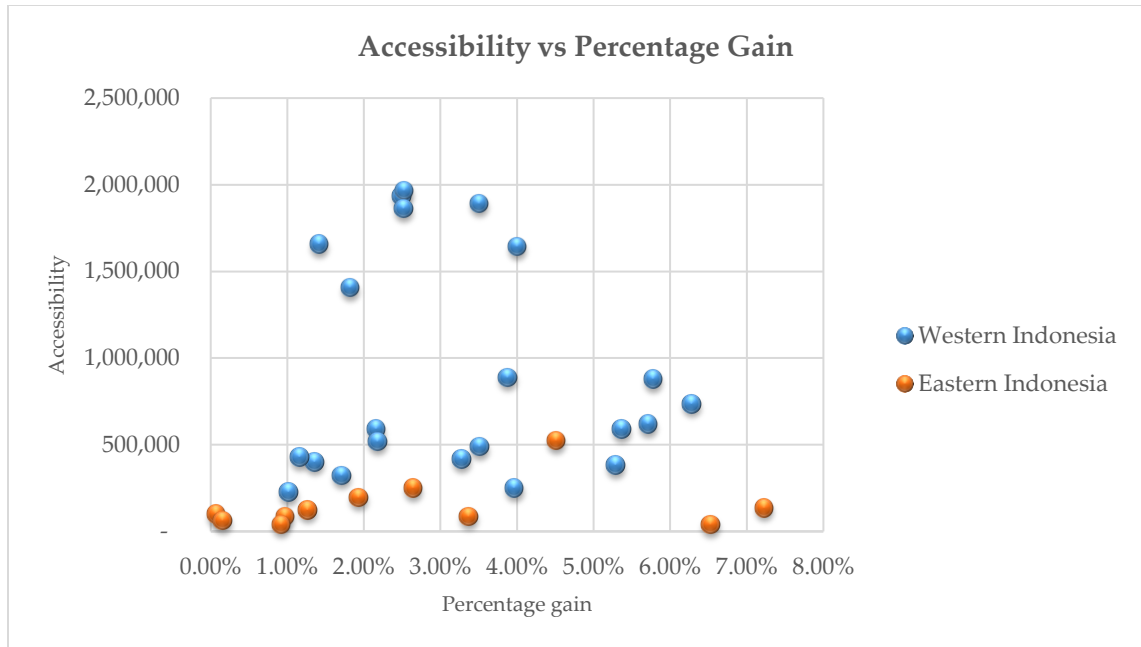


Figure 19 The comparison accessibility and percentage gain (transport changes) between western and eastern Indonesia

3. Accessibility measures of land use changes for future (the year 2019)

For the potential accessibility measures, land-use components are represented by the weight of opportunities. Based on the accessibility measures which developed in section 4.3, there are two types of opportunities for establishment of logistics clusters, i.e. economic and logistics opportunities. The fourth important factor in relation to current situation socio-economic in Indonesia is the target of GDRP growth set by the Indonesian government would be realized in 2019. GDRP growth indicates that economy is good, and the nation is moving forward. The economic and logistics activities are expected to escalate in 2019. Hence, it assumed that the weight of attractiveness of potential location would growth parallel with the GRDP growth. The adjustment to weight of attractiveness for accessibility measures of land-use changes in 2019 is shown in **Appendix 5: Accessibility measures of land-use changes (the year 2019)**

In this scenario, the land-use components consist of the economic and logistics activities changes caused by the growth of GDRP, keeping the travel costs and demand at base-year level (2010). Therefore, the value of β is same as the first scenario. Overall, the accessibility measures of land-use changes in 2019 have a similar pattern with the accessibility measures at base-year level. The multimodal freight accessibility measures show substantial variation across Indonesia's area. However, it becomes less vary when the value of beta is lower. They also exhibit high sensitivity to the travel impedance parameter β . The accessibility value increases when the value of β become smaller. Table 22 exhibits descriptive statistics of accessibility measure of land use changes in 2019.

Table 22 Descriptive statistics of accessibility measure of land use changes in the future (the year 2019)

Response of β	β parameter	Mean	Min	Max	Standard deviation	Coefficient of variation (%)
High	0.0000024783	1062137	66241	3307755	1033545	97%
Medium	0.0000023479	1118691	70937	3394545	1062025	95%
Low	0.0000019566	1347609	77909	3697843	1151215	85%

The output visualization for the third scenario also has the same pattern to the first and second scenario. Figure 20, Figure 21, and Figure 22 show the accessibility value of land-use changes in 2019. The spatial distribution of accessibility exhibits that Jawa Barat and Sulawesi Selatan still enjoy the highest accessibility when the attractiveness of the potential location, which is economic and logistics activities to establish logistics clusters are changing. The economic activities in both provinces are growing parallel to the nation GDRP/economy growth. It establishes that those regions are expected to counter other provinces in terms of advantages of accessibility in 2019. Thus, both regions have more attractiveness in the form of market potential to be chosen as the location for the establishment of logistic clusters.

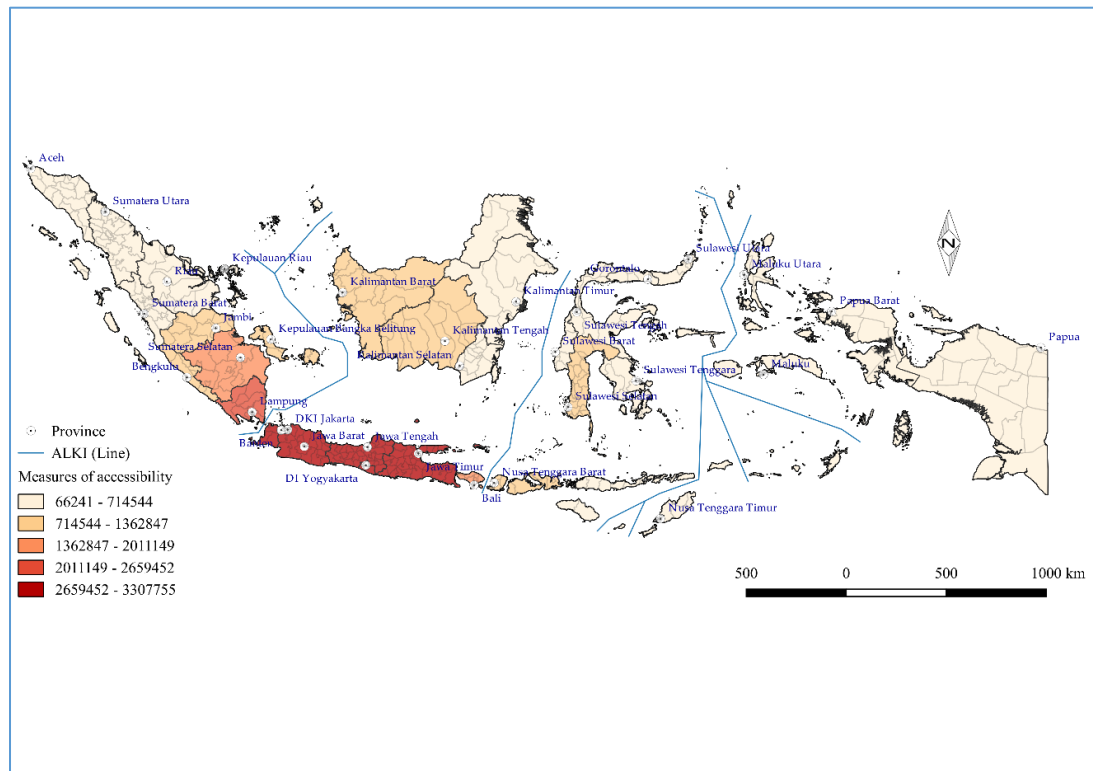


Figure 20 Measures of accessibility of land use changes under high beta

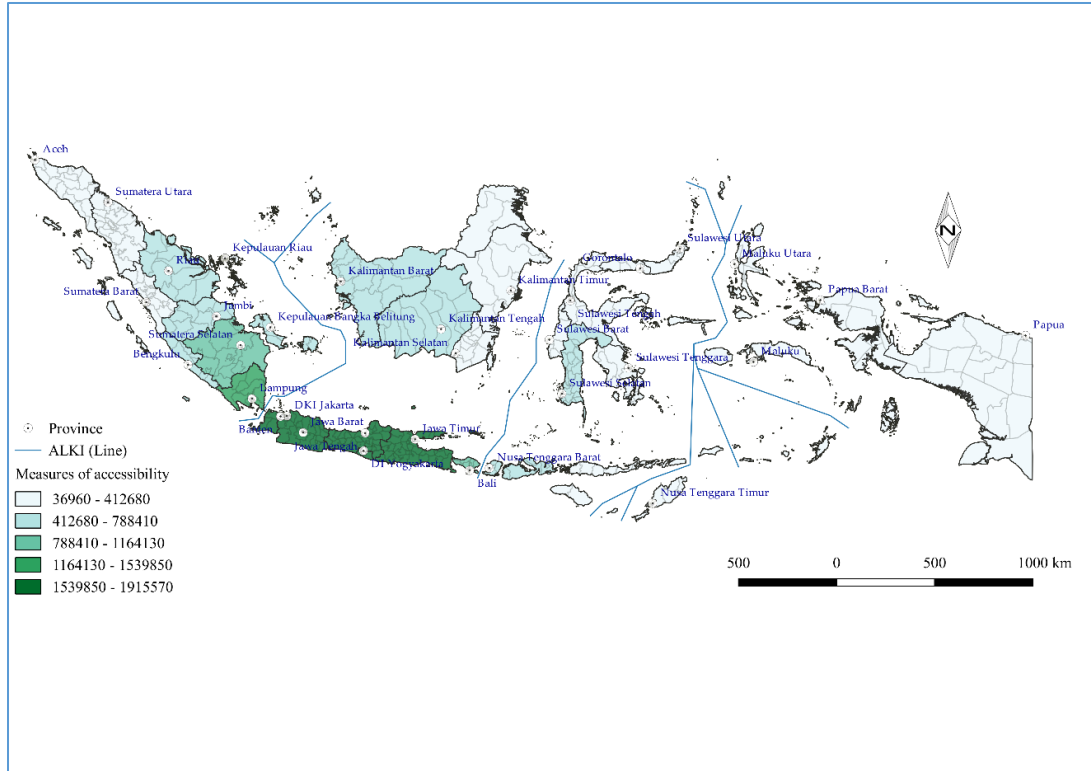


Figure 21 Measures of accessibility of land use changes in medium beta

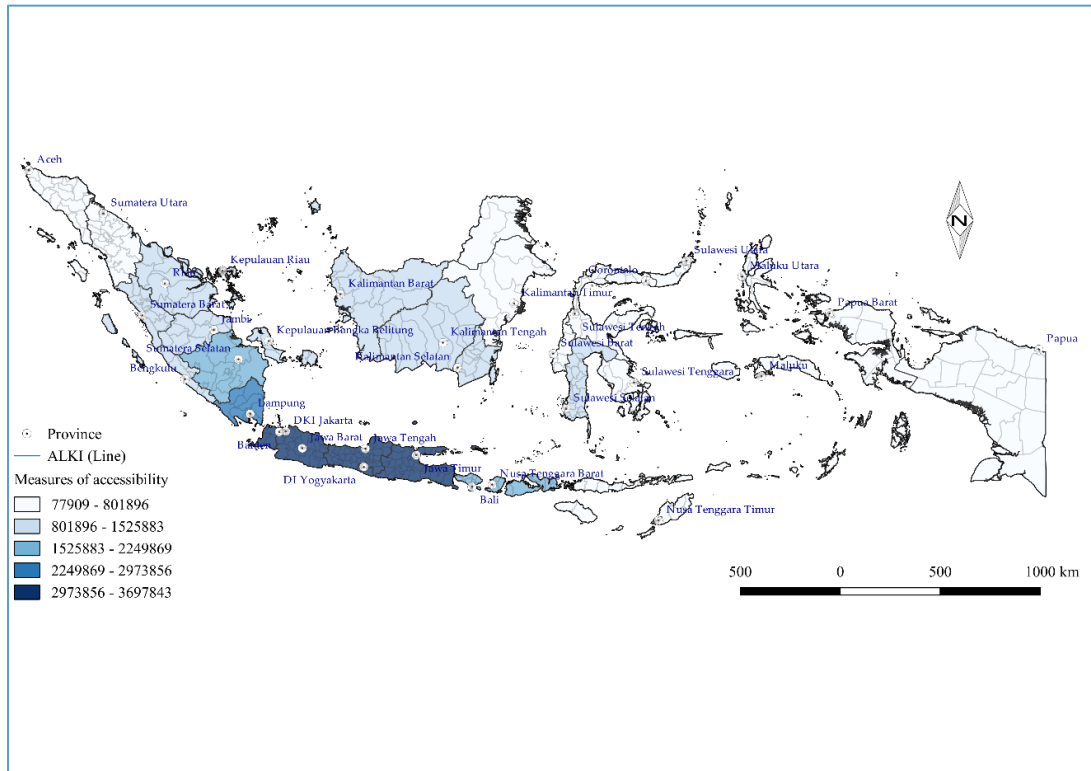


Figure 22 Measures of accessibility of land use changes under low beta

Table 23 demonstrates the descriptive of statistics of accessibility gain as the impact of land use changes. In proportion to present accessibility, accessibility gain are very high, more than 70% of mean in all three scenarios of sensitivity. Higher accessibility gain in the third scenario compare to the accessibility of transport changes exhibits that land-use component has more influence to multimodal freight accessibility regarding the establishment of logistics cluster in Indonesia. The variability of absolute gain in accessibility of land-use changes indicates a relatively high value across Indonesia. This is influenced by the distribution of attractiveness' region. The imbalance development progress causes inequality of economic and logistics potential between provinces.

Table 23 Descriptive statistics of accessibility gain of land use changes in the future (the year 2019)

Response of β	β parameter	Mean	Min	Max	Standard deviation	Coefficient of variation (%)
Absolute gain						
High	0.0000024783	460526	31124	1441379	449706	98%
Medium	0.0000023479	487527	31737	1478976	460982	95%
Low	0.0000019566	595170	35507	1610434	499503	84%
Percentage gain (%)						
High	0.0000024783	80	67	97	6	8%
Medium	0.0000023479	79	68	96	6	7%
Low	0.0000019566	79	70	93	5	6%

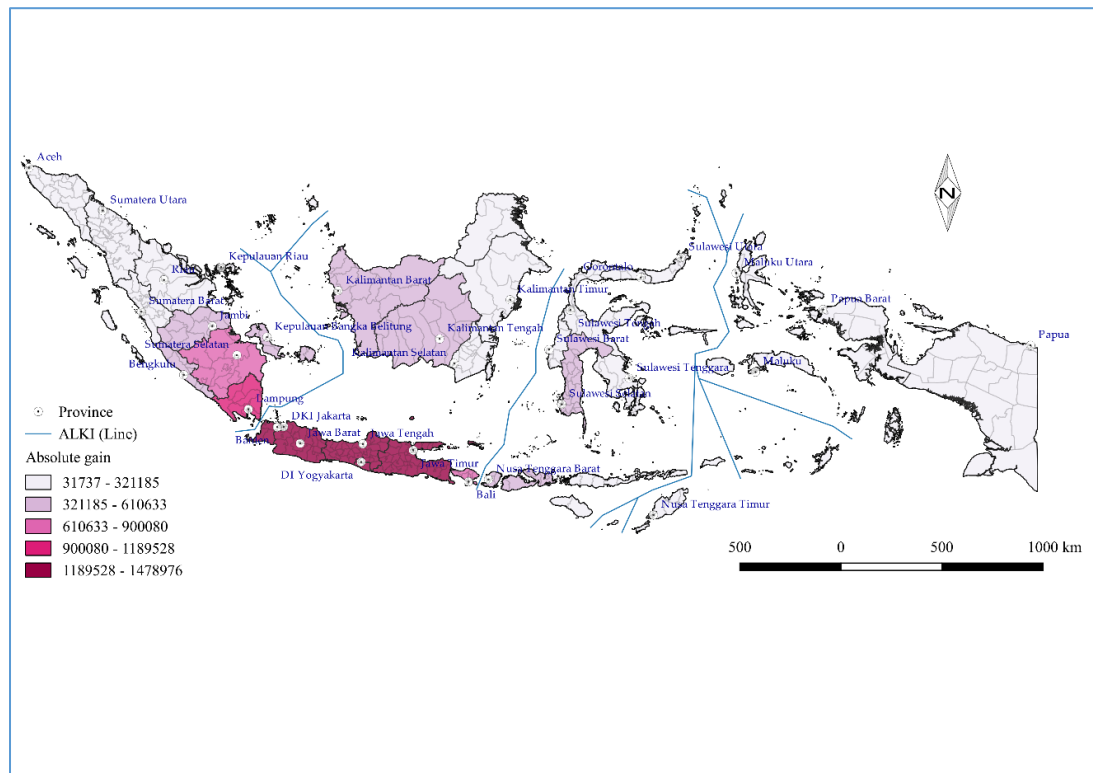


Figure 23 Absolute gain in accessibility as impact of land use changes in 2019

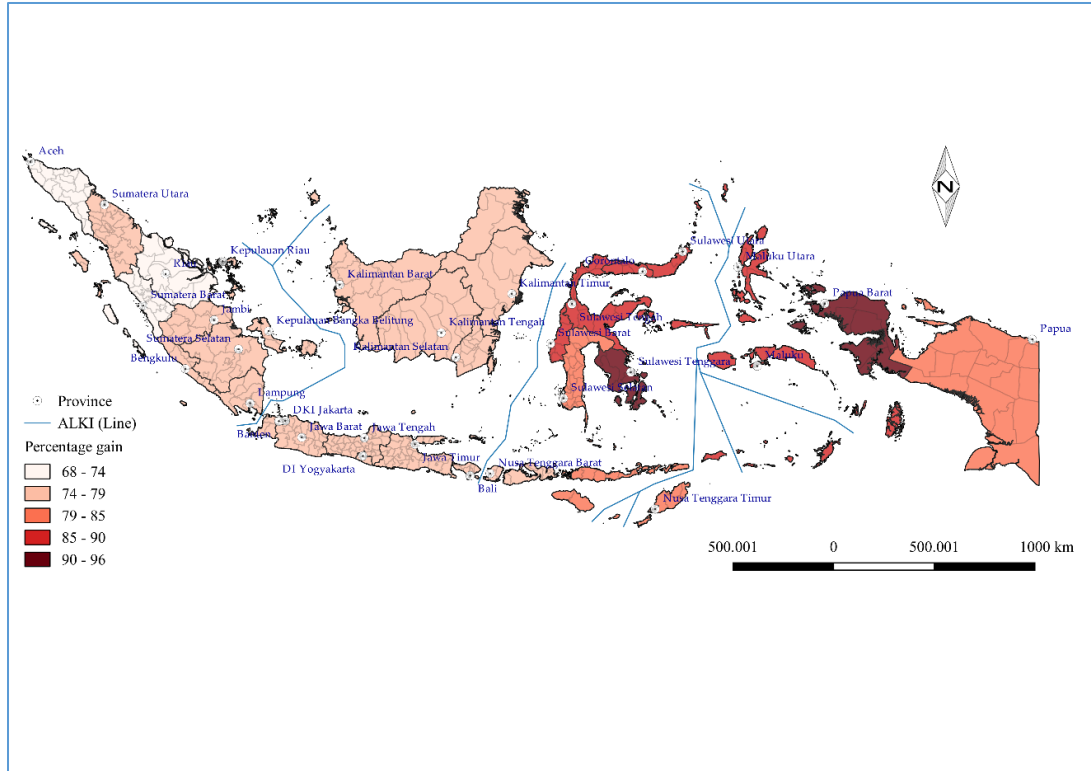


Figure 24 Percentage gain in accessibility as impact of land use changes in 2019

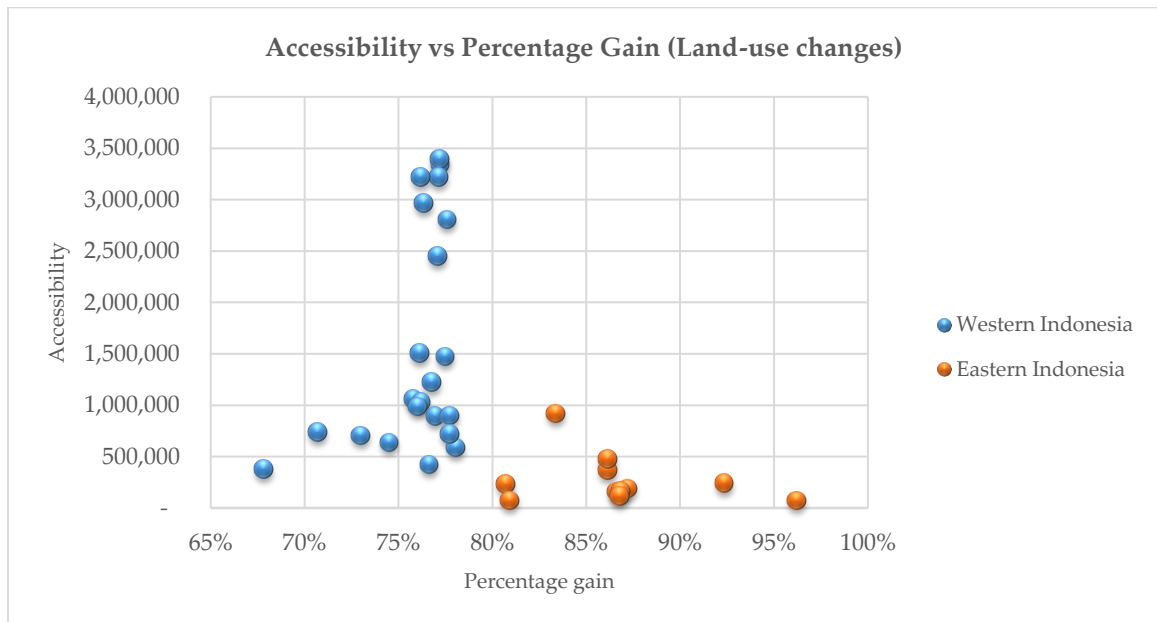


Figure 25 The comparison accessibility and percentage gain (land-use changes) between western and eastern Indonesia

The spatial pattern of absolute gain linked to land use changes in Figure 23 indicates that the highest accessibility gain consistent to the highest accessibility value in the current (2010) and 2019. It is because the weight of attractiveness of the location with the highest accessibility value will develop around period 2010-2019 as GDRP is expected to grow. Thus, the highest accessibility gain is again located in Jawa Barat, as part of the western region and Sulawesi Selatan, as part of the eastern region. At the same time, the spatial pattern of percentage gain exhibits significant accessibility improvement in western and eastern Indonesia. While the average accessibility gain of transport changes is around 3%, yet the average gain of land-use changes is roughly at 70%. This finding emphasizes that in multimodal freight accessibility regarding the establishment of logistics cluster in Indonesia, the land-use component has more power than transport component. Nevertheless, Figure 24 and Figure 25 display that the average percentage gain of eastern Indonesia is more than 80% compare to western Indonesia at less than 80%. It is caused by the aggressive GRDP growth target for eastern Indonesia up to 2019. The development planning that Indonesian government has created is supposed to be realized in order to achieve the significant improvement in the future as finding in this study.

5.5 Discussion

To analyze the opportunities for establishment of logistics clusters in Indonesia that take into account multimodal freight transportation, the modification of potential accessibility measures are applied. The weighted is taking into account both the significant market size and logistics activities of a possible location. It is assumed that location with the high economic attractiveness, more logistics activities, and better accessibility had bigger opportunities to attract companies to invest in the place and even convince the government to develop the place for the agglomeration of the logistics industry. In this study, the exponential function is used as impedance function of the travel costs. This function represents the disincentive to travel as cost increases.

The accessibility measures conducted on three different scenarios; one base scenario which counts both of land use and transport changes in 2010 and two developed scenarios which take into account changes in either transport or land use components in 2019. All scenario presents a similar spatial pattern of distribution of accessibility measures. The locations with the highest accessibility value are in Jawa Barat for western Indonesia and Sulawesi Selatan for eastern Indonesia. It is expected to occur due to a large number of population as well as social activities in both regions. The positive effect of the development of infrastructure that also enjoyed by provinces around Java impacts to relatively higher accessibility value in those areas that are illustrated in accessibility maps. The transport infrastructure is also highly developed throughout Java Islands and particularly in Sulawesi Selatan. Therefore, by considering the highest accessibility value, Jawa Barat (West Java) in western Indonesia and Sulawesi Selatan (South Sulawesi) in eastern Indonesia are selected as the most potential location for the establishment of logistics cluster. Both regions could serve as an alternative to establishing logistics clusters due to the highest accessibility signifies the advantage of geographical position and infrastructures, which is the important factor of the establishment of logistics clusters.

In addition to the results of selection, the most potential location for the establishment of logistics clusters, the analysis of multimodal freight accessibility measures also shows some finding in regards to the impact of government policy to accessibility value in the future. There is finding in relation to the “maritime highway” policy as one of government development plan, which aimed to reduce the transportation costs and increase demand flow across Indonesia. It impacts the changes of transport component of accessibility measures. The accessibility measures of transport changes exhibit that the highest accessibility value is located in Jawa Barat and Sulawesi Selatan. This result indicates that in 2019, even though “maritime highway” policy would able to lower the travel costs, however, the most attractive location for logistics clusters is still in Jawa Barat and Sulawesi Selatan, similar with the result of accessibility measures in 2010. In proportion to existing multimodal freight accessibility, the accessibility gain because of transport changes in 2019 are rather small, less than 4% on average in all three responses. It is observed that the transport components which is represented by shipping impedence have the relatively small influence to multimodal freight accessibility in Indonesia in terms of establishment of logistics clusters in Indonesia. In this study, the impact of lower transport costs has only covered the routes that are planned in the “maritime highway” policy. Whereas, the impact could affect to wider coverage because the neighborhood affect that indirectly reduces the travel costs in more freight routes. Thus, the accessibility gain would be higher than calculation in this study.

Moreover, the unchanged spatial distribution of accessibility does not conclude that the “maritime highway” policy is not effective because it is still offering a slightly improvement to accessibility value by average 3%. The biggest impact occurs in eastern Indonesia, i.e. NTT. Whereas, the highest absolute gain of the policy occurs in Sulawesi Selatan. Both of NTT and Sulawesi Selatan improve their accessibility due to the improvement of hub and feeder ports in those regions as a result of this policy implementation. Furthermore, the more efficient transportations systems due to “maritime highway” policy drive the changes in supply chain process. Companies could lower sourcing costs due to more options from a diverse base of lower costs suppliers. It is possible because of efficient freight flows can lead to more affordable shipment even over long distance. The “maritime highway” policy that has an objective to serve with routine and scheduled ship also could reduce variability in transit times, making it possible to improve the on-time performance. Then, the better transit time visibility could be created. This gives a benefit to make better inventory and buffer forecast which improves the overall warehouse performance. Finally, the infrastructure improvement opens more opportunities to increase revenue that in the end will improve the nation’s economic performance.

Another finding is that in relation to multimodal freight accessibility with the establishment of logistics clusters, the land-use component has more influence than transport-component. Thus, by considering the changes of land-use in the future, the accessibility value across Indonesia are anticipated increase significantly. Because the GDRP growth target for eastern Indonesia is quite higher than western, thus the improvement of accessibility value in those regions would be better. However, to achieve it, the government should complete the implementation of infrastructure development planning, including “maritime highway” policy.

6

Opportunities & challenges for the establishment of logistics clusters in Indonesia

Outlines

In this Chapter, four factors of the establishment of logistics clusters are analyzed using SWOT analysis. Those factors include government, human capital, collaboration, and value added service. The analysis is conducted in the selected province based on the analysis of multimodal freight accessibility level for both western and eastern Indonesia; the provinces are West Java and South Sulawesi respectively. Even though the infrastructure for both regions is assumed to be well-developed as indicated in accessibility analysis, however, in this chapter, these factors would also be reviewed deeper to develop the better SWOT analysis. Section 6.1 presents the potential framework of logistics clusters in West Java and refers to this framework, the SWOT analysis for the establishment of logistics clusters in West Java is performed. Next, Section 6.2 elaborates the analysis of South Sulawesi, the structure of analysis is similar to West Java analysis. Finally, Section 6.3 discusses the recommendation based on the SWOT analysis and the impact of the logistics clusters to innovation, entrepreneurship, and economic regional in selected region and at last, the stakeholders' analysis would be conducted to understand opportunities to implement those recommendation.

6.1 The case of West Java

6.1.1 Framework for developing potential logistics clusters

West Java is one of the developed regions in Indonesia. This province has an important role in the development of economic growth in Indonesia since 60% of manufactured industry is located in West Java. According to BPS (2016) in 2014, GDRP of West Java is 1,149 trillion Rupiahs. The biggest contribution came from manufactured industry by 502 trillion Rupiahs or 44% (BPS, 2016) of total GDRP. Followed by trade sector and construction sectors at 183.6 trillion Rupiahs (16%) and 92.6 (8%) trillion Rupiahs respectively. Transportation and logistics only contributed to 4.5% of total GDRP or 51.6 trillion Rupiahs.

In current condition, West Java is equipped with related and supported industries to develop potential logistics clusters. Within the province, various other clusters related to logistics activities, such as manufacturing (1,037 companies, 112 hundred employees), textile (851 companies, 254 hundred employees), and apparel and clothing (740 companies, 231 hundred employees), and plastics (390 companies, 104 hundred employees) (Ministry of Industry, 2016) have been developed. For instances, West Java has several regional headquarters for automotive companies (such as Toyota and Honda) and also development and manufacturing operations for high-value products. Furthermore, small and medium enterprises (SMEs) have been well developed in West Java. Mostly, companies in this province are SMEs. Based on a survey in 2013 (Ministry of Industry, 2016), West Java has 27 industry clusters, and it is the most number of industry cluster in Indonesia compare to Riau Islands (11 clusters), Banten (10 clusters), and Central Java (8 clusters). The biggest industry clusters are located in Karawang and Cikarang. In addition, financial services and construction industries have been established as well in this province. Regarding supported industries to enhance the economic activity of the potential logistics clusters, container maintenance industries as well as railways maintenance industries that monopolized by Indonesia Railways (*Kereta Api Indonesia*, KAI) are well developed.

West Java has educational institution in logistics and supply chain (The Center for Logistics and Supply Chain Studies) as part of Institute for Research and Community Services-Institut Teknologi Bandung (LPPM-ITB). This center is not only exclusive for researchers from ITB but also is well-opened to the non-ITB researchers as long as their studies aligned in logistics and supply chain. For example, in Sub-section 3.2.3, this institute offered the recommendation of the multimodal transportation system in Indonesia. There is also a collaboration between ITB with the Logistics Institute (LTI), Asia Pacific to continue research at the Georgia Institute of Technology (Georgia Tech) that focusing on global logistics, information technology, and supply chain management. There is Indonesia logistics association (*Asosiasi Logistik Indonesia*, ALI) that aims in bringing conducive atmosphere for Indonesian logistics industries.

From the framework, transportation services, logistics services, and infrastructure operators are the core of logistics clusters. Presently, logistics service, such as storage and warehousing, freight handling and distribution are offered widely in West Java, both domestics, and foreign third party logistics. The physical infrastructures to provide logistics service are owned by Government.

West Java has three airports dedicated only for passenger, nine seaports services for both passenger and cargo and 137 rail stations that mostly prioritized for the passenger. Thus, the logistics service in West Java mostly depends more on roadways and seaways. Besides that, the government also explored the opportunity to increase the cargo transport by launching the subsidiaries of KAI that focused on rail-based logistics transportation (Kereta api logistics, 2016). Although the core sector of logistics clusters is available in West Java. Nevertheless, different from industry clusters, the logistics activities are not agglomerated yet at a specific location in West Java. In the following section, the SWOT analysis of West Java is conducted to determine the opportunities and challenges to develop successful logistics clusters. Figure 26 presents the structure of the potential logistics cluster in West Java.

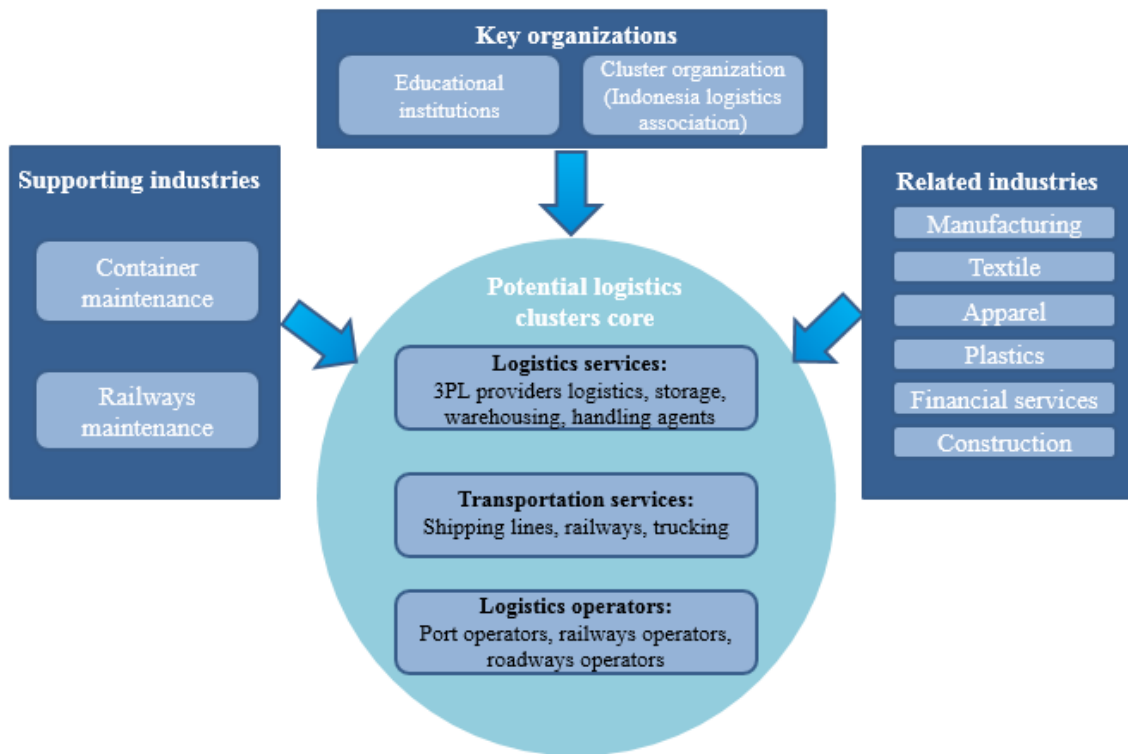


Figure 26 Potential logistics clusters in West Java

6.1.2 SWOT analysis

The SWOT analysis is conducted in order to define the current strength, weaknesses, opportunities, and threats of West Java. Therefore, besides the availability of three component of logistics clusters as explained above, the critical factors to develop logistics clusters in West Java can be determined. This section is concluded with the outcome of the SWOT analysis.

1. Government commitment

Section 3.3 presents the planning of central government to improve the logistics performance. This commitment was conducted seriously by the implementation of the “maritime highways”. In the first quarter of 2015, the government has invested 208.1 million Rupiahs to implement this planning. Furthermore, the Indonesian government proclaimed the intention to develop the shipping industry and related business to redefine its logistics system and to provide more opportunities for shipping companies while at the same time enable to lower the costs of shipping goods. The first key step is to free the shipyard business from the tariff that adds 25% of production costs. This policy could encourage investment in shipbuilding and shipyard, which is not available yet in West Java. The West Java government itself supported the national policy to improve logistics performance by issuing the Governor Regulation No. 21/2014 to accelerate the integrated transportation system. However, the government reputation that closes to corruption has become a challenge for implementation of all national and local government projects.

2. Human resources

Contrast to higher GDRP, the quantity and quality of education in West Java is relatively poor compared to another province in Indonesia. The net enrolment rate (NER) in higher education of West Java is in the second lowest after Papua. The net enrolment rate represents the extent of participation in a given level education. Higher NER means that more participant in certain level education in that region. The lower of NER is in accordance to lower HDI in West Java. According to BPS (2016), West Java is ranked at 15th in the level of national HDI and the lowest ranked in Java Islands. Lower HDI means that quality of education (and life) of people in West Java still needs significant improvement. Though, the number of academic education in West Java is high and eventually four of the best universities in Indonesia is located in this province, including Indonesia University (UI) and Institut Teknologi Bandung (ITB). Furthermore, the minimum labor costs in West Java is relatively higher compared to another province in Indonesia, especially in districts with a high standard of living and wider employment, such as Karawang and Cikarang.

3. Infrastructure

West Java has 27 industry clusters deployed in four districts, 18 clusters in Bekasi, 2 clusters in Bogor, 2 clusters in Cirebon, and 5 clusters in Karawang. The transportation is highly dependent on the road transportation. This province supported by 9 seaports, i.e. Muara Gembong, Pangadaran, Kejawanan, Muara Gebang, Eretan, Indramayu, Pamanukan, Pelabuhan Ratu, and Cirebon. Cirebon seaports are the longest seaports (1,214 meters). West Java is also supported by three airports, including Nusa Winu in Ciamis, Penggung in Cirebon, and Husein Sastranegara in Bandung. All of the airports are mostly servicing passengers. The road network is 73% in good condition with 99% of paved. The railway system is not a priority for freight. Then there is no significant inland water transport. Thus, West Java lacks significant other modes of transport rather than road transportation, particularly for the domestic transportation of goods.

Compared to the development of economic activities, the infrastructure in West Java is insufficient. Generally, the lack of infrastructure is a classic problem in Indonesia. The highly fragmented among different ministries and government caused the difficulties on decision-making process regarding the transport infrastructure planning. In addition, the geographical characteristics of West Java resulted in imbalance development among the districts. Mostly the districts in the south of the province are not well developed in term of infrastructures because they have mountain chain. Thereby, most of the manufacturing industries are located around Jakarta, such as Bekasi and Bogor and main road in the north of West Java, such as Cirebon. The agglomeration in certain location resulted in high congestion level around the industry clusters areas.

4. Collaboration of stakeholders

Using the triple helix model, it is expected that in the recent years, the relationship between institutional (university, industry, and government) in West Java inclines towards triple helix model II (the figure is shown in Figure 2, A. Triple Helix II). This model consists of separate institutional spheres with strong borders dividing them and highly restrict among them (Etzkowitz & Leydesdorff, 2000). The stakeholders worked independently either on developing clusters or innovation. The academics conducted research and presented papers regarding logistics systems. The industry and entrepreneur developed their own products or services. Then, the government was also working separately. The collaboration of stakeholders is still far away from perfect in this province. For example, the poor collaboration of stakeholders on innovation resulted in the dominance of low technology in industries. Thus the cost of production is high. To develop logistics clusters, the collaboration of stakeholders is expected ideally to incline towards the triple helix model III (the figure is shown in Figure 2, B. Triple Helix III), where the relationship among stakeholder is overlapping with each taking the role of others in order to realize the same objective.

5. Value added services

West Java has a group of well-developed industries as most manufacturing companies in Indonesia is located in this province. The manufacturing industries contributed the biggest revenue share at around 20% of total revenue. With many manufacturing industries, the potential logistics clusters have opportunities to move up to more value added ones. This process could be opportunities to attract other industry companies and stimulated the growth of start-up establishment, such as e-commerce that developed rapidly in Indonesia. The logistics provider and e-commerce have a mutual relationship. Eventually, local logistics company, JNE, gain more that 60% of their revenue from e-commerce.

Based on the description of five factors of successful logistics clusters in West Java, the outcome of the SWOT analysis is concluded in Figure 27.

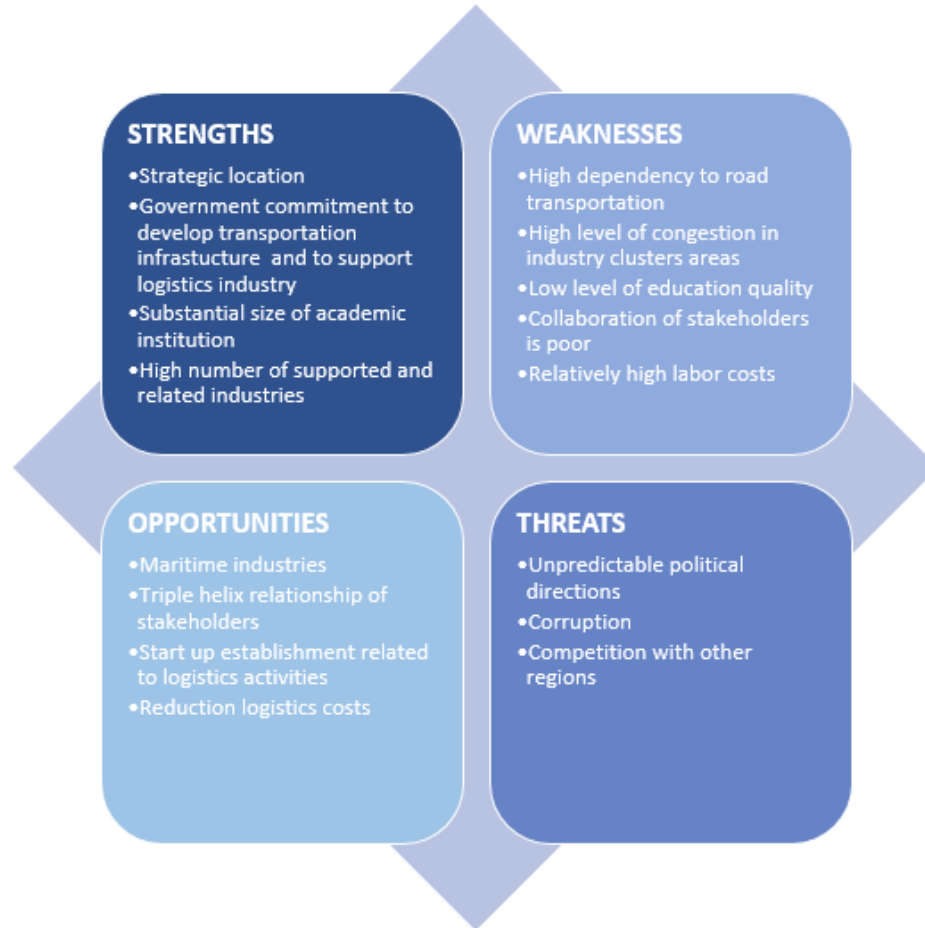


Figure 27 SWOT analysis for establishment of logistics clusters in West Java

6.2 The case of South Sulawesi

6.2.1 Framework for developing potential logistics clusters

In Chapter 2, the imbalanced development between western and eastern Indonesia has been discussed. Yet, as one of the provinces in eastern Indonesia, South Sulawesi manages to be one of the most competitive provinces and becomes a leader in terms of revenue in eastern Indonesia. In 2014, GDRP of South Sulawesi was 234 trillion Rupiahs (BPS, 2016). This province is discovered to be the potential region with numerous natural resources. Their economic activities are mostly in agriculture, forestry, fishing, manufacturing industry, and trading. Manufacturing industry contributed by 32 trillion Rupiahs or 14% of total GDRP. However, transportation and logistics sectors are only contributed around to 3.6% of total GDRP. This is even smaller than revenue from information and communication sectors which is 6.2% of total GDRP. The underrated of transportation and logistics industries could be opportunities to develop logistics clusters in South Sulawesi.

South Sulawesi has the potential to logistics cluster development due to the fact that this province is a central economic development and main bridging between western and eastern

Indonesia. The potential logistics clusters would be supported by a group of company services like container and shipping maintenance. The company of shipping maintenance is owned by state-owned companies (*Badan Usaha Milik Negara*, BUMN), which is under the management of Indonesia Port Corporation (*Pelabuhan Indonesia*, Pelindo) IV. Related industries which capable to increase the demand for potential logistics clusters are manufacturing industry, agroindustry, fisheries, mining, and construction.

Educational institution and clusters organization like ALFI (Indonesian Logistics and Forwarder Association) play an important role in the planning of establishment of logistics clusters in Sulawesi Selatan. An educational institution has offered the educational program in management and clusters-specific knowledge. Logistics service, such as storage and warehousing, freight handling and distribution are offered widely in South Sulawesi, mostly by domestic third party logistics. The physical port and airport facilities to provide logistics service are owned by Government. West Java has nine airports dedicated only for passenger and 13 seaports services both passenger and cargo. The core sector of logistics clusters in South Sulawesi is not well-developed yet compare to other industrial companies. Nonetheless, by taking into account the strategic location and ambition of the government of South Sulawesi to be the central economic development in eastern Indonesia, logistics clusters is one of the best solutions. In the following section, the SWOT analysis of South Sulawesi is discussed to determine the opportunities and challenges to develop successful logistics clusters. Figure 28 presents the framework of potential logistics clusters in South Sulawesi.

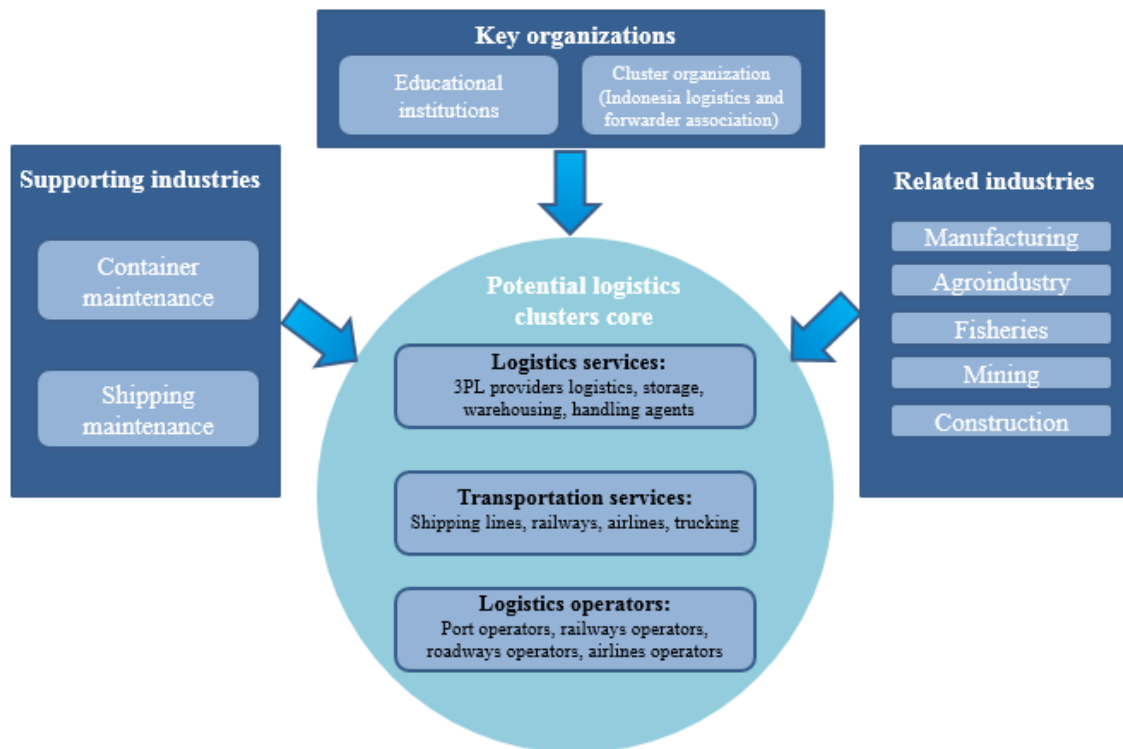


Figure 28 Potential logistics clusters in South Sulawesi

6.2.2 SWOT analysis

The SWOT analysis is conducted in order to determine the internal strengths and weaknesses as well as external opportunities and threats of South Sulawesi. This section is concluded with the outcome of the SWOT analysis of South Sulawesi.

1. Government commitment

The Indonesian government paid more attention to development infrastructure in South Sulawesi. In Masterplan Economic Development Acceleration and Expansion of Indonesia (MP3EI), the government laid down South Sulawesi as the central distribution of Indonesia Eastern Region (*Kawasan Timur Indonesia*, KTI) that focused on agroindustry, fisheries, mining, and oil and gas industry sectors. In addition, in 2011, the central government stated to construct integrated spatial city MAMMINASATA that consists of Makassar, Maros, Sungguminasa, and Takalar. This city is expected to be the central development in KTI. The commitment to develop infrastructure in South Sulawesi disclose the opportunities to the establishment of logistics clusters. Similar case with West Java, generally the Indonesian government suffered from corruption. Thus, it should be noted as one of threat in developing successful logistics clusters.

2. Human resources

In 2014, the net enrolment rate (NER) in higher education in South Sulawesi was around 60% or 5% higher than average national rate. It means that only 60% of youths belonging the official age-group corresponding to the higher education. NER of South Sulawesi has also indicated that the quality of education in this province is not at a high level. At the same time, South Sulawesi's HDI is lower than average national HDI. As the leader in KTI, the availability of academic education is relatively higher than another province in KTI. Hasanuddin University, which is located in Makassar (province city of South Sulawesi), is perceived to be the top on 25 of Indonesia's university. To increase the quality of education, the provincial government has priority to give free education from primary to higher education level. Even though the quality of education is below average, but, the minimum labor cost in this province is the second highest in KTI, after North Sulawesi.

3. Supporting infrastructure

South Sulawesi has nine airports, however, only one airport capable of cargo movement, i.e. Sultan Hasanuddin international airport. One of the biggest and the most important seaports in KTI, Soekarno-Hatta seaports is located in Makassar. All type of economic commodities in-out and distributed to remote areas in KTI. This seaport is included on five seaports that would be reconstructed as international seaports to support the "maritime highway". The other seaport is Belawan (North Sumatera), Tanjung Priok (Jakarta), Tanjung Perak (East Java), and Sorong (Papua). Soekarno-Hatta seaport is supposed to be a backup area that supports the economic growth in KTI. The geographic characteristics of this province caused the dominant role of road transportation for domestic transportation. The construction of a railway line Makassar-Pare Pare started in 2014 was welcomed enthusiastically by economic actors. This railways line is the first

stage of railways line Trans-Sulawesi which is supposed to connect cities in Sulawesi. Trans-Sulawesi railways project is intended to reach 2,000 kilometers, from Makassar to Manado. This railway is expected to press the high logistics cost component in the production cost structure and improve connectivity within Sulawesi Island.

4. Collaboration of stakeholders

The relationship between three institutional in South Sulawesi is described as the triple helix model II, where there are the strict borders between them. While the government is trying to approach industry stakeholder, yet, the role of academic in the innovation system in South Sulawesi specially and Indonesia generally is not visible yet. The collaboration is indeed important for any large-scale project. The funding might depend on government, industry institution that could offer their know-how and cutting-edge ideas, and the academic institution that could provide better knowledge for successful implementation of any project. Thus, there should be changes to the way the government managed by creating the collaboration as triple helix model III (the figure is shown in Figure 2, B. Triple Helix III) for successful establishment of potential logistics clusters.

5. Value added services

Mostly the type of manufacturing industry in South Sulawesi is agroindustry and fisheries industries. Compared to manufacturing industry in West Java that produces the high-value commodities, the opportunities to increase the value-added services from logistics industry perspective is not too significant. In this case, possibility to develop logistics clusters that lead to other types of economic clusters is a better scenario. The logistics clusters that provide the core of infrastructure and services would attract the investors either domestics and foreign direct investment (FDI) to build company in around logistics clusters.

Based on the description of five factors of successful logistics clusters in South Sulawesi, the outcome of the SWOT analysis is concluded in Figure 29.

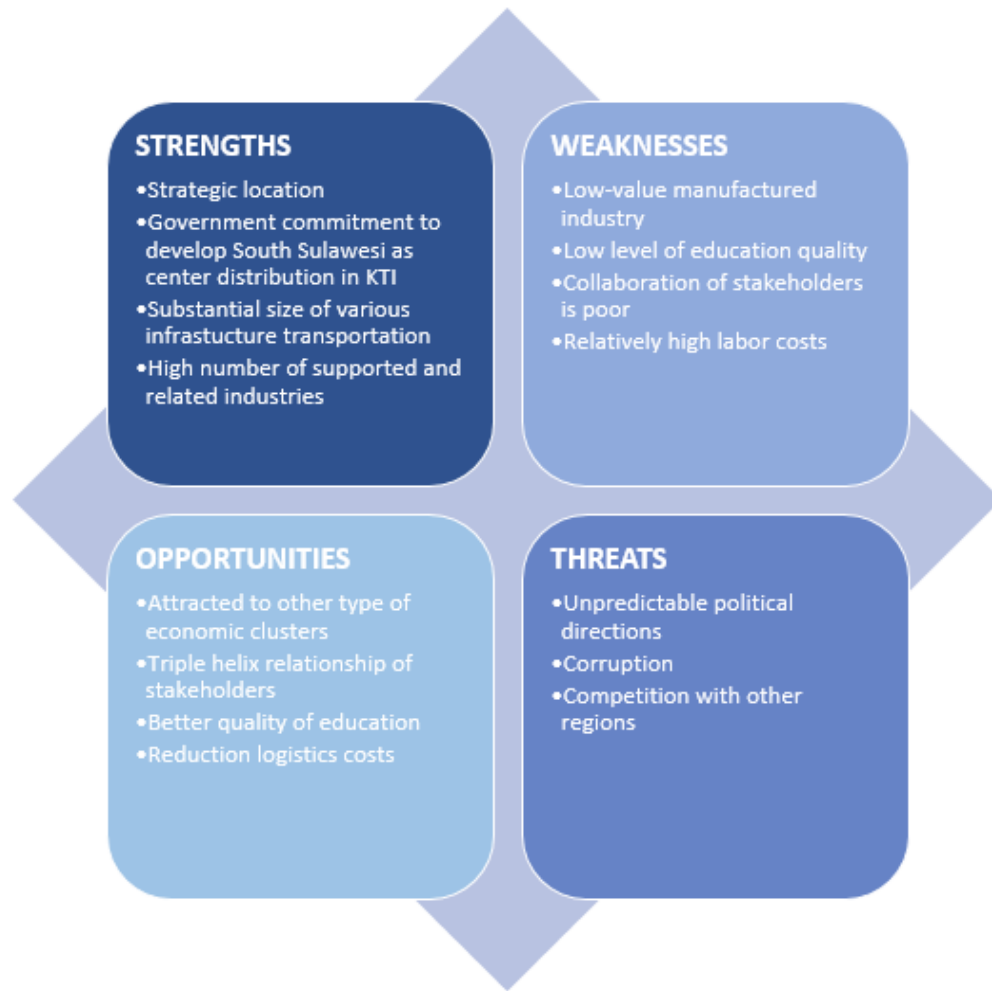


Figure 29 SWOT analysis for establishment of logistics clusters in South Sulawesi

6.3 Discussion

6.3.1 Recommendation

Looking at the framework of logistics clusters, both regions have supported and related industries to enhance the economic activities in logistics clusters. In West Java, the related industries to logistics operation mostly produce the high-value product, while in South Sulawesi, the manufacturing industry is not anchor companies and producing relatively low-value commodities. Furthermore, both region generally has the same issues in lack of transportation infrastructure, low quality of education, relatively high labor cost, and poor collaboration of stakeholders. Thereby, the recommendations in relation to establishing the potential logistics clusters could be applied in both West Java and South Sulawesi.

The first highlight would be the role of government in the investment and stewardship of clusters. Logistics cluster needs a significant base of physical assets, which require both initial and on-going government funding and are subject to government regulations. First, logistics relies on government investment in transportation infrastructure and 'soft' infrastructure. Second, the

control of the use of land is controlled by the government. Third, a government's capability to direct or indirect encourage new investment to bring wider employment in the specific area. Lastly, government control trade regulation, tax control, environmental policies, and another policies decision making that can make location open for logistics operation. Thus, the initiation of the logistics clusters project is ideally planned by the government.

The next recommendation is forming the triple helix relationship between the institutions. The government could lead the effective partnership between governments at all level, the business community, academia, and other institutions. The collaboration with each other could hold important knowledge that it is expected to make a big difference in the planning and developing logistics clusters. It is suggested to form the triple helix model III (the figure is shown in Figure 2, B. Triple Helix III), where the establishment of logistics clusters is initiated and encouraged by government and be accelerated by the strategic alliances among stakeholders, particularly the industries as part of their strategy to face the high competitiveness because of the globalization. Meanwhile, the governments and industries are supposed to work closely as well with universities and research institutions to support the acceleration of establishment of logistics clusters. The triple helix model III promotes the relationship that overlaps with each other, with each stakeholder possible to take the role of others in order to realize the same goals.

The last recommendation is more addressed to improve the quality of education by giving free education from primary to higher education. Besides, it is important to develop more infrastructures for education. In fact, Indonesia is insufficient of the research center. Thus, the government should also promote actively the importance of a research center as higher education, and research center is the engines of innovation. The availability of employees, both low skilled basic labor, and the advanced specialist would be an advantage for regions.

Specifically, the MP3EI that is aimed to accelerate and expand Indonesian economic development could be a window of opportunity for South Sulawesi to propose the establishment of logistics clusters. As compared to West Java, South Sulawesi is considered be more attractive to develop logistics clusters due to several reasons. First, this province is pointed as a central of development in eastern Indonesia, which currently these regions become government's priority. Second, the provincial government also give efforts to develop this province, both on expansion physical infrastructure and improvement of human capital's quality. In 2015, the railway Makassar-Pare Pare as the first level of Trans-Sulawesi started the groundbreaking process. Furthermore, the government of South Sulawesi supported by the central government also expanded transport infrastructure by reconstructing Soekarno-Hatta seaport and implementing the middle ring-road and flyover in Makassar. The government of South Sulawesi even spend local budgets to provide free education from primary to high education for a given population. This step is conducting to increase the quality of education as well as life inhabitants' South Sulawesi. Next, the industry clusters and SME (small and medium enterprises) have been well developed in West Java region compared to South Sulawesi. Therefore, by establishing logistics clusters in South Sulawesi, it could more likely to attract anchor manufacturing companies as in fact many of industry clusters started with a base of superior transportation services anchored in a logistics

clusters. Finally, logistics clusters are expected to give positive impact related to entrepreneurship and innovation. Those reasons should be enough to convince the government of South Sulawesi government and central government to initiate the establishment of logistics clusters in this province.

Taking into account aforementioned arguments, besides the general recommendations for both region, specifically we could recommend proposing a pilot project to establish logistics clusters in South Sulawesi. In fact that Indonesia does not have logistics clusters even though it has potential resources as an archipelagic country. Thus, the pilot project in South Sulawesi could be a crucial step to increasing the efficiency of logistics activities in Indonesia, as one of the major points of the economic growth system.

6.3.2 The expected impact of the establishment of logistics clusters to entrepreneurship, innovation, and regional economy in South Sulawesi

Related to entrepreneurship, logistics clusters are an opportunity for South Sulawesi to enhance entrepreneurial start-up. According to Delgado et al. (2010) that strong clusters enhance the range and diversity of entrepreneurial start-up opportunities. Logistics clusters provide an attraction to entry through better input in term of opportunities. The presence of logistics clusters itself signs an opportunity of transportation and logistics market. For entrepreneurs of logistics industries, the cluster is appealing because barriers to entry are lower than any location. Logistics clusters offer needed assets, skills, inputs, and human capital in regards to logistics which can be constructed more easily for new logistics firm. Moreover, logistics clusters introduce a significant local market. Then, those factors cause reducing the perceived risks of entry. Not only local logistics entrepreneurs who entrants to clusters, but also entrepreneurs who located outside a logistics clusters. Besides the lower entry barriers, they are likewise attracted due to the potential to produce more economic values from their skills and idea or the competence to perform more productively. Consequently, by establishing logistics clusters, it would stimulate the new small and medium enterprises in South Sulawesi.

The economic activities increased not only specific to logistics industries but also another type of industries. In fact, many of industry clusters started with a base of superior transportation services anchored in a logistics clusters because these clusters benefit low transportation costs. Then, the establishment of logistics clusters would expand the economic activities in South Sulawesi. Therefore, the region will not only depend on agroindustry and fisheries industry but also produce high-value commodities.

The establishment of logistics clusters in South Sulawesi could increase the companies' competitive advantages because of innovation compare to other isolated companies outside South Sulawesi. M. E. Porter (2008) argued that the benefit of clusters in innovation and productivity growth can be more important than those in current productivity. Companies within the logistics clusters are able to more explicitly and quickly to response new buyer needs in relation to logistics and supply chain process. Thus, the clusters firms' ability to grasp buyer trends often faster than isolated competition. In addition, logistics clusters participation allows advantages in

understanding new logistics technology, operating, and result in possibilities. The members could learn by makes a possible direct observation of others companies. This is more efficient in terms of time and money compare to isolated companies that devote resources to generating such knowledge internally. Companies within logistics clusters can also work together to implement innovation, whether new process or new logistics system, for example, innovation in intermodal transportation like intermodal rail transport.

The logistics clusters provide many advantages of industrial clusters, even in some cases offer more benefits to regional economics. Particularly, in increasing the number of jobs created, in the astonishing sophistication of the industry in terms of use of information technology, and global financial services (Sheffi, 2010). The establishment of logistics clusters in South Sulawesi exposes the vacancy job on three level. First is in the supply chain management activities, such as blue collar jobs and customer service and management. Next, the job creation for value-added activities, like preparing promotional tagging for retail display. The last is the job creation in manufacturing sectors. As mentioned before, that logistics clusters attract manufacturing to locate around these clusters. This creates the third level of job creation in manufacturing sectors. Those advantages could be enjoyed by society in South Sulawesi if the logistics clusters establish in their region.

6.3.3 Stakeholders analysis for the implementation of a pilot project to establish logistics clusters in South Sulawesi

As multiple stakeholders are involved in the establishment of logistics clusters pilot project in South Sulawesi, and the implementation of such project has an impact on these stakeholders, where some actors might be in favor and others against it. Knowing these actors' attitudes is pivotal to successfully implement policies. Therefore an actor analysis is performed. Based on the framework of logistics clusters in South Sulawesi, the establishment of logistics clusters that are involved in this issue including Ministry of National Development (Bappenas), Ministry of Transportation, South Sulawesi Government, industries/business community, cluster organization (ALFI), academia.

To understand how a problem could be solved, it is important to know how the actors that are involved with this project think about the project. In complex multi-actor systems, actors mostly have different desires and objectives, lead to complexity in the project implementation. To understand the position of the actors concerning the problem, an overview of actors' interests, objectives, and important resources with regards to the pilot project of establishment of logistics clusters in South Sulawesi can be made for each actor. The overview provides insight the desired situation and what resources that actors own for reaching that desired situation. The overview of actors involved can be found in Table 24.

In multi-actor systems, the significance of actors' behavior mostly depends on the power, resources, and influence of actors. In this way, some of the actors can be defined as critical if they have the power to influence other actors to stand regarding the project or even block the solution. In this case, the Ministry of National Development Planning (Bappenas) has the biggest power to issue the policy on Indonesian level. As the main policy maker, Bappenas is supportive towards

the policy in regards to establishment of logistics clusters. This is similar objective to another project in MP3EI, which expands and accelerates national economic development. However, before a policy is implemented, the policy issued by Bappenas should be agreed by the member states. The successful implementation of the establishment of logistics clusters policy would also be in favor with the central government as the logistics clusters have advantages to accelerate the nation's economy growth.

The South Sulawesi Government has a high interest and power in the network and fully supports the establishment of logistics clusters policy. Logistics clusters could be the solution to attract anchor manufacturing companies to invest in this region and also stimulate the small and medium enterprise. Thus, the economic activities do not only depend on the low-value product but also enable to produce such high-value product. Logistics clusters could open more opportunities for investors. However, there is a possibility that the local business players could lose market share due to the competition. The cluster organization (ALFI) would fully support the policy if the agreement to give priority to its members is present, and vice versa. Meanwhile, the academia would offer the knowledge to ensure the success of establishment of logistics clusters to achieve the objectives. However, they have a low interest and power in relation to project implementation. Figure 30 Power-interest matrix of the actors shows a distribution of interest stakeholders based on the actors' power to drive the project implementation.

Based on the power-interest matrix showed in Figure 30, there should be no stakeholders that oppose the establishment of logistics clusters. However, there are certain actors that have diffused attitude towards this policy. They can support the policy if the policy has favorable advantages for the effort they do but they can also oppose the policy if the risks are high. From the position of the actors within the clusters arena, it analyzed that most parties are seeking for logistics clusters policy, in combination with innovation to increase efficiency transportation system, such as "maritime highway" policy. A combination of these two mechanisms would result in appealing actors that are in favor of economy and logistics growth.

Table 24 The overview of actors' interests, objectives, and important resources with regards to the pilot project of establishment of logistics clusters in South Sulawesi

Actors	Interests	Objectives	Important Resources
Central Government	- Empowering economic growth in Indonesia	- Reducing price disparities in eastern Indonesia - accelerating development economy	- Formal authority to grant permission for big construction projects
Ministry of National Development Planning (Bappenas)	- Formulation the national and public policy on Indonesia's development	- Good public policy on Indonesia's development	- Formal authority in national policy formulation, regulation, and implementation
South Sulawesi Government	- Empowering economic growth in South Sulawesi	- Attracting anchor companies to invest in South Sulawesi - Stimulating the new small and medium enterprises in South Sulawesi	- Formal authority to propose construction projects in South Sulawesi
Local Industries community	- Profit and revenue	- Reducing logistics costs and then lead to high profit	- Investment/money - Technology - Experiences
Cluster organization (ALFI)	- Ensuring industries' interest can be realized	- Keeping the trust from members/ industries community	- National network member is over 3,800 companies - Independent - Financial donors
Academia	- Research and development of knowledge and technology/innovation for the society	- Technologies/innovation those are sustainable, useful for society, environmentally friendly, and economically benefits	- Human capital - Knowledge - Research facilities

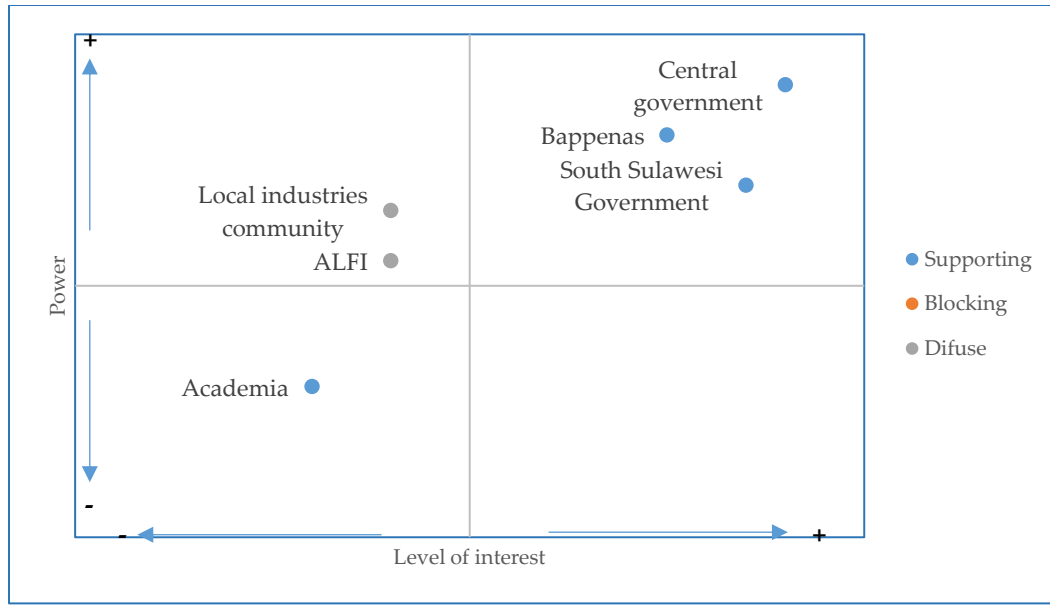


Figure 30 Power-interest matrix of the actors

7

Conclusions, implications, and reflections

Outlines

This chapter presents the conclusions of this study. Section 7.1 discusses the conclusions with regards to the research questions based on findings of this study. Then, Section 7.2 presents the implications, the limitations of this study and also comes up with recommendations for further research. Finally, Section 7.3 concludes with reflection towards the study.

7.1 Conclusions

This section provides conclusions of this study, by answering the sub question and the main research question.

7.1.1 Sub Question 1

The first research sub-question is posed as “*What are critical factors to analyze the opportunities for establishment of logistics clusters?*” This sub-question is essential as the foundation to analyze what is critical factors for the establishment of logistics clusters.

Chapter 2 of this study aimed to answer this research sub-question. The various perspective related to logistics clusters in this study coincides that logistics clusters are the geographical concentration of logistics activities. Even though the characteristics of logistics clusters are similar to other economic clusters, they have different characteristics related to the process of establishment of clusters. This type of clusters particularly depends on geographical position, quality of transportation infrastructure, and government role towards the initiation of establishment of logistics clusters. M. E. Porter (2008) emphasizes that in many cases the birth of logistics clusters is driven by the availability of comparative advantage linked to a geographical position. In addition, the establishment of logistics clusters might be caused by various factors as well. The three particular factors are argued by M. E. Porter (2008) as important factors: intensity local competition which drives rapid improvement and entrepreneurship, the location’s entrepreneurship climate, and the effectiveness of organizational and relationship-building mechanisms for bringing clusters members together.

Meanwhile, (Sheffi, 2012) argued that there are six factors that contribute to establishing the successful logistics clusters, i.e. geography of logistics clusters, infrastructure, government, education and human capital, a collaboration of stakeholders, and value-added services.

1. Geography of logistics clusters

The geographical position is considered as the basic factor in the foundation for the establishment of logistics clusters. Geography matters more to logistics clusters than other types of industrial or knowledge clusters. The location impacts the ease with which regions engage in trade. It considers the proximity to market of any region within a fixed time by a specific mode of transportation. The strategic geographical position provides high accessibility of both land and sea transportations. Then, it provides an advantage to develop air connectivity. Moreover, the establishment of logistics clusters requires the availability of massive, inexpensive land areas.

2. Infrastructure

Infrastructure is a key to ensuring the effective functioning of the economy. Logistics and transportation services require a well-developed infrastructure both physical and ‘soft.’ The physical infrastructure considered the condition of highways, railroads, seaports, and airports, whether the transportation infrastructure enables the economic agents to move their goods and services to market safely and timely manner. The ‘soft’ infrastructure,

such as financial service and information and communication technology (ICT) service are required to support at the basic level of establishment of logistics clusters to support a cluster which starts growing.

3. Government

The role of government is emphasized as crucial in driving the establishment of logistics clusters. The majority of the establishment of these clusters is driven by the government, such as the Plataforma Logistics de Zaragoza (PLAZA). Logistics clusters are highly dependent on supportive government. As a logistics cluster needs a significant base of physical assets, which require both initial and on-going government funding and are subjected to government regulations.

4. Education and human capital

Both of quantity and quality of human resources are the most significant factor to guarantee the sustainability of logistics clusters. The education increases the efficiency of individual workers. The availability of employees, both low skilled basic labor, and the advanced specialist would be an advantage for regions. They are sources of innovation and technology that help companies that want to move up the value chain beyond the simple supply chain concepts.

5. Collaboration of stakeholders

While collaboration is important for a significant transportation infrastructure development, it is also a key on innovation system in logistics clusters. The interaction between stakeholders could be explained by innovation system concept. According to Edquist (2001), the innovation system is defined as all important economic, social, political, organizational, and other factors that influence development, diffusion, and use of the innovation. The establishment of logistics clusters was a result of the active participation of stakeholders in the innovation system, i.e. government, university, and industry.

6. Value-added services

The logistics industry is beyond moving and storage activities and could attract anchor companies to invest in a region. They can provide value-added services that support many industries, particularly manufacturing industries. Many manufacturing clusters started with a foundation of superior transportation and logistics services in logistics clusters, such as in Memphis (Sheffi, 2012).

Related to geographical position and infrastructure factors, the literature study indicated the relationship between accessibility with the factors of the establishment of logistics clusters, where a region with higher accessibility is highly possible to attract logistics companies that lead to agglomeration. Then, in this research, **logistics clusters are defined as the geographical concentration of logistics firms and operations, in which the emergence of this clusters depends on accessibility and quality of transportation infrastructure. The logistics clusters would be expected to develop in the region with higher accessibility that has a high concentration of logistics activities and substantial market size.**

7.1.2 Sub Question 2

The second research sub-question is addressed at *“What are substantial inputs to be considered to analyze the opportunities for the establishment of logistics clusters based on the current situation of socio-economic and logistics in Indonesia?”* This sub-question is addressed to identify some useful information refers to the current situation of socio-economic and logistics in Indonesia as substantial inputs to analyze the critical factors of the establishment of logistics clusters.

Based on data availability, information, and discussion on Chapter 3, there are substantial inputs to be considered to identify the opportunities for establishment of logistics clusters in Indonesia that are determined.

1. The simulation would be conducted based on province level, which consisting of 33 provinces. Though presently Indonesia has 34 provinces, considering the data availability, North Kalimantan is assumed as a part of East Kalimantan.
2. By considering the priority of Indonesian government to develop eastern Indonesia due to the imbalance development progress compared to western Indonesia, the analysis of the opportunities for establishment of logistics clusters conducted for western and eastern Indonesia separately.
3. The multimodal transport system is expected to be the backbone of the transportation planning in Indonesia. Therefore, multimodal should be considered in the simulation. Nevertheless, based on the recommendation of multimodal transportation system by LPPM-ITB, there are three assumptions taken into account on strategy of multimodal transportation system for developing logistics clusters in this research: 1) the goods characteristic is suitable for container and dry bulk, and 2) considered the geographical characteristics of Indonesia, it is assumed that all freight shipping is long distance trip and inter-islands, 3) thus, only two modes that are recommended, i.e. roadway and sea modes.
4. The implementation of “maritime highway” policy is expected to impact the transportation costs in the future (2019) in the routes that serve by maritime connectivity include the alternative main routes as well as the routes for the affiliation between hub ports and feeder ports.
5. The target of GDRP growth is assumed would be realized in 2019. Therefore, the data for the period 2019 could be developed by adjusting the data based on the projection growth by Ministry of National Development Planning.

7.1.3 Sub Question 3

The third research sub-question is posed as *“How to analyze the critical factor for establishment of logistics clusters served by multimodal freight transportation in Indonesia?”* The methodology to identify the critical factors of logistics clusters in Indonesia discussed in Chapter 4.

Multimodal freight accessibility measures are conducted to analyze the geographical position and infrastructure factors. The region which results in the highest accessibility value is reviewed as the most potential location of the establishment of logistics clusters due to the advantage of strategic location and well-developed transportation infrastructure. To measure accessibility for

logistics clusters that served by multimodal freight transportation in Indonesia, the modification of potential accessibility measures is applied. Aligning with the definition of logistics clusters in this study, the weighted is taking into account both the significant market size and logistics activities of a possible location. It is assumed that location with the high economic attractiveness, more logistics activities and better accessibility had bigger opportunities to attract companies to invest in the place and even convince the government to develop the location for logistics clusters. By considering the data availability, only travel costs, both road modes and sea modes are used to calculate costs, done by multiplying the travel distance by a cost per kilometer. Lastly, the exponential function is used as impedance function of the travel costs. The calculation would be conducted in Excel, and then GIS approach was applied to analyze of the cartographical presentation as the output of accessibility measure process.

Meanwhile, the SWOT analysis is performed to analyze government, education and human capital, collaboration, and value-added services of the selected province based on the analysis of geographical position and infrastructure factors. The framework of logistics clusters, which could be structured into four components, 1) cluster core consist of logistics service, transportation service, and logistics operators, 2) related industries, 3) supporting industries, 4) key organizations which significant to accelerate the deployment of logistics clusters is a foundation to conduct the SWOT analysis for the selected province. The SWOT analysis would be the basis to find out the opportunities of the selected province for establishing logistics clusters.

To analyze the six critical factors, some assumptions and identified methods are needed to be applied in this study. The following are the assumptions and identified methods for each critical factor for establishing the logistics cluster.

1. To analyze the geographical position, it is assumed that the most strategic location has the highest accessibility value.
2. To analyze infrastructure factors, it is assumed that regions with the highest accessibility value have been supported by well-developed physical and 'soft' infrastructure.
3. To analyze the government factor, a long-term vision in both political and economic issues is identified to understand the condition in the region whether sustained for making an investment or entering a new market. National and local policies that related to national policies also would be identified.
4. To analyze education and human capital, quantity and quality of education given to the inhabitants is identified. It is analyzed by finding the size of people with higher education and level of human development index. In addition, the number of the academic institution, and research center also indicated the level of human resources in the region.
5. To analyze collaboration of stakeholders, the triple helix model is identified to understand the relationship of the stakeholders on forming the collaboration in logistics clusters.
6. To analyze value-added services, the size (by revenue and employment) of local (manufacturing industry) is identified.

7.1.4 Main Research Question

The main research question is addressed at *“What are the opportunities for establishment of logistics clusters served by door-to-door multimodal transportation systems in Indonesia?”* The answer for this research is derived from the finding in Chapter 5 and Chapter 6.

The analysis of multimodal freight accessibility value is conducted based on three different scenarios, one base scenario which counts both of land use and transport changes in 2010 and two developed scenarios which take into account changes either transport or land use components in 2019. All scenario provides a similar spatial pattern of distribution of accessibility measures. In western Indonesia, the opportunities for establishment of logistics clusters served by multimodal freight transportation are promising in West Java. Meanwhile, South Sulawesi is indicated as the most potential location for logistics clusters in eastern Indonesia. Both provinces have the highest accessibility value in each representative region. It is indicated that both regions have a strategic geographical position, supported by well-developed physic and “soft” infrastructure as well as economic activities to establish logistics clusters.

The implementation of “maritime highway” policy did not show the impact to the spatial pattern distribution of accessibility value in the future (scenario 2). The accessibility gain due to decreasing of travel costs as the impact of this policy is not significant compared to accessibility value in 2010. This result indicated that the transport components which are represented by shipping impedance have the relatively small influence to multimodal freight accessibility in Indonesia in terms of establishment of logistics clusters in Indonesia. However, this policy is still offering a slightly improvement to accessibility value overall. The biggest impact of this policy is shown on the province in eastern Indonesia, i.e. Nusa Tenggara Timur (NTT). This province is found to have the highest percentage gain compared to others region.

Meanwhile, if the GRDP growth is achieved in 2019 and then it increases the activities and logistics activities (scenario 3), the accessibility map is not changed as well. However, the accessibility value because the land-use changes increases significantly. It shows that the land-use component has more influence than transport component. If the Indonesian government is able to complete the implementation of infrastructure development planning to achieve the target of GDRP growth, hence, the accessibility value across the nation would improve. Then, it is supposed to increase the possibilities of establishment of logistics clusters to succeed in the future.

SWOT analysis is used to analyze the internal strengths and weakness as well as external opportunities and threats in regards to the establishment of logistics clusters in both selected regions, West Java and South Sulawesi. The strengths of West Java are mainly for government commitment to improve logistics performance, the large size of the academic institution, and a number of industries that related and supporter of logistics clusters. Meantime, South Sulawesi has additional strengths in terms of various transportation infrastructures. Both of provinces experience lack of transportation infrastructure, low quality of education, relatively high labor cost, and poor collaboration of stakeholders. Those weaknesses mostly result from the weak of governance systems in Indonesia. The highly fragmented among different ministries and

government caused the difficulties on decision-making process regarding the transport infrastructure planning. Then, it is compounded by the government reputation that close to the corruption that becomes a challenge for implementation of all national and local government planning.

In the process of establishment of logistics clusters, the role of government is crucial as a leader on the project initiation, a driver for collaboration of stakeholders, and a controller of the planning implementation. Considering the MP3EI as a window of opportunity, South Sulawesi might have more opportunities to develop logistics clusters than West Java. Finally, it suggested to start the pilot project for establishing logistics clusters in South Sulawesi that is expected to attract anchor industries and foreign direct investments (FDIs) as well as encourage the growth of small and medium enterprises (SMEs). The economic activities increased not only specific to logistics industries but also another type of industries. Then, the establishment of logistics clusters would expand the economic activities in South Sulawesi. Therefore, the region will not only depend on agroindustry and fisheries industry but also produce high-value commodities.

The establishment of logistics clusters in South Sulawesi also could increase the companies' competitive advantages because of innovation compare to other isolated companies outside South Sulawesi. Furthermore, the logistics clusters provide many advantages of industrial clusters, even in some cases offer more benefits to regional economics. The establishment of logistics clusters in South Sulawesi exposes the vacancy job on three level. First is in the supply chain management activities, such as blue collar jobs and customer service and management. Next, the job creation for value-added activities, like preparing promotional tagging for retail display. The last is the job creation in manufacturing sectors. Those advantages could be enjoyed by society in South Sulawesi if the logistics clusters establish in their region.

Based on the stakeholder analysis, there should be no stakeholders that oppose the establishment of logistics clusters in South Sulawesi. However, there are certain actors that have diffused attitude towards this policy. They can support the policy if the policy has favorable advantages for the effort they do but they can also oppose the policy if the risks are high. From the position of the actors within the clusters arena, it analyzed that most parties are seeking for logistics clusters policy, in combination with innovation to increase efficiency transportation system, such as "maritime highway" policy. A combination of these two mechanisms would result in appealing actors that are in favor of economy and logistics growth.

7.2 Recommendations, limitations, and further studies

Scientific contribution of this study is a theory regarding the multimodal freight accessibility measures related to the establishment of logistics clusters in Indonesia. This study develops modified potential accessibility measures for the establishment of logistics clusters that could be applied to the measurement of multi-modal freight accessibility generally and particularly for Indonesia. Some adaptation has been made considering the current situation of transportation and logistics in Indonesia, such as the type of freight shipping and recommended modes. Furthermore,

this study develops a framework of potential logistics clusters in selected provinces, West Java and South Sulawesi, and presented it as a foundation for development planning in the future.

In relation to policy analysis from the Indonesian government, the current economy growth target and planning from Indonesian government as applied in the accessibility measures seemingly still needs more acceleration for eastern Indonesia in the future for more balance future demand. Thus, the aims to reduce price disparities and the economic gap between eastern and western Indonesia could be realized immediately. Besides the infrastructure expansion, to reduce the logistic cost, the government is required to improve the performance all transportation infrastructures like seaports and airports. This could be done through human resources development, infrastructure improvement, equipment and facility purchasing, and supporting regulations in both local and national level.

Although this study could offer some recommendations for the development of potential logistics cluster, there are some limitations and assumptions used in this study. Accessibility measures in this study are only able to calculate at province level. The multimodal transportation systems are assumed for two modes instead of including all type of modes transportation. In addition, travel cost is also obtained from an online application tool for calculation distances and shipping rates instead of using the real data from port authority. There are still other important assumptions used in this study, and it will be better if the next studies can use minimize assumptions and limitation by establishing more detail approaches using real data and facts. In addition, this study is conducted to identify the opportunities for establishment of logistics clusters in Indonesia by considering the target of Indonesian government on expanding and accelerating the economy growth. To identify the most potential location for logistics cluster, accessibility analysis is conducted. Even though this study involved GIS on accessibility analysis, due to the limitations of software QGIS, the accessibility calculation is done by Excel. It will be better if all step of accessibility analysis is conducted using software that provides accessibility analysis extension, such as ArcView.

According to limitations and assumptions used in this thesis, future studies could be conducted for accessibility measures at the district level in order to obtain the most accurate value to choose the potential location, either for logistics clusters or for another interest. Furthermore, the future studies could include another mode of transportation on calculating the accessibility value. It is also better to use of generalized cost that considered not only distance but also time and convenience of travel. Currently, Indonesia does not have activities that focused on collecting transportation data, such as the Dutch National Travel Survey that has been conducted by Statistics Netherlands (CBS). Therefore, for better future studies regarding accessibility measures, it is suggested to Statistics Indonesia to conduct this kind of survey as accessibility measures are significant for developing spatial transportation planning. In addition, this study found that value of cost sensitivity parameter (β) in Indonesia is close to zero, meaning that the sensitivity to travel cost is low. It needs further validation since the travel cost which is used in this study was not based on real data. Consequently, the future studies are expected to process bigger data. To work

with bigger data, it is difficult to depend on Excel. Thus, application of software that provides accessibility analysis extension, such as ArcView is highly recommended.

7.3 Reflection

This section explicates the experienced gained during the research. This research is divided into three different parts of approach, first through literature review and then accessibility measurement that is conducted in Excel and QGIS as well as SWOT analysis. The literature review is performed to understand the concept of logistics cluster, develop accessibility measures for the establishment of logistics clusters, and gain more perspective about the current situation in Indonesia in regards to opportunities for establishment of logistics clusters. This approach was proven to be challenging, particularly to select the suitable variables of accessibility measure in relation to the establishment of logistics clusters in Indonesia that served by multimodal freight transportation. The selection of variables should not only fit the objective of accessibility measures, in this case, to select the most potential location for logistics clusters, but also applicable in Indonesia case.

However, the biggest challenge comes from in accessibility measurement approach. The zero experiences and knowledge in terms of accessibility, makes this approach came as quite a struggle. Introduction to the GIS application became the most prominent challenge, mainly because this application is not familiar for many students and is used by a specific field of study. Therefore, self-study is inevitable to enable utilizing this application. Moreover, so many kinds of GIS application is available that have different advantages and disadvantages. Even, to select the most appropriate application requires a quite effort and time. Yet, the efforts have paid off through this study.

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Appendix 1: National final demand and purchases of commodities from the manufacturing sector in 2010

Year : 2010		Personal consumption expenditures for manufactured goods (Million Rupiahs)	Purchase from manufacturing (Million Rupiahs)									Total
No.	Province		Agriculture	Mining	Manufacturing	Construction	Transportation, storage, and communication	Utilities	Trade, hotel, and restaurant	Finance, Insurance, and real estate	Other Services	
1	Aceh	36,622,572	1,515,215	258,811	4,645,421	11,211,618	1,742,016	447,549	3,756,995	295,197	2,856,191	26,729,012
2	Sumatera Utara	109,977,748	5,380,186	582,509	27,158,593	31,499,850	7,220,186	1,535,228	14,290,297	1,319,103	6,984,799	95,970,751
3	Sumatera Barat	38,021,397	1,684,586	552,365	8,255,608	10,717,485	2,378,824	451,494	4,855,133	495,846	2,678,320	32,069,660
4	Riau	60,598,533	1,813,300	705,249	7,571,043	12,816,700	2,394,617	845,904	4,881,357	653,245	2,921,897	34,603,312
5	Jambi	28,160,398	1,517,232	553,057	2,985,430	5,993,145	1,309,156	239,186	2,750,617	291,107	1,712,266	17,351,196
6	Sumatera Selatan	88,012,423	3,716,119	624,933	10,010,563	13,271,446	3,584,217	862,548	5,955,841	712,743	3,306,069	42,044,480
7	Bengkulu	12,298,106	886,163	197,050	1,227,311	3,640,847	573,988	153,005	1,506,286	152,293	935,178	9,272,121
8	Lampung	62,383,650	3,949,144	392,894	17,308,830	15,706,939	3,862,472	475,783	6,785,128	415,166	3,238,218	52,134,574
9	Kepulauan Bangka Belitung	11,866,466	358,261	2,612,893	1,559,536	2,680,040	353,733	93,578	1,502,568	117,482	611,061	9,889,152
10	Kepulauan Riau	26,214,006	183,541	264,706	15,086,396	5,227,522	1,309,717	406,986	1,834,792	359,714	998,508	25,671,883
11	DKI Jakarta	309,225,923	53,284	428,352	45,063,769	19,692,600	9,958,312	2,154,275	20,721,495	6,759,254	9,519,880	114,351,221
12	Jawa Barat	317,581,246	7,417,597	2,524,383	202,300,770	103,519,502	28,263,777	7,303,922	50,283,497	7,310,487	20,966,849	429,890,783
13	Banten	95,370,388	1,352,191	658,828	62,906,810	23,388,465	9,014,798	1,949,611	14,220,242	3,295,562	6,363,117	123,149,624
14	Jawa Tengah	228,129,404	10,509,232	2,613,519	168,039,986	107,643,890	15,537,205	2,413,681	40,500,977	3,890,174	15,480,897	366,629,559
15	DI Yogyakarta	24,184,819	1,009,852	314,141	14,748,560	11,305,199	1,576,181	208,240	5,238,634	836,239	2,512,071	37,749,118
16	Jawa Timur	318,555,796	14,855,765	2,989,622	148,179,958	92,003,075	17,678,062	3,164,281	45,274,031	5,019,468	19,304,483	348,468,745
17	Bali	27,095,282	1,257,778	157,238	18,120,710	14,812,770	2,227,402	487,249	6,828,242	1,272,868	2,534,655	47,698,911
18	Nusa Tenggara Barat	28,228,386	1,880,930	1,392,702	12,183,038	8,741,880	2,552,989	607,335	4,453,081	331,177	2,164,338	34,307,470
19	Nusa Tenggara Timur	22,618,700	2,495,404	673,565	8,593,444	6,424,444	2,300,305	213,418	1,802,042	211,294	1,818,017	24,531,933
20	Kalimantan Barat	33,515,940	2,369,653	1,199,694	6,025,832	10,496,488	1,309,811	352,244	3,266,243	387,343	1,755,767	27,163,075
21	Kalimantan Tengah	17,427,127	1,056,823	1,247,053	2,122,635	5,477,519	831,047	252,994	1,671,005	154,760	1,014,510	13,828,347
22	Kalimantan Selatan	24,375,371	1,362,471	1,697,220	7,746,884	7,761,636	1,849,079	348,422	4,642,902	404,002	1,934,940	27,747,557
23	Kalimantan Timur	34,470,988	854,051	2,587,037	4,964,634	9,084,328	1,830,759	781,546	3,913,586	949,480	2,226,658	27,192,079
24	Sulawesi Utara	13,697,682	669,036	384,588	3,021,481	6,082,408	1,821,845	561,470	2,064,487	324,059	1,438,215	16,367,589
25	Sulawesi Tengah	22,344,912	1,240,824	556,094	2,318,771	4,488,740	1,031,836	340,408	1,961,467	171,809	1,379,083	13,489,031
26	Sulawesi Selatan	59,336,648	2,942,306	377,398	11,779,008	16,325,710	4,073,299	1,300,974	7,215,280	836,131	3,944,842	48,794,948
27	Sulawesi Tenggara	16,486,038	928,179	478,547	3,203,232	3,866,369	1,070,768	299,599	1,893,432	142,233	1,386,768	13,269,128
28	Gorontalo	5,921,868	331,141	205,111	2,102,699	2,087,183	780,300	83,715	851,543	100,541	641,684	7,183,917
29	Sulawesi Barat	7,324,689	599,099	51,244	1,755,672	1,528,572	372,169	41,426	770,504	36,845	518,448	5,673,980
30	Maluku	9,229,231	564,178	87,729	1,752,389	1,938,995	851,846	66,454	1,023,960	111,402	828,551	7,225,505
31	Maluku Utara	6,675,223	446,810	141,943	585,423	1,260,475	552,136	184,814	523,311	76,222	566,108	4,337,242
32	Papua Barat	7,328,187	320,075	150,874	734,166	1,648,686	352,025	72,372	452,432	61,510	426,648	4,218,788
33	Papua	24,862,254	2,121,823	349,912	1,087,401	2,813,214	901,049	159,170	1,149,834	140,134	937,718	9,660,255
	INDONESIA	2,128,141,401	77,642,251	28,011,258	825,146,003	575,157,741	131,465,929	28,858,880	268,841,240	37,634,887	125,906,756	2,098,664,945

Source: (BPS, 2016)

Appendix 2: National purchases of services from logistics industry in 2010

Year : 2010		Purchase from Logistics (Million Rupiahs)									
No.	Province	Agriculture	Mining	Manufacturing	Construction	Transportation, storage, and communication	Utilities	Trade, hotel, and restaurant	Finance, Insurance, and real estate	Other Services	Total
1	Aceh	25,036	172,995	350,336	1,138,129	546,524	59,313	580,103	75,622	727,535	3,675,594
2	Sumatera Utara	88,896	389,363	2,048,176	3,197,657	2,265,195	203,460	2,206,510	337,923	1,779,183	12,516,364
3	Sumatera Barat	27,834	369,214	622,600	1,087,968	746,310	59,835	749,663	127,024	682,228	4,472,677
4	Riau	29,961	471,405	570,973	1,301,067	751,265	112,106	753,712	167,346	744,272	4,902,107
5	Jambi	25,069	369,677	225,147	608,385	410,722	31,699	424,712	74,575	436,152	2,606,138
6	Sumatera Selatan	61,401	417,720	754,951	1,347,230	1,124,479	114,311	919,619	182,588	842,129	5,764,428
7	Bengkulu	14,642	131,713	92,558	369,595	180,078	20,277	232,580	39,014	238,211	1,318,667
8	Lampung	65,251	262,620	1,305,352	1,594,465	1,211,776	63,054	1,047,666	106,356	824,846	6,481,387
9	Kepulauan Bangka Belitung	5,920	1,746,521	117,613	272,060	110,977	12,402	232,006	30,096	155,651	2,683,245
10	Kepulauan Riau	3,033	176,936	1,137,747	530,664	410,899	53,937	283,303	92,150	254,342	2,943,010
11	DKI Jakarta	880	286,321	3,398,502	1,999,063	3,124,229	285,501	3,199,527	1,731,563	2,424,925	16,450,511
12	Jawa Barat	122,560	1,687,358	15,256,594	10,508,617	8,867,216	967,970	7,764,082	1,872,776	5,340,722	52,387,896
13	Banten	22,342	440,376	4,744,142	2,374,243	2,828,219	258,377	2,195,693	844,246	1,620,827	15,328,466
14	Jawa Tengah	173,643	1,746,939	12,672,803	10,927,297	4,874,499	319,879	6,253,601	996,572	3,943,328	41,908,561
15	DI Yogyakarta	16,686	209,980	1,112,269	1,147,629	494,497	27,597	808,877	214,225	639,880	4,671,640
16	Jawa Timur	245,460	1,998,335	11,175,051	9,339,545	5,546,152	419,354	6,990,590	1,285,871	4,917,280	41,917,639
17	Bali	20,782	105,102	1,366,581	1,503,695	698,804	64,574	1,054,323	326,079	645,633	5,785,572
18	Nusa Tenggara Barat	31,078	930,916	918,789	887,418	800,951	80,489	687,583	84,840	551,305	4,973,368
19	Nusa Tenggara Timur	41,231	450,227	648,078	652,167	721,677	28,284	278,246	54,129	463,089	3,337,128
20	Kalimantan Barat	39,154	801,904	454,441	1,065,534	410,928	46,682	504,328	99,228	447,233	3,869,432
21	Kalimantan Tengah	17,462	833,560	160,079	556,042	260,725	33,529	258,014	39,646	258,418	2,417,474
22	Kalimantan Selatan	22,512	1,134,463	584,234	787,910	580,113	46,176	716,893	103,496	492,872	4,468,668
23	Kalimantan Timur	14,111	1,729,238	374,410	922,181	574,366	103,576	604,282	243,235	567,179	5,132,578
24	Sulawesi Utara	11,054	257,068	227,866	617,446	571,569	74,410	318,769	83,016	366,345	2,527,545
25	Sulawesi Tengah	20,502	371,707	174,871	455,667	323,719	45,113	302,863	44,013	351,283	2,089,738
26	Sulawesi Selatan	48,615	252,262	888,319	1,657,278	1,277,919	172,415	1,114,084	214,197	1,004,839	6,629,928
27	Sulawesi Tenggara	15,336	319,872	241,573	392,488	335,933	39,705	292,358	36,437	353,241	2,026,943
28	Gorontalo	5,471	137,101	158,576	211,877	244,804	11,095	131,484	25,756	163,451	1,089,615
29	Sulawesi Barat	9,899	34,253	132,405	155,171	116,761	5,490	118,971	9,439	132,060	714,448
30	Maluku	9,322	58,640	132,157	196,834	267,250	8,807	158,106	28,539	211,050	1,070,705
31	Maluku Utara	7,383	94,878	44,150	127,955	173,222	24,493	80,802	19,526	144,200	716,610
32	Papua Barat	5,289	100,848	55,367	167,364	110,441	9,591	69,858	15,757	108,677	643,193
33	Papua	35,059	233,889	82,007	285,579	282,687	21,094	177,541	35,899	238,858	1,392,613
	INDONESIA	1,282,875	18,723,401	62,228,716	58,386,219	41,244,906	3,824,595	41,510,747	9,641,181	32,071,246	268,913,886

Source: (BPS, 2016)

Appendix 3: Accessibility measures of transport and land use for 'current' (the year 2010)

- Travel Cost

Travel cost per tonnage in Rupiah in 2016 (1 of 2)

Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	-	526,588	1,042,051	1,001,877	1,478,402	1,776,308	1,723,154	2,125,512	3,153,348	1,301,019	2,378,299	2,532,814	2,351,722	2,862,241	2,936,408	3,191,668	3,634,199
2 Medan	526,588	-	802,861	710,770	1,191,004	1,488,909	1,518,576	1,879,524	2,907,977	801,625	2,132,929	2,287,444	2,106,352	2,616,871	2,691,038	2,946,297	3,388,829
3 Padang	1,042,051	802,861	-	348,586	653,291	836,237	580,977	1,155,774	2,183,610	1,597,688	1,408,561	1,563,077	1,381,985	1,892,503	1,966,670	2,221,930	2,664,461
4 Pekanbaru	1,001,877	710,770	348,586	-	479,615	776,903	809,042	1,168,135	2,196,589	1,509,923	1,421,541	1,576,056	1,394,964	1,905,482	1,979,032	2,234,909	2,676,823
5 Jambi	1,478,402	1,191,004	653,291	479,615	-	297,287	477,761	687,902	1,716,356	1,985,830	941,307	1,095,822	914,730	1,425,249	1,499,416	1,754,675	2,197,207
6 Palembang	1,776,308	1,488,909	836,237	776,903	297,287	-	468,490	397,413	1,425,867	2,280,645	650,818	805,952	624,242	1,134,760	1,208,928	1,464,805	1,906,718
7 Bengkulu	1,723,154	1,518,576	580,977	809,042	477,761	468,490	-	621,151	1,648,987	2,323,292	873,938	1,029,072	847,362	1,358,498	1,432,048	1,687,925	2,129,839
8 Bandar Lampung	2,125,512	1,879,524	1,155,774	1,168,135	687,902	397,413	621,151	-	1,029,690	1,498,180	254,641	409,775	228,065	739,201	812,750	1,068,628	1,510,541
9 Pangkal Pinang	3,153,348	2,907,977	2,183,610	2,196,589	1,716,356	1,425,867	1,648,987	1,029,690	-	1,992,011	778,757	927,710	807,188	1,257,136	1,330,686	1,586,563	2,028,477
10 Batam	1,301,019	801,625	1,597,688	1,509,923	1,985,830	2,280,645	2,323,292	1,498,180	1,992,011	-	1,246,629	1,394,964	1,275,060	1,724,390	1,798,558	2,053,817	2,496,349
11 Jakarta	2,378,299	2,132,929	1,408,561	1,421,541	941,307	650,818	873,938	254,641	778,757	1,246,629	-	164,404	95,181	493,831	567,998	823,257	1,265,789
12 Bandung	2,532,814	2,287,444	1,563,077	1,576,056	1,095,822	805,952	1,029,072	409,775	927,710	1,394,964	164,404	-	188,509	488,886	431,407	818,313	1,260,845
13 Tangerang	2,351,722	2,106,352	1,381,985	1,394,964	914,730	624,242	847,362	228,065	807,188	1,275,060	95,181	188,509	-	518,553	592,103	847,980	1,289,894
14 Semarang	2,862,241	2,616,871	1,892,503	1,905,482	1,425,249	1,134,760	1,358,498	739,201	1,257,136	1,724,390	493,831	488,886	518,553	-	132,265	339,316	781,229
15 Yogyakarta	2,936,408	2,691,038	1,966,670	1,979,032	1,499,416	1,208,928	1,432,048	812,750	1,330,686	1,798,558	567,998	431,407	592,103	132,265	-	361,566	751,562
16 Surabaya	3,191,668	2,946,297	2,221,930	2,234,909	1,754,675	1,464,805	1,687,925	1,068,628	1,586,563	2,053,817	823,257	818,313	847,980	339,316	361,566	-	448,712
17 Denpasar	3,634,199	3,388,829	2,664,461	2,676,823	2,197,207	1,906,718	2,129,839	1,510,541	2,028,477	2,496,349	1,265,789	1,260,845	1,289,894	781,229	751,562	448,712	-
18 Mataram	3,767,700	3,522,330	2,797,963	2,810,324	2,330,708	2,040,220	2,263,340	1,644,043	2,161,978	2,629,850	1,399,290	1,394,346	1,423,395	914,730	885,063	582,214	144,008
19 Kupang	5,237,450	4,992,080	4,267,712	4,280,691	3,800,458	3,510,587	3,733,707	3,114,410	3,632,345	4,099,599	2,869,040	2,864,095	2,893,762	2,385,098	2,355,431	2,052,581	1,614,376
20 Pontianak	3,234,314	2,988,943	2,264,576	2,277,555	1,797,322	1,506,833	1,730,571	1,111,274	1,605,105	2,072,977	860,341	1,009,294	890,626	932,654	1,064,301	1,545,153	1,996,337
21 Palangkaraya	3,882,660	3,637,290	2,912,922	2,925,283	2,445,668	2,155,179	2,378,299	1,759,002	2,276,937	2,744,809	1,514,250	1,509,305	1,538,354	1,029,690	1,161,337	822,021	1,273,206
22 Banjarmasin	4,090,328	3,844,958	3,120,591	3,133,570	2,653,336	2,362,848	2,586,586	1,967,288	2,485,224	2,952,478	1,721,918	1,716,974	1,746,641	1,237,976	1,369,005	1,030,308	1,480,874
23 Samarinda	4,718,278	4,472,908	3,748,541	3,761,520	3,281,286	2,990,798	3,214,536	2,594,621	3,112,556	3,580,428	2,349,868	2,344,924	2,374,591	1,865,308	1,996,955	1,658,258	2,108,824
24 Manado	5,859,837	5,614,467	4,890,099	4,903,079	4,422,845	4,132,357	4,356,095	3,736,797	4,254,733	4,721,987	3,491,427	3,486,483	3,516,150	3,007,485	3,029,736	2,675,587	2,836,900
25 Palu	4,948,815	4,703,445	3,979,077	3,992,057	3,511,823	3,221,953	3,445,073	2,825,775	3,343,711	3,810,965	2,580,405	2,575,461	2,605,128	2,096,463	2,118,713	1,765,183	1,925,878
26 Makassar	4,070,550	3,825,180	3,100,813	3,113,792	2,633,558	2,343,070	2,566,808	1,947,511	2,465,446	2,932,700	1,702,140	1,697,196	1,726,863	1,218,198	1,240,449	886,300	1,047,614
27 Kendari	5,127,435	4,882,065	4,157,697	4,170,676	3,690,443	3,399,954	3,623,692	3,003,777	3,521,712	3,989,584	2,759,025	2,754,080	2,783,747	2,274,465	2,296,715	1,943,184	2,104,498
28 Gorontalo	5,492,091	5,246,721	4,522,353	4,535,332	4,055,099	3,765,228	3,988,348	3,369,051	3,886,986	4,354,240	3,123,681	3,118,736	3,148,403	2,639,739	2,661,989	2,308,458	2,469,154
29 Mamuju	4,538,423	4,293,052	3,568,685	3,581,664	3,101,431	2,810,942	3,034,680	2,415,383	2,933,318	3,400,572	2,170,013	2,165,068	2,194,735	1,686,071	1,708,321	1,354,172	1,515,486
30 Ambon	5,297,402	5,052,031	4,327,664	4,340,643	3,860,410	3,570,539	3,793,659	3,174,362	3,692,297	4,159,551	2,928,992	2,924,047	2,953,714	2,445,050	2,467,300	2,113,769	2,274,465
31 Ternate	6,202,861	5,956,873	5,233,123	5,245,485	4,765,869	4,475,380	4,698,500	4,079,203	4,597,138	5,065,011	3,834,451	3,829,507	3,858,555	3,349,891	3,372,141	3,018,610	3,179,306
32 Sorong	6,839,464	6,594,094	5,869,726	5,882,706	5,402,472	5,111,983	5,335,721	4,716,424	5,233,741	5,701,614	4,471,054	4,466,110	4,495,776	3,987,112	4,009,362	3,655,213	3,816,527
33 Jayapura	8,134,920	7,889,550	7,165,182	7,177,544	6,697,928	6,407,439	6,630,560	6,011,262	6,529,197	6,997,070	5,766,510	5,761,566	5,790,614	5,281,950	5,304,200	4,950,669	5,111,365

Source: www.searates.com

Travel cost per tonnage in Rupiah in 2016 (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura
1 Banda Aceh	3,767,700	5,237,450	3,234,314	3,882,660	4,090,328	4,718,278	5,859,837	4,948,815	4,070,550	5,127,435	5,492,091	4,538,423	5,297,402	6,202,861	6,839,464	8,134,920
2 Medan	3,522,330	4,992,080	2,988,943	3,637,290	3,844,958	4,472,908	5,614,467	4,703,445	3,825,180	4,882,065	5,246,721	4,293,052	5,052,031	5,956,873	6,594,094	7,889,550
3 Padang	2,797,963	4,267,712	2,264,576	2,912,922	3,120,591	3,748,541	4,890,099	3,979,077	3,100,813	4,157,697	4,522,353	3,568,685	4,327,664	5,233,123	5,869,726	7,165,182
4 Pekanbaru	2,810,324	4,280,691	2,277,555	2,925,283	3,133,570	3,761,520	4,903,079	3,992,057	3,113,792	4,170,676	4,535,332	3,581,664	4,340,643	5,245,485	5,882,706	7,177,544
5 Jambi	2,330,708	3,800,458	1,797,322	2,445,668	2,653,336	3,281,286	4,422,845	3,511,823	2,633,558	3,690,443	4,055,099	3,101,431	3,860,410	4,765,869	5,402,472	6,697,928
6 Palembang	2,040,220	3,510,587	1,506,833	2,155,179	2,362,848	2,990,798	4,132,357	3,221,953	2,343,070	3,399,954	3,765,228	2,810,942	3,570,539	4,475,380	5,111,983	6,407,439
7 Bengkulu	2,263,340	3,733,707	1,730,571	2,378,299	2,586,586	3,214,536	4,356,095	3,445,073	2,566,808	3,623,692	3,988,348	3,034,680	3,793,659	4,698,500	5,335,721	6,630,560
8 Bandar Lampung	1,644,043	3,114,410	1,111,274	1,759,002	1,967,288	2,594,621	3,736,797	2,825,775	1,947,511	3,003,777	3,369,051	2,415,383	3,174,362	4,079,203	4,716,424	6,011,262
9 Pangkal Pinang	2,161,978	3,632,345	1,605,105	2,276,937	2,485,224	3,112,556	4,254,733	3,343,711	2,465,446	3,521,712	3,886,986	2,933,318	3,692,297	4,597,138	5,233,741	6,529,197
10 Batam	2,629,850	4,099,599	2,072,977	2,744,809	2,952,478	3,580,428	4,721,987	3,810,965	2,932,700	3,989,584	4,354,240	3,400,572	4,159,551	5,065,011	5,701,614	6,997,070
11 Jakarta	1,399,290	2,869,040	860,341	1,514,250	1,721,918	2,349,868	3,491,427	2,580,405	1,702,140	2,759,025	3,123,681	2,170,013	2,928,992	3,834,451	4,471,054	5,766,510
12 Bandung	1,394,346	2,864,095	1,009,294	1,509,305	1,716,974	2,344,924	3,486,483	2,575,461	1,697,196	2,754,080	3,118,736	2,165,068	2,924,047	3,829,507	4,466,110	5,761,566
13 Tangerang	1,423,395	2,893,762	890,626	1,538,354	1,746,641	2,374,591	3,516,150	2,605,128	1,726,863	2,783,747	3,148,403	2,194,735	2,953,714	3,858,555	4,495,776	5,790,614
14 Semarang	914,730	2,385,098	932,654	1,029,690	1,237,976	1,865,308	3,007,485	2,096,463	1,218,198	2,274,465	2,639,739	1,686,071	2,445,050	3,349,891	3,987,112	5,281,950
15 Yogyakarta	885,063	2,355,431	1,064,301	1,161,337	1,369,005	1,996,955	3,029,736	2,118,713	1,240,449	2,296,715	2,661,989	1,708,321	2,467,300	3,372,141	4,009,362	5,304,200
16 Surabaya	582,214	2,052,581	1,545,153	822,021	1,030,308	1,658,258	2,675,587	1,765,183	886,300	1,943,184	2,308,458	1,354,172	2,113,769	3,018,610	3,655,213	4,950,669
17 Denpasar	144,008	1,614,376	1,996,337	1,273,206	1,480,874	2,108,824	2,836,900	1,925,878	1,047,614	2,104,498	2,469,154	1,515,486	2,274,465	3,179,306	3,816,527	5,111,365
18 Mataram	-	1,478,402	2,132,929	1,409,797	1,617,466	1,680,508	2,700,927	1,789,905	911,640	1,968,525	2,333,181	1,379,512	2,138,491	3,043,333	3,680,554	4,975,392
19 Kupang	1,478,402	-	3,696,623	2,312,785	2,123,040	1,740,460	2,760,879	1,850,475	971,592	2,028,477	2,393,751	1,439,464	1,888,795	3,103,903	3,740,506	5,035,962
20 Pontianak	2,132,929	3,696,623	-	1,380,749	1,588,417	2,216,367	3,461,760	2,491,404	2,734,302	3,291,793	3,094,632	2,914,776	4,310,976	3,804,784	4,441,387	5,736,843
21 Palangkaraya	1,409,797	2,312,785	1,380,749	-	208,287	836,237	2,081,630	1,110,656	1,354,172	1,911,663	1,713,883	1,534,646	2,930,846	2,424,654	3,061,257	4,356,713
22 Banjarmasin	1,617,466	2,123,040	1,588,417	208,287	-	653,909	1,899,302	928,328	1,171,844	1,729,335	1,531,555	1,352,318	2,748,518	2,242,326	2,878,929	4,174,385
23 Samarinda	1,680,508	1,740,460	2,216,367	836,237	653,909	-	1,509,923	539,567	782,465	1,339,956	1,142,795	962,939	2,359,139	1,852,947	2,489,550	3,785,006
24 Manado	2,700,927	2,760,879	3,461,760	2,081,630	1,899,302	1,509,923	-	1,019,183	1,804,738	1,729,335	428,934	1,442,555	1,021,655	344,878	981,481	2,276,937
25 Palu	1,789,905	1,850,475	2,491,404	1,110,656	928,328	539,567	1,019,183	-	891,862	846,744	649,582	429,552	1,865,926	1,359,734	1,996,337	3,291,793
26 Makassar	911,640	971,592	2,734,302	1,354,172	1,171,844	782,465	1,804,738	891,862	-	1,069,246	1,434,520	480,233	1,248,483	2,144,672	2,781,275	4,076,731
27 Kendari	1,968,525	2,028,477	3,291,793	1,911,663	1,729,335	1,339,956	1,729,335	846,744	1,069,246	-	1,370,860	1,115,600	1,031,544	2,081,012	1,508,687	2,796,726
28 Gorontalo	2,333,181	2,393,751	3,094,632	1,713,883	1,531,555	1,142,795	428,934	649,582	1,434,520	1,370,860	-	1,076,044	1,449,353	772,576	1,409,179	2,704,635
29 Mamuju	1,379,512	1,439,464	2,914,776	1,534,646	1,352,318	962,939	1,442,555	429,552	480,233	1,115,600	1,076,044	-	1,718,210	1,783,106	2,419,709	3,715,165
30 Ambon	2,138,491	1,888,795	4,310,976	2,930,846	2,748,518	2,359,139	1,021,655	1,865,926	1,248,483	1,031,544	1,449,353	1,718,210	-	683,576	976,537	2,264,576
31 Ternate	3,043,333	3,103,903	3,804,784	2,424,654	2,242,326	1,852,947	344,878	1,359,734	2,144,672	2,081,012	772,576	1,783,106	683,576	-	642,784	1,937,622
32 Sorong	3,680,554	3,740,506	4,441,387	3,061,257	2,878,929	2,489,550	981,481	1,996,337	2,781,275	1,508,687	1,409,179	2,419,709	976,537	642,784	-	1,297,928
33 Jayapura	4,975,392	5,035,962	5,736,843	4,356,713	4,174,385	3,785,006	2,276,937	3,291,793	4,076,731	2,796,726	2,704,635	3,715,165	2,264,576	1,937,622	1,297,928	-

Source: www.searates.com

Notes: Red highlight is multimodal freight transportation, and the black highlight is unimodal freight transportation.

Adjusted with the inflation period 2011-2015 as below.

Year	Inflation	Inflation+1
2011	0.075	1.075
2012	0.038	1.038
2013	0.047	1.047
2014	0.054	1.054
2015	0.064	1.064
Total Inflation		1.310

Source:(The World Bank, 2016a), (ADB, 2016)

We could obtain travel cost per tonnage in Rupiah in 2010 (1 of 2)

Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	-	401,917	795,343	764,680	1,128,386	1,355,762	1,315,193	1,622,291	2,406,784	992,999	1,815,230	1,933,164	1,794,946	2,184,598	2,241,206	2,436,032	2,773,793
2 Medan	401,917	-	612,782	542,493	909,030	1,136,406	1,159,049	1,434,541	2,219,506	611,838	1,627,952	1,745,886	1,607,668	1,997,319	2,053,927	2,248,753	2,586,515
3 Padang	795,343	612,782	-	266,058	498,622	638,255	443,429	882,142	1,666,634	1,219,431	1,075,081	1,193,014	1,054,796	1,444,448	1,501,056	1,695,882	2,033,643
4 Pekanbaru	764,680	542,493	266,058	-	366,065	592,969	617,499	891,576	1,676,541	1,152,445	1,084,987	1,202,920	1,064,702	1,454,354	1,510,491	1,705,788	2,043,078
5 Jambi	1,128,386	909,030	498,622	366,065	-	226,904	364,650	525,039	1,310,004	1,515,680	718,450	836,383	698,166	1,087,817	1,144,425	1,339,251	1,677,012
6 Palembang	1,355,762	1,136,406	638,255	592,969	226,904	-	357,574	303,325	1,088,289	1,740,696	496,735	615,140	476,451	866,103	922,711	1,118,008	1,455,298
7 Bengkulu	1,315,193	1,159,049	443,429	617,499	364,650	357,574	-	474,092	1,258,585	1,773,246	667,031	785,436	646,747	1,036,870	1,093,006	1,288,304	1,625,593
8 Bandar Lampung	1,622,291	1,434,541	882,142	891,576	525,039	303,325	474,092	-	785,908	1,143,482	194,354	312,759	174,070	564,193	620,329	815,627	1,152,917
9 Pangkal Pinang	2,406,784	2,219,506	1,666,634	1,676,541	1,310,004	1,088,289	1,258,585	785,908	-	1,520,397	594,384	708,072	616,084	959,506	1,015,642	1,210,940	1,548,229
10 Batam	992,999	611,838	1,219,431	1,152,445	1,515,680	1,740,696	1,773,246	1,143,482	1,520,397	-	951,486	1,064,702	973,186	1,316,136	1,372,744	1,567,570	1,905,331
11 Jakarta	1,815,230	1,627,952	1,075,081	1,084,987	718,450	496,735	667,031	194,354	594,384	951,486	-	125,481	72,647	376,915	433,523	628,349	966,110
12 Bandung	1,933,164	1,745,886	1,193,014	1,202,920	836,383	615,140	785,436	312,759	708,072	1,064,702	125,481	-	143,879	373,141	329,270	624,575	962,336
13 Tangerang	1,794,946	1,607,668	1,054,796	1,064,702	698,166	476,451	646,747	174,070	616,084	973,186	72,647	143,879	-	395,784	451,921	647,218	984,508
14 Semarang	2,184,598	1,997,319	1,444,448	1,454,354	1,087,817	866,103	1,036,870	564,193	959,506	1,316,136	376,915	373,141	395,784	-	100,951	258,982	596,271
15 Yogyakarta	2,241,206	2,053,927	1,501,056	1,510,491	1,144,425	922,711	1,093,006	620,329	1,015,642	1,372,744	433,523	329,270	451,921	100,951	-	275,964	573,628
16 Surabaya	2,436,032	2,248,753	1,695,882	1,705,788	1,339,251	1,118,008	1,288,304	815,627	1,210,940	1,567,570	628,349	624,575	647,218	258,982	275,964	-	342,478
17 Denpasar	2,773,793	2,586,515	2,033,643	2,043,078	1,677,012	1,455,298	1,625,593	1,152,917	1,548,229	1,905,331	966,110	962,336	984,508	596,271	573,628	342,478	-
18 Mataram	2,875,687	2,688,409	2,135,537	2,144,972	1,778,907	1,557,192	1,727,488	1,254,811	1,650,124	2,007,226	1,068,005	1,064,231	1,086,402	698,166	675,522	444,373	109,914
19 Kupang	3,997,469	3,810,191	3,257,319	3,267,226	2,900,689	2,679,446	2,849,742	2,377,065	2,772,377	3,129,008	2,189,787	2,186,013	2,208,656	1,820,419	1,797,776	1,566,627	1,232,168
20 Pontianak	2,468,581	2,281,303	1,728,431	1,738,338	1,371,801	1,150,086	1,320,854	848,177	1,225,092	1,582,194	656,653	770,341	679,768	711,846	812,325	1,179,334	1,523,699
21 Palangkaraya	2,963,430	2,776,151	2,223,280	2,232,714	1,866,649	1,644,935	1,815,230	1,342,553	1,737,866	2,094,968	1,155,747	1,151,973	1,174,145	785,908	886,387	627,405	971,771
22 Banjarmasin	3,121,932	2,934,654	2,381,782	2,391,689	2,025,152	1,803,437	1,974,204	1,501,528	1,896,840	2,253,471	1,314,249	1,310,476	1,333,119	944,882	1,044,890	786,380	1,130,273
23 Samarinda	3,601,213	3,413,935	2,861,063	2,870,970	2,504,433	2,282,718	2,453,486	1,980,337	2,375,650	2,732,752	1,793,531	1,789,757	1,812,400	1,423,692	1,524,171	1,265,661	1,609,555
24 Manado	4,472,505	4,285,227	3,732,355	3,742,261	3,375,725	3,154,010	3,324,777	2,852,100	3,247,413	3,604,044	2,664,822	2,661,048	2,683,692	2,295,455	2,312,437	2,042,134	2,165,257
25 Pahu	3,777,170	3,589,892	3,037,020	3,046,926	2,680,389	2,459,146	2,629,442	2,156,765	2,552,078	2,908,708	1,969,487	1,965,713	1,988,356	1,600,120	1,617,102	1,347,271	1,469,921
26 Makassar	3,106,837	2,919,558	2,366,687	2,376,593	2,010,056	1,788,342	1,959,109	1,486,432	1,881,745	2,238,375	1,299,154	1,295,380	1,318,023	929,787	946,769	676,466	799,588
27 Kendari	3,913,501	3,726,223	3,173,351	3,183,257	2,816,720	2,595,006	2,765,773	2,292,625	2,687,937	3,045,039	2,105,818	2,102,044	2,124,687	1,735,979	1,752,962	1,483,130	1,606,252
28 Gorontalo	4,191,823	4,004,545	3,451,674	3,461,580	3,095,043	2,873,800	3,044,096	2,571,419	2,966,732	3,323,362	2,384,141	2,380,367	2,403,010	2,014,774	2,031,756	1,761,924	1,884,575
29 Mamuju	3,463,939	3,276,661	2,723,789	2,733,695	2,367,158	2,145,444	2,316,211	1,843,534	2,238,847	2,595,477	1,656,256	1,652,482	1,675,125	1,286,889	1,303,871	1,033,568	1,156,690
30 Ambon	4,043,227	3,855,949	3,303,078	3,312,984	2,946,447	2,725,204	2,895,500	2,422,823	2,818,136	3,174,766	2,235,545	2,231,771	2,254,414	1,866,178	1,883,160	1,613,328	1,735,979
31 Ternate	4,734,317	4,546,567	3,994,167	4,003,602	3,637,537	3,415,822	3,586,118	3,113,441	3,508,753	3,865,856	2,926,634	2,922,860	2,945,032	2,556,795	2,573,778	2,303,946	2,426,597
32 Sorong	5,220,202	5,032,924	4,480,053	4,489,959	4,123,422	3,901,707	4,072,475	3,599,798	3,994,639	4,351,741	3,412,520	3,408,746	3,431,389	3,043,152	3,060,135	2,789,832	2,912,954
33 Jayapura	6,208,956	6,021,678	5,468,806	5,478,241	5,112,175	4,890,461	5,060,756	4,588,080	4,983,392	5,340,494	4,401,273	4,397,499	4,419,671	4,031,434	4,048,416	3,778,585	3,901,236
Total	88,123,111	82,059,449	67,339,007	67,411,654	58,958,190	54,457,381	58,701,567	48,128,134	63,123,125	69,068,853	45,062,338	46,246,861	45,340,661	42,758,863	43,912,252	42,903,686	49,863,169

Travel cost per tonnage in Rupiah in 2010 (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Total
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura	
1 Banda Aceh	2,875,687	3,997,469	2,468,581	2,963,430	3,121,932	3,601,213	4,472,505	3,777,170	3,106,837	3,913,501	4,191,823	3,463,939	4,043,227	4,734,317	5,220,202	6,208,956	88,123,111
2 Medan	2,688,409	3,810,191	2,281,303	2,776,151	2,934,654	3,413,935	4,285,227	3,589,892	2,919,558	3,726,223	4,004,545	3,276,661	3,855,949	4,546,567	5,032,924	6,021,678	82,059,449
3 Padang	2,135,537	3,257,319	1,728,431	2,223,280	2,381,782	2,861,063	3,732,355	3,037,020	2,366,687	3,173,351	3,451,674	2,723,789	3,303,078	3,994,167	4,480,053	5,468,806	67,339,007
4 Pekanbaru	2,144,972	3,267,226	1,738,338	2,232,714	2,391,689	2,870,970	3,742,261	3,046,926	2,376,593	3,183,257	3,461,580	2,733,695	3,312,984	4,003,602	4,489,959	5,478,241	67,411,654
5 Jambi	1,778,907	2,900,689	1,371,801	1,866,649	2,025,152	2,504,433	3,375,725	2,680,389	2,010,056	2,816,720	3,095,043	2,367,158	2,946,447	3,637,537	4,123,422	5,112,175	58,958,190
6 Palembang	1,557,192	2,679,446	1,150,086	1,644,935	1,803,437	2,282,718	3,154,010	2,459,146	1,788,342	2,595,006	2,873,800	2,145,444	2,725,204	3,415,822	3,901,707	4,890,461	54,457,381
7 Bengkulu	1,727,488	2,849,742	1,320,854	1,815,230	1,974,204	2,453,486	3,324,777	2,629,442	1,959,109	2,765,773	3,044,096	2,316,211	2,895,500	3,586,118	4,072,475	5,060,756	58,701,567
8 Bandar Lampung	1,254,811	2,377,065	848,177	1,342,553	1,501,528	1,980,337	2,852,100	2,156,765	1,486,432	2,292,625	2,571,419	1,843,534	2,422,823	3,113,441	3,599,798	4,588,080	48,128,134
9 Pangkal Pinang	1,650,124	2,772,377	1,225,092	1,737,866	1,896,840	2,375,650	3,247,413	2,552,078	1,881,745	2,687,937	2,966,732	2,238,847	2,818,136	3,508,753	3,994,639	4,983,392	63,123,125
10 Batam	2,007,226	3,129,008	1,582,194	2,094,968	2,253,471	2,732,752	3,604,044	2,908,708	2,238,375	3,045,039	3,323,362	2,595,477	3,174,766	3,865,856	4,351,741	5,340,494	69,068,853
11 Jakarta	1,068,005	2,189,787	656,653	1,155,747	1,314,249	1,793,531	2,664,822	1,969,487	1,299,154	2,105,818	2,384,141	1,656,256	2,235,545	2,926,634	3,412,520	4,401,273	45,062,338
12 Bandung	1,064,231	2,186,013	770,341	1,151,973	1,310,476	1,789,757	2,661,048	1,965,713	1,295,380	2,102,044	2,380,367	1,652,482	2,231,771	2,922,860	3,408,746	4,397,499	46,246,861
13 Tangerang	1,086,402	2,208,656	679,768	1,174,145	1,333,119	1,812,400	2,683,692	1,988,356	1,318,023	2,124,687	2,403,010	1,675,125	2,254,414	2,945,032	3,431,389	4,419,671	45,340,661
14 Semarang	698,166	1,820,419	711,846	785,908	944,882	1,423,692	2,295,455	1,600,120	929,787	1,735,979	2,014,774	1,286,889	1,866,178	2,556,795	3,043,152	4,031,434	42,758,863
15 Yogyakarta	675,522	1,797,776	812,325	886,387	1,044,890	1,524,171	2,312,437	1,617,102	946,769	1,752,962	2,031,756	1,303,871	1,883,160	2,573,778	3,060,135	4,048,416	43,912,252
16 Surabaya	444,373	1,566,627	1,179,334	627,405	786,380	1,265,661	2,042,134	1,347,271	676,466	1,483,130	1,761,924	1,033,568	1,613,328	2,303,946	2,789,832	3,778,585	42,903,686
17 Denpasar	109,914	1,232,168	1,523,699	971,771	1,130,273	1,609,555	2,165,257	1,469,921	799,588	1,606,252	1,884,575	1,156,690	1,735,979	2,426,597	2,912,954	3,901,236	49,863,169
18 Mataram	-	1,128,386	1,627,952	1,076,024	1,234,526	1,282,643	2,061,475	1,366,140	695,807	1,502,471	1,780,794	1,052,909	1,632,198	2,322,816	2,809,173	3,797,454	50,337,733
19 Kupang	1,128,386	-	2,821,438	1,765,227	1,620,404	1,328,401	2,107,233	1,412,370	741,565	1,548,229	1,827,024	1,098,667	1,441,617	2,369,045	2,854,931	3,843,684	71,950,201
20 Pontianak	1,627,952	2,821,438	-	1,053,853	1,212,355	1,691,636	2,642,179	1,901,558	2,086,949	2,512,452	2,361,969	2,224,695	3,290,341	2,903,991	3,389,877	4,378,630	58,148,696
21 Palangkaraya	1,076,024	1,765,227	1,053,853	-	158,974	638,255	1,588,798	847,705	1,033,568	1,459,072	1,308,117	1,171,314	2,236,960	1,850,610	2,336,496	3,325,249	49,301,335
22 Banjarmasin	1,234,526	1,620,404	1,212,355	158,974	-	499,094	1,449,637	708,544	894,407	1,319,910	1,168,955	1,032,153	2,097,799	1,711,449	2,197,334	3,186,088	50,640,586
23 Samarinda	1,282,643	1,328,401	1,691,636	638,255	499,094	-	1,152,445	411,823	597,215	1,022,718	872,235	734,961	1,800,607	1,414,257	1,900,142	2,888,896	56,530,650
24 Manado	2,061,475	2,107,233	2,642,179	1,588,798	1,449,637	1,152,445	-	777,888	1,377,462	1,319,910	327,383	1,101,026	779,775	263,227	749,113	1,737,866	72,050,680
25 Palu	1,366,140	1,412,370	1,901,558	847,705	708,544	411,823	777,888	-	680,711	646,275	495,792	327,855	1,424,163	1,037,814	1,523,699	2,512,452	56,870,298
26 Makassar	695,807	741,565	2,086,949	1,033,568	894,407	597,215	1,377,462	680,711	-	816,099	1,094,893	366,537	952,902	1,636,915	2,122,801	3,111,554	47,608,283
27 Kendari	1,502,471	1,548,229	2,512,452	1,459,072	1,319,910	1,022,718	1,319,910	646,275	816,099	-	1,046,305	851,479	787,323	1,588,327	1,151,501	2,134,594	62,816,970
28 Gorontalo	1,780,794	1,827,024	2,361,969	1,308,117	1,168,955	872,235	327,383	495,792	1,094,893	1,046,305	-	821,288	1,106,215	589,667	1,075,552	2,064,306	65,785,117
29 Mamuju	1,052,909	1,098,667	2,224,695	1,171,314	1,032,153	734,961	1,101,026	327,855	366,537	851,479	821,288	-	1,311,419	1,360,951	1,846,836	2,835,590	53,607,318
30 Ambon	1,632,198	1,441,617	3,290,341	2,236,960	2,097,799	1,800,607	779,775	1,424,163	952,902	787,323	1,106,215	1,311,419	-	521,737	745,339	1,728,431	67,175,315
31 Ternate	2,322,816	2,369,045	2,903,991	1,850,610	1,711,449	1,414,257	263,227	1,037,814	1,636,915	1,588,327	589,667	1,360,951	521,737	-	490,603	1,478,884	78,602,115
32 Sorong	2,809,173	2,854,931	3,389,877	2,336,496	2,197,334	1,900,142	749,113	1,523,699	2,122,801	1,151,501	1,075,552	1,846,836	745,339	490,603	-	990,640	91,509,685
33 Jayapura	3,797,454	3,843,684	4,378,630	3,325,249	3,186,088	2,888,896	1,737,866	2,512,452	3,111,554	2,134,594	2,064,306	2,835,590	1,728,431	1,478,884	990,640	-	122,145,471
Total	50,337,733	71,950,201	58,148,696	49,301,335	50,640,586	56,530,650	72,050,680	56,870,298	47,608,283	62,816,970	65,785,117	53,607,318	67,175,315	78,602,115	91,509,685	122,145,471	2,028,538,751

- OD Demand

OD demand 2011 (1 of 2)

Origin \ Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	38,685,881	47,040,807	8,916,035	6,936,864	2,893,548	5,984,110	2,029,796	5,335,520	808,226	1,202,025	5,405,222	24,002,314	20,748,054	17,630,709	1,777,238	17,828,872	1,360,151
2 Medan	86,877,503	291,943,329	34,715,449	32,593,084	10,701,690	20,662,918	7,085,321	16,386,361	2,631,818	4,521,140	16,847,076	74,086,960	18,998,483	52,184,986	5,072,574	51,382,217	4,004,952
3 Padang	10,540,083	21,682,042	55,978,976	17,063,477	7,776,289	10,655,780	4,372,295	7,917,243	1,204,002	1,869,042	6,700,902	29,915,662	8,156,001	20,468,000	1,824,158	18,843,110	1,388,726
4 Pekanbaru	12,527,288	31,592,822	25,725,418	13,167,290	5,262,215	6,692,162	2,213,242	4,971,704	891,604	1,972,937	4,245,214	19,031,249	5,181,235	13,011,292	1,276,131	12,300,432	910,317
5 Jambi	3,408,135	6,814,842	7,662,124	3,342,670	3,357,576	5,727,801	1,881,837	3,212,996	587,431	696,844	2,504,193	10,513,783	2,999,949	6,724,690	660,321	6,028,384	442,952
6 Palembang	6,657,962	11,858,576	10,094,768	4,023,440	5,474,662	44,501,787	6,300,950	17,855,539	2,212,930	1,219,198	10,221,751	41,523,922	12,727,546	21,529,708	2,239,946	19,470,636	1,334,323
7 Bengkulu	2,305,706	4,080,082	4,241,461	1,380,200	1,852,763	6,355,051	2,388,203	2,977,801	303,671	251,552	1,944,458	8,334,723	2,656,993	4,814,317	480,522	4,234,283	301,164
8 Bandar Lampung	9,393,688	16,629,018	11,759,709	4,731,967	4,776,180	29,671,343	4,743,163	24,836,032	1,271,759	638,742	15,872,564	50,668,900	22,617,535	22,678,886	2,067,213	17,377,012	1,110,424
9 Pangkal Pinang	874,927	1,574,860	1,086,708	510,332	520,405	2,163,972	277,853	735,590	758,612	218,984	1,821,078	7,364,255	2,027,578	4,710,479	434,674	3,971,036	258,986
10 Batam	2,088,938	4,225,156	2,681,244	1,887,384	1,029,431	2,000,730	362,853	614,212	379,638	3,871,748	1,166,743	4,565,640	1,185,102	3,310,768	327,829	3,178,622	226,731
11 Jakarta	10,632,430	16,679,778	11,235,808	4,606,209	4,166,118	18,450,269	3,299,579	15,935,104	3,189,530	1,096,483	252,351,925	388,589,781	107,876,133	49,617,559	4,507,574	33,779,731	1,781,765
12 Bandung	46,133,424	73,210,120	49,254,425	20,288,776	17,711,683	71,166,190	14,037,914	54,710,606	12,980,175	3,630,248	341,537,447	1,961,544,047	239,093,601	430,462,472	35,209,567	222,921,683	12,141,289
13 Tangerang	33,703,881	20,489,338	14,241,672	5,671,795	5,290,039	23,594,760	4,602,339	26,656,970	3,995,358	1,481,530	110,966,030	236,768,649	182,796,186	120,842,593	10,664,033	54,682,043	2,363,501
14 Semarang	32,383,135	51,153,466	32,205,342	12,739,450	10,583,705	37,850,998	7,758,314	22,985,639	8,025,016	2,923,888	47,692,118	413,594,682	100,009,830	1,476,884,066	170,418,947	704,785,836	26,026,491
15 Yogyakarta	4,707,080	7,023,305	4,193,928	1,768,574	1,544,328	5,164,516	1,094,940	3,007,204	1,062,761	465,107	5,800,102	46,183,498	14,458,366	255,542,393	82,434,059	120,630,772	4,496,854
16 Surabaya	34,363,962	52,643,332	30,899,614	12,755,299	10,119,995	33,977,384	7,286,560	18,628,920	7,127,481	2,946,599	32,284,745	220,005,246	52,929,041	769,860,220	84,648,095	1,659,910,335	64,650,799
17 Denpasar	509,689	1,345,883	594,071	581,582	372,546	801,990	281,426	772,533	167,227	156,520	345,415	2,667,216	613,008	4,650,644	435,373	12,985,047	35,540,230
18 Mataram	560,138	1,492,959	660,534	673,930	397,831	866,598	305,174	806,868	167,943	166,604	347,667	2,564,842	680,777	4,176,398	387,486	8,537,734	16,103,290
19 Kupang	507,846	1,252,991	533,116	522,694	309,513	646,133	240,021	578,522	124,074	137,662	240,563	1,728,076	411,430	2,414,771	261,541	3,685,982	3,167,652
20 Pontianak	973,671	2,717,162	1,249,373	1,348,599	850,765	1,678,334	535,850	1,379,667	477,229	477,766	516,644	3,442,777	864,360	3,871,086	330,949	4,140,822	2,037,425
21 Palangkaraya	573,206	1,602,469	694,378	723,500	452,973	1,001,087	315,107	877,521	241,209	217,926	351,097	2,624,251	609,589	3,719,645	318,457	4,798,047	2,583,553
22 Banjarmasin	965,610	2,603,850	1,146,372	1,141,802	697,015	1,479,067	504,598	1,339,803	338,580	321,318	692,341	4,140,686	953,012	6,176,733	558,676	9,354,873	5,262,733
23 Samarinda	409,265	1,088,726	455,928	463,644	262,280	538,481	188,811	467,672	118,011	136,023	226,005	1,378,056	336,595	1,764,573	155,934	3,355,977	1,525,081
24 Manado	280,158	706,565	290,781	284,104	165,990	320,978	114,441	273,570	65,256	78,618	126,994	771,174	185,243	985,110	88,772	1,290,462	891,392
25 Palu	341,034	887,680	360,580	363,730	204,980	418,731	148,184	373,815	87,318	95,707	187,872	1,048,573	247,822	1,363,882	125,221	1,907,193	1,330,223
26 Makassar	1,673,097	4,365,642	1,850,118	1,823,128	1,068,900	2,218,830	807,936	2,002,382	477,628	493,115	937,044	6,002,047	1,337,730	8,438,532	756,351	13,247,245	10,396,660
27 Kendari	372,731	992,272	407,982	402,539	230,824	482,280	170,894	443,228	95,411	107,552	174,581	1,252,897	307,748	1,690,994	154,968	2,550,080	1,920,580
28 Gorontalo	153,039	381,405	156,804	154,719	85,654	172,894	65,679	159,288	36,148	41,167	61,136	441,582	103,038	540,609	49,919	767,979	519,099
29 Mamuju	160,994	430,274	177,899	183,312	103,110	211,012	80,659	196,718	45,186	47,343	76,772	585,283	128,752	821,109	69,866	1,203,218	839,679
30 Ambon	131,850	326,046	130,913	128,944	75,205	146,122	54,933	129,947	29,333	34,131	50,495	362,044	85,881	471,270	43,420	638,693	452,101
31 Ternate	113,770	274,420	109,430	115,649	64,087	124,346	47,119	112,313	25,073	30,251	42,117	301,052	73,530	386,298	34,465	516,579	365,700
32 Sorong	70,414	169,088	67,309	67,039	37,876	75,620	27,594	67,391	15,156	16,721	25,916	176,912	42,102	221,929	20,304	301,351	205,431
33 Jayapura	146,214	352,544	143,409	137,527	80,368	155,572	55,765	136,607	29,023	36,652	54,964	369,217	103,259	448,099	40,938	611,107	408,188

Source: (Indonesia Ministry of Development Planning, 2015)

OD demand 2011 (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura
1 Banda Aceh	1,644,972	1,490,869	2,811,781	1,024,334	1,739,912	1,302,166	736,564	888,026	2,800,219	933,432	413,654	421,479	372,263	319,652	175,145	421,839
2 Medan	4,892,067	3,994,694	8,596,556	3,051,814	4,700,498	3,442,136	1,985,686	2,328,294	7,832,272	2,509,612	1,120,571	1,140,535	1,015,973	847,637	454,956	1,087,154
3 Padang	1,661,094	1,343,784	3,158,909	1,035,223	1,880,488	1,162,616	610,589	824,575	2,787,962	842,600	355,071	370,932	326,142	265,880	147,119	355,284
4 Pekanbaru	1,102,694	869,422	2,273,815	711,180	1,140,064	838,429	447,494	564,828	1,850,801	560,528	237,107	264,311	216,041	176,767	96,195	236,332
5 Jambi	501,670	390,226	1,073,740	341,063	551,076	359,592	198,580	246,366	828,571	249,579	106,102	118,090	95,635	79,931	41,676	103,272
6 Palembang	1,525,102	1,154,943	3,120,761	1,038,517	1,609,806	1,038,689	521,117	755,276	2,416,141	733,413	284,982	332,198	266,870	218,905	112,831	280,323
7 Bengkulu	340,736	270,257	601,921	214,065	344,377	226,096	122,608	159,806	537,374	162,721	65,314	75,422	63,418	50,473	27,104	67,477
8 Bandar Lampung	1,279,505	922,599	2,190,500	829,240	1,317,337	811,454	406,642	528,186	1,883,481	579,704	228,652	263,436	208,854	168,249	87,792	227,173
9 Pangkal Pinang	294,910	220,349	828,698	237,611	351,123	222,070	106,847	136,225	483,577	137,562	57,907	66,571	51,408	41,185	22,351	52,945
10 Batam	272,378	214,398	750,488	207,483	320,734	219,640	111,024	146,924	484,831	147,684	64,274	71,559	52,723	47,449	23,634	56,999
11 Jakarta	2,015,343	1,267,602	2,803,049	1,215,193	1,946,968	1,151,547	531,800	769,447	2,843,288	840,961	314,587	393,645	288,760	228,576	124,216	299,122
12 Bandung	13,344,885	8,787,483	16,645,386	7,786,411	12,346,716	7,074,602	3,556,601	4,839,602	17,907,477	5,274,038	2,046,174	2,435,240	1,798,002	1,451,611	752,336	1,896,291
13 Tangerang	3,291,631	1,767,110	3,950,948	1,538,240	2,497,064	1,521,054	768,088	1,001,528	3,809,877	1,103,685	423,778	491,995	392,465	300,741	160,830	393,835
14 Semarang	25,274,588	14,514,243	22,893,020	13,484,464	22,585,107	11,351,495	5,309,804	7,773,114	30,765,832	8,365,012	3,158,722	4,120,184	2,857,839	2,235,603	1,176,160	2,800,048
15 Yogyakarta	4,429,675	2,886,557	3,604,653	2,027,083	3,414,926	1,833,158	857,056	1,295,514	4,969,636	1,380,566	526,137	662,420	475,653	365,746	188,531	449,773
16 Surabaya	42,067,677	17,674,752	19,158,475	13,302,680	26,378,076	12,528,422	5,649,497	8,339,455	37,503,830	9,775,710	3,375,074	4,784,014	2,933,315	2,332,784	1,205,633	2,759,020
17 Denpasar	17,169,829	3,421,788	2,219,487	1,656,638	3,522,767	1,772,463	870,940	1,323,924	6,700,532	1,782,905	510,664	755,713	481,650	364,035	187,465	444,901
18 Mataram	17,684,766	2,765,890	1,035,522	759,887	1,667,323	906,639	512,583	747,656	4,301,964	1,109,494	298,179	454,578	281,929	208,249	109,275	249,661
19 Kupang	2,556,693	5,207,163	550,409	352,625	767,127	537,652	408,701	551,014	2,887,053	1,100,433	236,487	289,389	323,067	193,175	105,055	243,898
20 Pontianak	995,600	553,535	3,561,557	546,369	706,902	468,071	178,458	259,005	826,310	234,727	104,853	117,075	77,628	69,374	34,605	80,832
21 Palangkaraya	1,195,940	593,201	886,076	1,112,503	914,944	311,052	76,458	125,323	454,293	112,579	47,897	71,551	34,055	29,451	13,401	30,948
22 Banjarmasin	2,711,518	1,290,498	1,139,803	915,895	21,029,693	4,784,172	1,156,468	2,194,321	8,407,923	1,950,242	782,271	1,403,505	507,860	445,549	210,101	450,263
23 Samarinda	815,307	490,807	429,599	164,070	2,669,400	7,135,870	305,974	583,417	1,432,293	374,449	187,824	251,076	104,284	97,996	41,178	93,043
24 Manado	540,321	463,235	194,669	48,598	738,090	358,933	20,369,103	2,255,923	4,137,495	1,714,883	2,339,118	586,705	806,250	1,397,535	341,625	571,861
25 Palu	764,304	594,786	266,705	80,410	1,366,550	669,270	2,375,414	877,122	965,060	310,033	242,001	160,611	73,648	74,834	26,121	52,417
26 Makassar	6,841,421	4,634,928	1,369,756	473,444	7,996,092	2,697,496	6,575,828	1,615,181	156,634,718	17,761,692	4,093,047	12,135,888	2,470,042	2,101,041	949,343	1,863,999
27 Kendari	1,245,490	1,304,476	275,366	82,988	1,417,931	481,303	1,834,210	335,662	12,862,385	1,336,179	120,434	145,606	100,155	78,073	32,164	63,468
28 Gorontalo	308,909	255,515	113,890	30,251	465,925	227,677	2,154,557	219,402	2,395,988	101,537	4,069,067	522,133	424,615	556,227	176,225	307,479
29 Mamuju	501,558	337,749	141,900	49,016	1,003,383	349,036	642,184	185,509	8,146,792	144,360	567,052	1,997,997	282,713	264,617	104,947	222,389
30 Ambon	269,220	316,053	79,754	20,111	313,432	118,469	799,844	67,713	1,500,465	87,235	420,530	244,152	368,667	111,863	77,859	124,807
31 Temate	212,643	206,428	72,428	18,512	267,864	113,049	1,376,761	72,787	1,293,892	72,341	548,902	222,063	125,386	540,958	48,900	64,135
32 Sorong	124,106	125,393	40,557	9,557	145,391	54,011	377,375	28,964	631,214	32,756	184,660	101,249	87,696	51,820	268,819	174,045
33 Jayapura	231,983	234,074	75,757	18,151	272,064	95,227	524,602	46,697	1,085,670	52,597	291,205	179,220	114,868	58,264	133,922	1,361,828

Source: (Indonesia Ministry of Development Planning, 2015)

To determine OD demand in 2010, we used growth factor to adjust the OD demand in 2011.

No.	Province	PDRB 2011	(1+growth)
1	Aceh	3.28%	1.033
2	Sumatera Utara	6.66%	1.067
3	Sumatera Barat	6.34%	1.063
4	Riau	5.57%	1.056
5	Jambi	7.86%	1.079
6	Sumatera Selatan	6.36%	1.064
7	Bengkulu	6.85%	1.069
8	Lampung	6.56%	1.066
9	Kepulauan Bangka Belitung	6.90%	1.069
10	Kepulauan Riau	6.96%	1.070
11	DKI Jakarta	6.73%	1.067
12	Jawa Barat	6.50%	1.065
13	Banten	7.03%	1.070
14	Jawa Tengah	5.30%	1.053
15	DI Yogyakarta	5.21%	1.052
16	Jawa Timur	6.44%	1.064
17	Bali	6.66%	1.067
18	Nusa Tenggara Barat	-3.91%	0.961
19	Nusa Tenggara Timur	5.67%	1.057
20	Kalimantan Barat	5.50%	1.055
21	Kalimantan Tengah	7.01%	1.070
22	Kalimantan Selatan	6.97%	1.070
23	Kalimantan Timur	6.47%	1.065
24	Sulawesi Utara	6.17%	1.062
25	Sulawesi Tengah	9.82%	1.098
26	Sulawesi Selatan	8.13%	1.081
27	Sulawesi Tenggara	10.63%	1.106
28	Gorontalo	7.71%	1.077
29	Sulawesi Barat	10.73%	1.107
30	Maluku	6.34%	1.063
31	Maluku Utara	6.80%	1.068
32	Papua Barat	3.64%	1.036
33	Papua	-4.28%	0.957

Source: (Indonesia Ministry of National Development Planning, 2014)

Thus, we could get OD demand 2010 (1 of 2)

Destination \ Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	-	1,372.443878	449.398139	227.563008	83.899591	189.855233	44.911624	79.898210	3.232587	33.710694	196.268988	636.894472	190.585435	348.625109	38.040013	183.558634	5.945663
2 Medan	694.096958	-	557.467342	288.235742	119.785695	282.031216	59.480948	115.302029	4.859042	56.143621	286.908076	937.552951	278.237606	519.536340	56.823142	276.194439	9.036960
3 Padang	492.149751	1,207.146234	-	290.752532	191.681275	580.964326	147.190098	299.582534	15.435597	22.931615	801.550622	2,710.281281	772.283679	1,589.494683	175.681412	881.165510	30.058754
4 Pekanbaru	512.581241	1,283.758490	598.023908	-	198.861216	607.428613	130.158973	295.425146	15.131206	25.810183	788.298638	2,663.066591	759.648923	1,559.565888	172.487543	863.700809	29.464014
5 Jambi	292.867441	826.781325	610.977105	308.177051	-	604.014171	148.656977	452.644621	30.761572	13.159610	1,358.123888	4,817.559932	1,296.043646	3,035.051399	339.601256	1,764.317907	62.847124
6 Palembang	194.440291	571.130464	543.309323	276.183606	177.214630	-	-	466.304979	45.569800	8.402733	1,674.421286	6,310.421968	1,577.161496	4,308.998119	488.252215	2,623.144496	97.251846
7 Bengkulu	209.679491	549.097584	627.494310	269.780322	198.825117	676.901437	-	466.820691	33.796737	7.863007	1,441.933368	5,167.190400	1,372.940336	3,304.123500	370.903407	1,938.451707	69.665439
8 Bandar Lampung	116.080951	331.234307	397.442585	190.550602	188.395283	661.500641	145.270291	-	72.425969	26.215310	1,441.860914	7,061.291264	1,268.150935	6,170.070604	722.421915	4,211.711838	169.564008
9 Pangkal Pinang	22.246405	66.120278	96.998952	46.229809	60.646661	306.212590	49.818103	343.067846	-	13.039111	1,553.006919	5,699.970349	1,416.763568	3,741.374739	421.726116	2,229.517224	81.188096
10 Batam	366.904005	1,208.257867	227.904765	124.713885	41.031420	89.297980	18.330582	196.388411	20.621638	-	979.312793	3,380.419584	881.588905	2,024.098346	224.539184	1,138.314978	39.358661
11 Jakarta	78.517979	226.952336	292.807628	140.006167	155.648726	654.061332	123.556451	397.024118	90.277851	35.995988	-	4,617.782021	689.563892	6,718.725965	821.915941	5,288.701743	231.317856
12 Bandung	61.473882	178.934227	238.875455	114.115371	133.210679	594.727296	106.826851	469.119385	79.944051	29.978439	1,114.138446	-	1,134.096348	6,717.262555	819.376106	5,308.948684	232.693935
13 Tangerang	81.859776	236.304029	302.894719	144.854746	159.473757	661.444362	126.309295	374.910741	88.423687	34.790623	740.351443	5,046.701694	-	6,716.200482	816.645184	5,185.856610	224.676504
14 Semarang	36.051681	106.232460	150.092826	71.599426	89.912828	435.090366	73.185649	439.170418	56.219691	19.231524	1,736.746179	7,196.743354	1,616.998662	-	455.744028	5,713.477331	374.665802
15 Yogyakarta	31.908059	94.245242	134.561106	64.232737	81.605189	399.889745	66.638216	417.087083	51.402072	17.304821	1,723.339008	7,120.653766	1,594.822288	3,696.697117	-	5,824.295728	382.370787
16 Surabaya	20.862628	62.070263	91.450417	43.580929	57.446000	291.107050	47.190218	329.479912	36.820987	11.886990	1,502.539321	6,251.432778	1,372.251959	6,279.540344	789.183292	-	417.228398
17 Denpasar	9.842053	29.578918	45.434988	21.652912	29.802974	157.188080	24.700493	193.194703	19.528469	5.986059	957.143771	3,990.684107	865.889079	5,997.394949	754.588909	6,076.662395	-
18 Mataram	7.821853	23.567799	36.574569	17.426469	24.234433	128.933655	20.121716	161.187729	15.955329	4.834183	811.110409	3,383.082641	732.470399	5,383.114511	681.202429	6,044.156739	245.630705
19 Kupang	0.582645	1.789868	2.989394	1.420637	2.117539	11.873679	1.776527	16.342215	1.434689	0.403817	89.116755	372.374745	79.697329	751.212659	97.026046	1,140.433346	147.372388
20 Pontianak	19.420289	57.842477	85.617870	40.796952	54.051900	275.419509	44.443728	314.735546	35.901092	11.548785	1,458.455457	5,271.438910	1,323.932639	5,296.168095	573.287533	2,357.946184	85.182091
21 Palangkaraya	6.411399	19.357845	30.287006	14.428166	20.227050	108.333528	16.817906	137.175138	13.365824	4.013233	698.167788	2,912.791119	629.667398	4,819.889378	515.650785	5,293.774220	229.262429
22 Banjarmasin	4.466863	13.532925	21.457801	10.208668	14.512704	78.548192	12.081443	101.335973	9.635998	2.854893	525.044107	2,191.375880	472.220635	3,827.626170	401.997717	4,382.640682	176.349176
23 Samarinda	1.475758	4.508969	7.382404	3.509783	5.140287	28.475718	4.300286	38.325786	3.460748	0.991574	205.217295	857.174281	183.872734	1,653.824541	167.947670	2,020.263921	71.925487
24 Manado	0.188785	0.582969	0.991980	0.471233	0.713665	4.052613	0.600242	5.678479	0.486676	0.134699	31.406759	131.273665	28.044365	274.320047	32.593069	429.983191	22.703400
25 Palu	0.978090	2.996051	4.951809	2.353745	3.476336	19.360573	2.912214	26.343063	2.346351	0.666916	142.398104	594.896188	127.468663	1,173.106548	139.826322	1,738.136213	94.552241
26 Makassar	4.623814	14.004085	22.178222	10.551691	14.983103	81.019292	12.470620	104.346569	9.943274	2.949671	539.860284	2,253.138741	485.626046	3,917.761161	470.506048	5,022.025742	295.606377
27 Kendari	0.710098	2.179101	3.625559	1.723098	2.559813	14.333334	2.146431	19.645877	1.733777	0.489220	106.687258	445.762478	95.443175	892.903524	106.340557	1,342.404024	72.398928
28 Gorontalo	0.367979	1.132999	1.907894	0.906526	1.360815	7.670060	1.142948	10.647426	0.924668	0.258319	58.437463	244.215553	52.224367	500.748405	59.556803	770.592182	41.096000
29 Mamuju	2.030789	6.191298	10.054769	4.781124	6.950780	38.288451	5.807915	50.979669	4.660213	1.347320	271.119626	1,132.244510	243.130211	2,136.035088	255.251651	3,022.629001	168.452417
30 Ambon	0.523003	1.607544	2.690288	1.278441	1.908913	10.717577	1.601943	14.782531	1.294269	0.363619	80.741754	337.391686	72.194918	683.441965	81.339668	1,039.717741	55.780955
31 Ternate	0.100936	0.312798	0.536192	0.254953	0.388427	2.216875	0.327413	3.134846	0.265928	0.072978	17.421969	72.829414	15.563647	154.522984	18.345716	245.026719	12.867303
32 Sorong	0.031332	0.097358	0.169310	0.080394	0.123955	0.712862	0.104544	1.019117	0.085230	0.023127	5.718849	23.911018	5.098725	51.711971	6.133021	83.526411	4.343039
33 Jayapura	0.002825	0.008832	0.015670	0.007446	0.011651	0.067744	0.009862	0.098601	0.008061	0.002152	0.559217	2.338719	0.498523	5.200322	0.615917	8.577166	0.441535

OD demand 2010 (2 of 2)

Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Origin	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura
1 Banda Aceh	3.636607	0.136964	6.051078	1.016711	1.666812	0.284114	0.034205	0.119848	4.457396	0.127350	0.029692	0.209243	0.027494	0.004625	0.000699	0.000148
2 Medan	5.541551	0.212789	9.114849	1.552485	2.553885	0.439016	0.053419	0.185664	6.827492	0.197645	0.046235	0.322622	0.042739	0.007249	0.001099	0.000234
3 Padang	18.622242	0.769577	29.215107	5.259776	8.768701	1.556472	0.196830	0.664481	23.413892	0.712070	0.168593	1.134551	0.154881	0.026907	0.004138	0.000900
4 Pekanbaru	18.249762	0.752224	28.632931	5.153676	8.580530	1.522015	0.192317	0.649640	22.912051	0.696070	0.164763	1.109627	0.151382	0.026315	0.004041	0.000880
5 Jambi	39.330627	1.737583	58.789433	11.196665	18.903561	3.454429	0.451364	1.486913	50.418961	1.602512	0.383291	2.499948	0.350293	0.062129	0.009655	0.002133
6 Palembang	61.392700	2.858590	87.889187	17.594279	30.018149	5.614563	0.752004	2.429598	79.989507	2.632648	0.633842	4.040337	0.577024	0.104035	0.016292	0.003639
7 Bengkulu	43.676615	1.949718	64.652412	12.451280	21.047476	3.865202	0.507744	1.665992	56.126263	1.797199	0.430569	2.793853	0.393167	0.070044	0.010892	0.002415
8 Bandar Lampung	108.878627	5.581330	142.477656	31.604157	54.937839	10.719946	1.494780	4.689674	146.144665	5.118907	1.248209	7.631450	1.129032	0.208696	0.033040	0.007514
9 Pangkal Pinang	51.050748	2.320974	76.982910	14.586471	24.745163	4.585188	0.606836	1.978586	65.965963	2.139857	0.513469	3.304468	0.468239	0.083859	0.013089	0.002910
10 Batam	24.462146	1.033170	39.164999	6.926663	11.594676	2.077723	0.265626	0.889423	30.948473	0.954929	0.226861	1.510920	0.208049	0.036396	0.005617	0.001228
11 Jakarta	150.863492	8.380687	181.797395	44.291678	78.378552	15.805528	2.276470	6.980300	208.199506	7.654413	1.886372	11.175437	1.698044	0.319367	0.051053	0.011735
12 Bandung	151.817739	8.449018	158.536548	44.583833	78.926721	15.928318	2.295737	7.035853	209.648608	7.716291	1.902020	11.260288	1.711949	0.322110	0.051501	0.011841
13 Tangerang	146.270813	8.046879	177.183710	42.888114	75.685002	15.204628	2.182468	6.708674	201.077604	7.352036	1.809975	10.759842	1.630125	0.306314	0.048870	0.011232
14 Semarang	258.813678	18.261338	170.649756	79.040344	147.699964	32.925616	5.139795	14.864721	390.558141	16.559733	4.178352	22.759429	3.715368	0.732208	0.119332	0.028208
15 Yogyakarta	265.657864	19.131584	149.833626	68.589923	125.825117	27.121352	4.953434	14.371467	380.457221	15.997076	4.030972	22.060453	3.586704	0.705130	0.114798	0.027100
16 Surabaya	319.386585	30.469614	83.503590	95.412332	185.872048	44.205869	8.854562	24.206413	550.242358	27.362727	7.067038	35.396895	6.212166	1.276093	0.211844	0.051135
17 Denpasar	189.040499	57.346170	43.935017	60.181531	108.928846	22.921650	6.809226	19.178283	471.715485	21.493123	5.489132	28.730873	4.854056	0.975995	0.160427	0.038338
18 Mataram	-	68.845243	35.763273	50.769785	90.644996	42.857600	8.498612	23.366429	538.125992	26.355627	6.799631	34.284993	5.982939	1.224747	0.202817	0.048922
19 Kupang	136.162603	-	2.754727	13.795443	43.478784	39.392046	7.709740	21.412548	508.981187	24.102369	6.183561	31.749479	8.687889	1.107204	0.182927	0.043892
20 Pontianak	53.363825	2.078282	-	52.684504	94.317639	19.446921	2.394474	8.046237	42.833174	3.161427	1.980111	3.407073	0.159496	0.336179	0.053801	0.012385
21 Palangkaraya	148.849429	20.450013	103.517804	-	193.082143	114.548862	22.478588	56.067991	331.176819	28.662515	17.141492	28.005077	1.692858	3.344587	0.578923	0.146836
22 Banjarmasin	112.939683	27.390264	78.756419	82.054611	-	128.778919	29.486663	67.375651	412.023524	37.277623	22.022477	35.479174	2.282402	4.446902	0.782741	0.202270
23 Samarinda	103.499198	48.098747	31.473880	94.353509	249.603789	-	50.897593	84.922649	597.348940	62.714865	35.635104	54.853500	4.253612	7.978709	1.469666	0.398214
24 Manado	21.807876	10.002791	4.117805	19.673994	60.727898	54.082091	-	61.728804	179.960839	37.277623	55.411966	31.622461	26.416980	29.910323	11.669862	4.824878
25 Palu	88.659781	41.078897	20.460557	72.561701	205.179778	133.428536	91.276047	-	547.596983	105.811291	54.080920	70.772074	8.982538	15.632336	3.146531	0.924660
26 Makassar	259.531356	124.114835	13.844473	54.478350	159.486948	119.295712	33.823498	69.603743	-	85.792916	25.023638	71.527377	20.550118	5.166122	0.918493	0.239936
27 Kendari	68.324770	31.592257	5.492603	25.344123	77.562232	67.323422	37.660638	72.294044	461.158675	-	27.144784	46.892363	26.152624	5.690204	6.278955	2.105248
28 Gorontalo	39.179009	18.014527	7.646239	33.687972	101.843087	85.023115	124.424619	82.125470	298.959739	60.332272	-	48.936084	15.992112	28.592333	7.149946	2.445664
29 Mamuju	154.705121	72.435811	10.303206	43.101813	128.490609	102.493385	55.607187	84.164362	669.217144	81.620251	38.323196	-	11.099849	8.823501	1.641554	0.449181
30 Ambon	52.913677	38.849346	0.945354	5.106601	16.201036	15.577657	91.048160	20.937178	376.844195	89.220327	24.546585	21.755536	-	30.203492	11.725949	4.918260
31 Ternate	12.426772	5.680098	2.285981	11.574777	36.213197	33.522433	118.268150	41.802440	108.685307	22.270761	50.349312	19.840489	34.651006	-	15.001457	8.069073
32 Sorong	4.225638	1.927005	0.751218	4.114029	13.088919	12.679382	94.752093	17.277710	39.678805	50.462762	25.853722	7.579543	27.623778	30.804192	-	19.318481
33 Jayapura	0.433620	0.196700	0.073568	0.443910	1.438912	1.461546	16.665822	2.159999	4.409563	7.197873	3.762135	0.882321	4.929057	7.048834	8.218456	-

Applying the equation (7), (8), (9), (10), we obtained the value of β

Beta	0.000026088
95%	0.000024783
90%	0.000023479
75%	0.000019566

Then, we use the value of beta to calculate the impedance function with three scenarios of the response of cost sensitivity parameter (β) by applying equation (6).

- Impedance function for 95% response of β (1 of 2)

Origin \ Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	1.00000000	0.369323468	0.139300636	0.150299001	0.061022473	0.034734409	0.038408329	0.017942697	0.002567549	0.085351414	0.011123020	0.008304015	0.011696488	0.004453112	0.003870214	0.002388026	0.001033947
2 Medan	0.369323468	1.000000000	0.219001884	0.260675892	0.105096475	0.059821632	0.056557058	0.028573774	0.004084049	0.219514558	0.017692731	0.013208706	0.018604912	0.007083301	0.006156121	0.003798492	0.001644639
3 Padang	0.139300636	0.219001884	1.000000000	0.517172658	0.290616680	0.205603251	0.333216062	0.112338660	0.016075346	0.048696338	0.069640879	0.051991177	0.073231342	0.027880791	0.024231287	0.014951355	0.006473511
4 Pekanbaru	0.150299001	0.260675892	0.517172658	1.000000000	0.403640765	0.230023847	0.216456418	0.109742404	0.015685480	0.057490376	0.067951921	0.050730266	0.071455307	0.027204615	0.023671279	0.014588748	0.006323902
5 Jambi	0.061022473	0.105096475	0.290616680	0.403640765	1.000000000	0.569872686	0.405058953	0.272199416	0.038905458	0.023368810	0.168544449	0.125828744	0.177234068	0.067476929	0.058644421	0.036185181	0.015667153
6 Palembang	0.034734409	0.059821632	0.205603251	0.230023847	0.569872686	1.000000000	0.412224986	0.471546173	0.067398087	0.013379670	0.291978915	0.217725431	0.307032424	0.116894033	0.101592989	0.062612357	0.027141079
7 Bengkulu	0.038408329	0.056557058	0.333216062	0.216456418	0.405058953	0.412224986	1.000000000	0.308832454	0.044193054	0.012342736	0.191451132	0.142762980	0.201321746	0.076558083	0.066614717	0.041055042	0.017796457
8 Bandar Lampung	0.017942697	0.028573774	0.112338660	0.109742404	0.272199416	0.471546173	0.308832454	1.000000000	0.142596172	0.058781705	0.617748628	0.460648284	0.649597791	0.247027273	0.214943362	0.132470858	0.057423203
9 Pangkal Pinang	0.002567549	0.004084049	0.016075346	0.015685480	0.038905458	0.067398087	0.044193054	0.142596172	1.000000000	0.023097194	0.229218490	0.172935717	0.217216935	0.092738517	0.080693635	0.049731962	0.021547711
10 Batam	0.085351414	0.219514558	0.048696338	0.057490376	0.023368810	0.013379670	0.012342736	0.058781705	0.023097194	1.000000000	0.094600122	0.071455307	0.089646994	0.038318626	0.033302844	0.020548749	0.008897023
11 Jakarta	0.011123020	0.017692731	0.069640879	0.067951921	0.168544449	0.291978915	0.191451132	0.617748628	0.229218490	0.094600122	1.000000000	0.732725983	0.835234241	0.392931674	0.341498211	0.2107113560	0.091232969
12 Bandung	0.008304015	0.013208706	0.051991177	0.050730266	0.125828744	0.217725431	0.142762980	0.460648284	0.172935717	0.071455307	0.732725983	1.000000000	0.70067305	0.396623959	0.442179510	0.212693585	0.092090263
13 Tangerang	0.011696488	0.018604912	0.073231342	0.071455307	0.177234068	0.307032424	0.201321746	0.649597791	0.217216935	0.089646994	0.835234241	0.70067305	1.000000000	0.374979481	0.326277132	0.201086516	0.087166581
14 Semarang	0.004453112	0.007083301	0.027880791	0.027204615	0.067476929	0.116894033	0.076558083	0.247027273	0.092738517	0.038318626	0.392931674	0.396623959	0.374979481	1.000000000	0.778653048	0.526322131	0.228149065
15 Yogyakarta	0.003870214	0.006156121	0.024231287	0.023671279	0.058644421	0.101592989	0.066614717	0.214943362	0.080693635	0.033302844	0.341498211	0.442179510	0.326277132	0.778653048	1.000000000	0.504629983	0.24138233
16 Surabaya	0.002388026	0.003798492	0.014951355	0.014588748	0.036185181	0.062612357	0.041055042	0.132470858	0.049731962	0.020548749	0.210713560	0.212693585	0.201086516	0.526322131	0.504629983	1.000000000	0.427939071
17 Denpasar	0.001033947	0.001644639	0.006473511	0.006323902	0.015667153	0.027141079	0.017796457	0.057423203	0.021557711	0.008897023	0.091232969	0.092090263	0.087166581	0.228149065	0.241318233	0.427939071	1.000000000
18 Mataram	0.000803206	0.001277612	0.005028846	0.004912625	0.012170785	0.021084127	0.013824902	0.044608326	0.016746774	0.006911514	0.070872919	0.071538895	0.067714008	0.177234068	0.187464331	0.332437839	0.211206831
19 Kupang	0.00049822	0.000079250	0.000311937	0.000304372	0.000754947	0.001306309	0.000856550	0.002763798	0.001037580	0.000428718	0.004396210	0.004437520	0.004195357	0.010980892	0.011614728	0.020596852	0.047183197
20 Pontianak	0.002202952	0.003504106	0.013792614	0.013458110	0.033380805	0.057827423	0.037873248	0.122204276	0.048017931	0.019817346	0.196439211	0.148205129	0.185502173	0.171325809	0.133559418	0.053784119	0.022908943
21 Palangkaraya	0.000646231	0.001027921	0.004046029	0.003952522	0.007921777	0.016963532	0.011123020	0.035890258	0.013473854	0.005560756	0.057021808	0.057557628	0.054480262	0.142596172	0.111162830	0.211206831	0.089961968
22 Banjarmasin	0.000436302	0.000694000	0.002731674	0.002665425	0.006611183	0.011452919	0.007500926	0.024202975	0.009086236	0.003754342	0.038498241	0.038860000	0.036739340	0.096161236	0.075051521	0.142429559	0.060737771
23 Samarinda	0.000133023	0.000211591	0.000832850	0.000812651	0.002015659	0.003491837	0.002286929	0.007387786	0.002773509	0.001144647	0.011737584	0.011847879	0.011201319	0.029352533	0.022882175	0.043424811	0.018518110
24 Manado	0.000015351	0.000024418	0.000096111	0.000093780	0.000232608	0.000402959	0.000263912	0.000851557	0.000319690	0.000132093	0.001354522	0.001367250	0.001292636	0.003383336	0.003243893	0.006338705	0.004671764
25 Palu	0.000086008	0.000136808	0.000538493	0.000525434	0.001303258	0.002255069	0.001478653	0.004771118	0.001791164	0.000740091	0.007589135	0.007660448	0.007242404	0.018956207	0.018174934	0.035473105	0.026175032
26 Makassar	0.000452934	0.000720456	0.002835806	0.002767031	0.006863202	0.011889506	0.007786863	0.025125596	0.009432604	0.003897458	0.039965800	0.040341349	0.038139850	0.099826918	0.095712593	0.187026510	0.137842599
27 Kendari	0.000061348	0.000097583	0.000384100	0.000374784	0.001610390	0.001054702	0.003407152	0.012791077	0.000527897	0.000541323	0.005464089	0.005165904	0.013537011	0.012979089	0.025332062	0.018670280	0.001867028
28 Gorontalo	0.000030778	0.000048956	0.000192698	0.000188025	0.000466368	0.000806971	0.000529132	0.001707333	0.000640964	0.000264840	0.002715753	0.002741272	0.002591676	0.006783431	0.006503855	0.012693961	0.009366669
29 Manuju	0.000186929	0.000297337	0.001170358	0.001141974	0.002832493	0.004906885	0.003213694	0.010369515	0.003892904	0.001608509	0.016494474	0.016649166	0.015740591	0.041199288	0.039501277	0.077187188	0.056888634
30 Ambon	0.000044481	0.000070753	0.000278494	0.000271740	0.001166260	0.001662600	0.000764719	0.002467492	0.001662600	0.000827551	0.003924893	0.003961774	0.003745573	0.009803632	0.009395759	0.018345720	0.013537011
31 Ternate	0.000008023	0.000012777	0.000050232	0.000049071	0.000121571	0.000210604	0.000138093	0.000445581	0.000162729	0.000069037	0.000707931	0.000714584	0.000676378	0.001770345	0.001697381	0.003312881	0.002444521
32 Sorong	0.00002406	0.000003828	0.000015066	0.000014701	0.000036464	0.000063168	0.000041371	0.000133490	0.000050173	0.000020707	0.000212335	0.000214330	0.000202633	0.000530371	0.000508512	0.000993654	0.000732345
33 Jayapura	0.000000208	0.000000330	0.000001300	0.000001270	0.000003145	0.000005448	0.000003573	0.000011528	0.000004328	0.000001786	0.000018315	0.000018487	0.000017498	0.000045800	0.000043913	0.000085707	0.000063242

Impedance function for 95% response of β (2 of 2)

Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Origin	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura
1 Banda Aceh	0.000803206	0.000049822	0.002202952	0.000646231	0.000436302	0.000133023	0.000015351	0.000086008	0.000452934	0.000061348	0.000030778	0.000186929	0.000044481	0.000008023	0.000002406	0.000000208
2 Medan	0.001277612	0.000079250	0.003504106	0.001027921	0.000694000	0.000211591	0.000024418	0.000136808	0.000720456	0.000097583	0.000048956	0.000297337	0.000070753	0.000012777	0.000003828	0.000000330
3 Padang	0.005028846	0.000311937	0.013792614	0.004046029	0.002731674	0.000832850	0.000096111	0.000538493	0.002835806	0.000384100	0.000192698	0.001170358	0.000278494	0.000050232	0.000015066	0.000001300
4 Pekanbaru	0.004912625	0.000304372	0.013458110	0.003952522	0.002665425	0.000812651	0.000093780	0.000525434	0.002767031	0.000374784	0.000188025	0.001141974	0.000271740	0.000049071	0.000014701	0.000001270
5 Jambi	0.012170785	0.000754947	0.033380805	0.009792177	0.006611183	0.002015659	0.000232608	0.001303258	0.006863202	0.000929596	0.000466368	0.002832493	0.000674010	0.000121571	0.000036464	0.000003145
6 Palembang	0.021084127	0.001306309	0.057827423	0.016963532	0.011452919	0.003491837	0.000402959	0.002255069	0.011889506	0.001610390	0.000806971	0.004906885	0.001166260	0.000210604	0.000063168	0.000005448
7 Bengkulu	0.013824902	0.000856550	0.037873248	0.011123020	0.007500926	0.002286929	0.000263912	0.001478653	0.007786863	0.001054702	0.000529132	0.003213694	0.000764719	0.000138093	0.000041371	0.000003573
8 Bandar Lampung	0.044608326	0.002763798	0.122204276	0.035890258	0.024202975	0.007387786	0.000851557	0.004771118	0.025125596	0.003407152	0.001707333	0.010369515	0.002467492	0.000445581	0.000133490	0.000011528
9 Pangkal Pinang	0.016746774	0.001037580	0.048017931	0.013473854	0.009086236	0.002773509	0.000319690	0.001791164	0.009432604	0.001279107	0.000640964	0.003892904	0.000926341	0.000167279	0.000050173	0.000004328
10 Batam	0.006911514	0.000428718	0.019817346	0.005560756	0.003754342	0.001144647	0.000132093	0.000740091	0.003897458	0.000527897	0.000264840	0.001608509	0.000382755	0.000069037	0.000020707	0.000001786
11 Jakarta	0.070872919	0.004396210	0.196439211	0.057021808	0.038498241	0.011737584	0.001354522	0.007589135	0.039965800	0.005413223	0.002715753	0.016494174	0.003924893	0.000707931	0.000212335	0.000018315
12 Bandung	0.071538895	0.004437520	0.148205129	0.057557628	0.038860000	0.011847879	0.001367250	0.007660448	0.040341349	0.005464089	0.002741272	0.016649166	0.003961774	0.000714584	0.000214330	0.000018487
13 Tangerang	0.067714008	0.004195357	0.185502173	0.054480262	0.036739340	0.011201319	0.001292636	0.007242404	0.038139850	0.005165904	0.002591676	0.015740591	0.003745573	0.000676378	0.000202633	0.000017498
14 Semarang	0.177234068	0.010980892	0.171325809	0.142596172	0.096161236	0.029352533	0.003383336	0.018956207	0.099826918	0.013537011	0.006783431	0.041199288	0.009803632	0.001770345	0.000530371	0.000045800
15 Yogyakarta	0.187464331	0.011614728	0.133559418	0.111162830	0.075051521	0.022882175	0.003243893	0.018174934	0.095712593	0.012979089	0.006503855	0.039501277	0.009399579	0.001697381	0.000508512	0.000043913
16 Surabaya	0.332437839	0.020596852	0.053784119	0.211206831	0.142429559	0.043424811	0.006338705	0.035473105	0.187026510	0.025332062	0.012693961	0.077187188	0.018345720	0.003312881	0.000993654	0.000085707
17 Denpasar	0.761547433	0.047183197	0.022908943	0.089961968	0.060737771	0.018518110	0.004671764	0.026175032	0.137842599	0.018670280	0.009366669	0.056888634	0.013537011	0.002444521	0.000732345	0.000063242
18 Mataram	1.000000000	0.061022473	0.017692731	0.069478233	0.046908190	0.041635076	0.006042036	0.033852416	0.178273133	0.024146449	0.012114002	0.073574606	0.017507544	0.003161522	0.000947148	0.000081791
19 Kupang	0.061022473	1.000000000	0.000918791	0.012590501	0.018026802	0.037171384	0.005394270	0.030187789	0.159160493	0.021557711	0.010802624	0.065686682	0.028077053	0.002819278	0.000845605	0.000072937
20 Pontianak	0.017692731	0.000918791	1.000000000	0.073402774	0.049557841	0.015109503	0.001432707	0.008980626	0.005672381	0.001975993	0.002869155	0.004031864	0.000287425	0.000748794	0.000224591	0.000019372
21 Palangkaraya	0.069478233	0.012590501	0.073402774	1.000000000	0.674360568	0.205603251	0.019495625	0.122347230	0.077187188	0.026888415	0.039087823	0.054863766	0.003911151	0.010189253	0.003056130	0.000263604
22 Banjarmasin	0.046908190	0.018026802	0.049557841	0.674360568	1.000000000	0.290277116	0.027524534	0.172733654	0.108975292	0.037961907	0.055185414	0.077458385	0.005521886	0.014385507	0.004314740	0.000372165
23 Samarinda	0.041635076	0.037171384	0.015109503	0.205603251	0.290277116	1.000000000	0.057490376	0.360366489	0.227616225	0.079290874	0.115130859	0.161786996	0.011533540	0.030046947	0.009012179	0.000777339
24 Manado	0.006042036	0.005394270	0.001432707	0.019495625	0.027524534	0.057490376	1.000000000	0.145458605	0.032915764	0.037961907	0.444252180	0.065303827	0.144779965	0.520813205	0.156210945	0.013473854
25 Palu	0.033852416	0.030187789	0.008980626	0.122347230	0.172733654	0.360366489	0.145458605	1.000000000	0.185068935	0.201557251	0.292662426	0.443733104	0.029318237	0.076379283	0.022908943	0.001975993
26 Makassar	0.178273133	0.159160493	0.005672381	0.077187188	0.108975292	0.227616225	0.032915764	0.185068935	1.000000000	0.132316075	0.066303924	0.403169140	0.094268909	0.017304053	0.005190119	0.000447670
27 Kendari	0.024146449	0.021557711	0.001975993	0.026888415	0.037961907	0.079290874	0.037961907	0.201557251	0.132316075	1.000000000	0.074788752	0.121208265	0.142096916	0.019518430	0.057624959	0.005040619
28 Gorontalo	0.012114002	0.010802624	0.002869155	0.039087823	0.055185414	0.115130859	0.444252180	0.292662426	0.066303924	0.074788752	1.000000000	0.130625357	0.064469382	0.231914034	0.069559509	0.005999801
29 Mamuju	0.073574606	0.065686682	0.004031864	0.054863766	0.077458385	0.161786996	0.065303827	0.443733104	0.403169140	0.121208265	0.130625357	1.000000000	0.038769243	0.034290577	0.010284999	0.000887125
30 Ambon	0.017507544	0.028077053	0.000287425	0.003911151	0.005521886	0.011533540	0.144779965	0.029318237	0.094268909	0.142096916	0.064469382	0.038769243	1.000000000	0.274436175	0.157678822	0.013792614
31 Temate	0.003161522	0.002819278	0.000748794	0.010189253	0.014385507	0.030046947	0.520813205	0.076379283	0.017304053	0.019518430	0.231914034	0.034290577	0.274436175	1.000000000	0.296450434	0.025600013
32 Sorong	0.000947148	0.000845605	0.000224591	0.003056130	0.004314740	0.009012179	0.156210945	0.022908943	0.005190119	0.057624959	0.069559509	0.010284999	0.157678822	0.296450434	1.000000000	0.085851801
33 Jayapura	0.000081791	0.000072937	0.000019372	0.000263604	0.000372165	0.000777339	0.013473854	0.001975993	0.000447670	0.005040619	0.005999801	0.000887125	0.013792614	0.025600013	0.085851801	1.000000000

- Impedance function for 90% response of β (1 of 2)

Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	1.000000000	0.389201909	0.154528361	0.166063503	0.070698695	0.041453578	0.045596272	0.022171158	0.003514471	0.097154470	0.014094612	0.010685609	0.014782122	0.005921315	0.005184374	0.003281232	0.001484670
2 Medan	0.389201909	1.000000000	0.237225364	0.279790138	0.118326907	0.069379974	0.065787806	0.034453430	0.005455355	0.237751438	0.021878432	0.016586791	0.022945623	0.009191390	0.008047470	0.005093309	0.002304587
3 Padang	0.154528361	0.237225364	1.000000000	0.535435755	0.310146458	0.223453054	0.223453054	0.353057641	0.019978963	0.057092024	0.080124646	0.060745247	0.084032984	0.033661320	0.029471980	0.018653056	0.008440011
4 Pekanbaru	0.166063503	0.279790138	0.535435755	1.000000000	0.423381742	0.248521385	0.234612404	0.123276722	0.019519631	0.066815868	0.078282521	0.059348668	0.082101003	0.032887421	0.028826307	0.018224208	0.008255107
5 Jambi	0.070698695	0.118326907	0.310146458	0.423381742	1.000000000	0.586991266	0.424790867	0.291494234	0.046155186	0.028477236	0.185103101	0.140333019	0.194132100	0.077764022	0.068085852	0.043092090	0.019498024
6 Palembang	0.041453578	0.069379974	0.223453054	0.248521385	0.586991266	1.000000000	0.431907157	0.490576974	0.077677939	0.016790110	0.311523552	0.235915266	0.326719115	0.130874762	0.114586662	0.07242551	0.032814651
7 Bengkulu	0.045596272	0.065787806	0.353057641	0.234612404	0.424790867	0.431907157	1.000000000	0.328533470	0.052077625	0.015554766	0.208854752	0.158164685	0.219042315	0.087645246	0.076822342	0.048567663	0.021999928
8 Bandar Lampung	0.022171158	0.034453430	0.126037965	0.123276722	0.291494234	0.490576974	0.328533470	1.000000000	0.157989602	0.068236840	0.633609522	0.479829400	0.664515864	0.265892262	0.233058462	0.147341315	0.066741905
9 Pangkal Pinang	0.003514471	0.005455355	0.019978963	0.019519631	0.046155186	0.077677939	0.052077625	0.157989602	1.000000000	0.028163568	0.247696984	0.189668859	0.235393255	0.105102942	0.092124269	0.058241656	0.026382004
10 Batam	0.097154470	0.237751438	0.057092024	0.066815868	0.028477236	0.016790110	0.015554766	0.068236840	0.028163568	1.000000000	0.107100657	0.082101003	0.101780699	0.045495381	0.039833225	0.025210772	0.011407204
11 Jakarta	0.014094612	0.021878432	0.080124646	0.078282521	0.185103101	0.311523552	0.208854752	0.633609522	0.247696984	0.107100657	1.000000000	0.744817598	0.843186498	0.412732600	0.361365707	0.228711297	0.103485776
12 Bandung	0.010685609	0.016586791	0.060745247	0.059348668	0.140333019	0.235915266	0.158164685	0.479829400	0.189668859	0.082101003	0.744817598	1.000000000	0.713329743	0.416405920	0.461584608	0.230746828	0.104406799
13 Tangerang	0.014782122	0.022945623	0.084032984	0.082101003	0.194132100	0.326719115	0.219042315	0.664515864	0.235393255	0.101780699	0.843186498	0.713329743	1.000000000	0.394846380	0.346088637	0.218799842	0.099110819
14 Semarang	0.005921315	0.009191390	0.033661320	0.032887421	0.077764022	0.130874762	0.087645246	0.265892262	0.105102942	0.045495381	0.412732600	0.416405920	0.394846380	1.000000000	0.788974061	0.544405619	0.246602036
15 Yogyakarta	0.005184374	0.008047470	0.029471980	0.028826307	0.068085852	0.114586662	0.076822342	0.233058462	0.092124269	0.039833225	0.361365707	0.461584608	0.346088637	0.788974061	1.000000000	0.523125690	0.260067086
16 Surabaya	0.003281232	0.005093309	0.018653056	0.018224208	0.043092090	0.07242551	0.048567663	0.147341315	0.058241656	0.025210772	0.228711297	0.230746828	0.218799842	0.544405619	0.523125690	1.000000000	0.447489542
17 Denpasar	0.001484670	0.002304587	0.008440011	0.008255107	0.019498024	0.032814651	0.021999928	0.066741905	0.026382004	0.011407204	0.103485776	0.104406799	0.099110819	0.246602036	0.260067086	0.447489542	1.000000000
18 Mataram	0.001168774	0.001814236	0.006642116	0.006498654	0.015349396	0.025832622	0.017318966	0.052541116	0.020768660	0.008980073	0.081466931	0.082191987	0.078022841	0.194132100	0.204732169	0.352276429	0.772544375
19 Kupang	0.000083922	0.000130268	0.000477078	0.000466110	0.001102140	0.001852819	0.001242186	0.003768460	0.001489612	0.000644801	0.005849611	0.005901672	0.005596111	0.013923934	0.014684213	0.025266680	0.055409985
20 Pontianak	0.003039813	0.004718566	0.017280644	0.016883349	0.039921560	0.067186914	0.044994264	0.136500577	0.056338238	0.024359854	0.214006369	0.163870965	0.202701494	0.187995697	0.148488099	0.062728044	0.027946059
21 Palangkaraya	0.000951178	0.001476471	0.005407230	0.005288769	0.012491726	0.021023240	0.014094612	0.042759286	0.016902059	0.007308210	0.066299844	0.066889913	0.063496957	0.157989602	0.124787834	0.229218490	0.102119452
22 Banjarmasin	0.000655603	0.001017663	0.003726951	0.003641266	0.008609963	0.014490337	0.009704004	0.029439355	0.011636904	0.005037208	0.045697387	0.046104094	0.043717041	0.108774313	0.086010427	0.157814713	0.070386170
23 Samarinda	0.000212779	0.000330288	0.001209601	0.001181792	0.002794408	0.004702913	0.003149484	0.009565282	0.003781002	0.001634852	0.014831320	0.014963319	0.014188589	0.035442382	0.027915124	0.051219572	0.022844191
24 Manado	0.000027510	0.000042703	0.000156389	0.000152794	0.000361289	0.000608039	0.000407197	0.001235326	0.000488304	0.000211370	0.001917541	0.001934607	0.001834442	0.004564356	0.004385943	0.008273414	0.006196404
25 Palu	0.000140770	0.000218511	0.000800246	0.000781848	0.001848720	0.003107901	0.002083630	0.006321178	0.002498660	0.001081582	0.009812081	0.009899408	0.009386863	0.023355872	0.022442929	0.042288307	0.031707085
26 Makassar	0.000679256	0.001054378	0.003861413	0.003772636	0.008920594	0.015013121	0.010054106	0.030501471	0.012056742	0.005218941	0.047346061	0.047767441	0.045294268	0.112698682	0.108293474	0.204279156	0.152995643
27 Kendari	0.000102211	0.000158657	0.000581045	0.000567687	0.001342325	0.002259097	0.001512890	0.004594790	0.001816247	0.000785319	0.007124390	0.007187797	0.006815647	0.016977107	0.016313500	0.030738869	0.023021992
28 Gorontalo	0.000053174	0.000082539	0.000302281	0.000295331	0.000698327	0.001173964	0.000787061	0.002387732	0.000943832	0.000408552	0.003706369	0.003739356	0.003545749	0.008822337	0.008477486	0.015973785	0.011976885
29 Mamuju	0.000293700	0.000455898	0.001669620	0.001631234	0.003857138	0.006491460	0.004347252	0.013188403	0.005213164	0.002256596	0.020471764	0.020653963	0.019584598	0.048729309	0.046824560	0.088327405	0.066153142
30 Ambon	0.000075373	0.000116999	0.000428480	0.000418629	0.000989871	0.001664082	0.001115650	0.003384585	0.001337872	0.000579118	0.005253739	0.005300497	0.005026062	0.012505569	0.012016747	0.022642671	0.016977107
31 Ternate	0.000014878	0.000023119	0.000084575	0.000082722	0.000195385	0.000328828	0.000220456	0.000668804	0.000264368	0.000114309	0.001037006	0.001046235	0.000993165	0.002471138	0.002374546	0.004474260	0.003354728
32 Sorong	0.00004754	0.000007380	0.000027027	0.000026406	0.000062437	0.000105081	0.000070371	0.000213487	0.000084482	0.000036529	0.000331387	0.000334336	0.000317026	0.000788806	0.000757973	0.001429801	0.001070855
33 Jayapura	0.000000467	0.000000724	0.000002652	0.000002594	0.000006127	0.000010311	0.000006913	0.000020972	0.000008290	0.000003584	0.000032518	0.000032808	0.000031144	0.000077490	0.000074461	0.000140303	0.000105197

Impedance function for 90% response of β (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura
1 Banda Aceh	0.001168774	0.000083922	0.003039813	0.000951178	0.000655603	0.000212779	0.000027510	0.000140770	0.000679256	0.000102211	0.000053174	0.000293700	0.000075373	0.000014878	0.000004754	0.000000467
2 Medan	0.001814236	0.000130268	0.004718566	0.001476471	0.001017663	0.000330288	0.000042703	0.000218511	0.001054378	0.000158657	0.000082539	0.000455898	0.000116999	0.000023119	0.000007380	0.000000724
3 Padang	0.006644216	0.000477078	0.017280644	0.005407230	0.003726951	0.001209601	0.000156389	0.000800246	0.003861413	0.000581045	0.000302281	0.001669620	0.000428480	0.000084575	0.000027027	0.000002652
4 Pekanbaru	0.006498654	0.000466110	0.016883349	0.005288769	0.003641266	0.001181792	0.000152794	0.000781848	0.003772636	0.000567687	0.000295331	0.001631234	0.000418629	0.000082722	0.000026406	0.000002594
5 Jambi	0.015349396	0.001102140	0.039921560	0.012491726	0.008609963	0.002794408	0.000361289	0.001848720	0.008920594	0.001342325	0.000698327	0.003857138	0.000989871	0.000195385	0.000062437	0.000006127
6 Palembang	0.025832622	0.001852819	0.067186914	0.021023240	0.014490337	0.004702913	0.000608039	0.003107901	0.015013121	0.002259097	0.001173964	0.006491460	0.001664082	0.000328828	0.000105081	0.000010311
7 Bengkulu	0.017318966	0.001242186	0.044994264	0.014094612	0.009704004	0.003149484	0.000407197	0.002083630	0.010054106	0.001512890	0.000787061	0.004347252	0.001115650	0.000220456	0.000070371	0.000006913
8 Bandar Lampung	0.052541116	0.003768460	0.136500577	0.042759286	0.029439355	0.009565282	0.001235326	0.006321178	0.030501471	0.004594790	0.002387732	0.013188403	0.003384585	0.000668804	0.000213487	0.000020972
9 Pangkal Pinang	0.020768660	0.001489612	0.056338238	0.016902059	0.011636904	0.003781002	0.000488304	0.002498660	0.012056742	0.001816247	0.000943832	0.005213164	0.001337872	0.000264368	0.000084482	0.000008290
10 Batam	0.008980073	0.000644801	0.024359854	0.007308210	0.005037208	0.001634852	0.000211370	0.001081582	0.005218941	0.000785319	0.000408552	0.002256596	0.000579118	0.000114309	0.000036529	0.000003584
11 Jakarta	0.081466931	0.005849611	0.214006369	0.066299844	0.045697387	0.014831320	0.001917541	0.009812081	0.047346061	0.007124390	0.003706369	0.020471764	0.005253739	0.000103706	0.000033187	0.000032518
12 Bandung	0.082191987	0.005901672	0.163870965	0.066889913	0.046104094	0.014963319	0.001934607	0.009899408	0.047767441	0.007187797	0.003739356	0.020653963	0.005300497	0.001046235	0.000334336	0.000032808
13 Tangerang	0.078022841	0.005596111	0.202701494	0.063496957	0.043717041	0.014188589	0.001834442	0.009386863	0.045294268	0.006815647	0.003545749	0.019584598	0.005026062	0.000993165	0.000317026	0.000031144
14 Semarang	0.194132100	0.013923934	0.187995697	0.157989602	0.108774313	0.035342382	0.004564356	0.023355872	0.112698682	0.016977107	0.008822337	0.048729309	0.012505569	0.002471138	0.000788806	0.000077490
15 Yogyakarta	0.204732169	0.014684213	0.148488099	0.124787834	0.086010427	0.027915124	0.004385943	0.022442929	0.108293474	0.016313500	0.008477486	0.046824560	0.012016747	0.002374546	0.000757973	0.000074461
16 Surabaya	0.352276429	0.025266680	0.062728044	0.229218490	0.157814713	0.051219572	0.008273414	0.042288307	0.204279156	0.030738869	0.015973785	0.088327405	0.022642671	0.004474260	0.001429801	0.000140303
17 Denpasar	0.772544375	0.055409985	0.027946059	0.102119452	0.070386170	0.022844191	0.006196404	0.031707085	0.152995643	0.023021992	0.011976885	0.066153142	0.016977107	0.003354728	0.001070855	0.000105197
18 Mataram	1.000000000	0.070698695	0.021878432	0.079947354	0.055103978	0.049217482	0.007906115	0.040455697	0.195210165	0.029374214	0.015281544	0.084406102	0.021661426	0.004280363	0.001366325	0.000134223
19 Kupang	0.070698695	1.000000000	0.001327540	0.015850419	0.022269601	0.044203933	0.007100757	0.036294447	0.175325039	0.026382004	0.013709693	0.075808056	0.033885760	0.003840088	0.001227144	0.000120417
20 Pontianak	0.021878432	0.001327540	1.000000000	0.084219336	0.058048456	0.018839923	0.002022243	0.011508728	0.007447119	0.002742284	0.003904419	0.005389293	0.000441487	0.001093628	0.000349481	0.000034294
21 Palangkaraya	0.079947354	0.015850419	0.084219336	1.000000000	0.688490327	0.223453054	0.023985041	0.136651845	0.088327405	0.032525177	0.046360122	0.063920329	0.005236311	0.012971105	0.004145064	0.000406746
22 Banjarmasin	0.055103978	0.022269601	0.058048456	0.688490327	1.000000000	0.309803136	0.033253700	0.189458902	0.122460206	0.045094044	0.064275295	0.088621382	0.007259805	0.017983594	0.005746861	0.000563927
23 Samarinda	0.049217482	0.044203933	0.018839923	0.223453054	0.309803136	1.000000000	0.066815868	0.380253868	0.246056378	0.090606389	0.129003860	0.178064834	0.014586953	0.036134007	0.011547032	0.001133084
24 Manado	0.007906115	0.007100757	0.002022243	0.023985041	0.033253700	0.066815868	1.000000000	0.160992545	0.039394475	0.045094044	0.463634110	0.075389399	0.160280875	0.539005828	0.172245427	0.016902059
25 Palu	0.040455697	0.036294447	0.011508728	0.136651845	0.189458902	0.380253868	0.160992545	1.000000000	0.202252975	0.219285056	0.312214391	0.463120883	0.035303259	0.087451313	0.027946059	0.002742284
26 Makassar	0.195210165	0.175325039	0.007447119	0.088327405	0.122460206	0.246056378	0.039394475	0.202252975	1.000000000	0.147178213	0.076482748	0.422913073	0.106745380	0.021422833	0.006845909	0.000671774
27 Kendari	0.029374214	0.026382004	0.002742284	0.032525177	0.045094044	0.090606389	0.045094044	0.219285056	0.147178213	1.000000000	0.085725111	0.135446373	0.157465516	0.024011621	0.066964040	0.006658950
28 Gorontalo	0.015281544	0.013709693	0.003904419	0.046360122	0.064275295	0.129003860	0.463634110	0.312214391	0.076482748	0.085725111	1.000000000	0.145395966	0.074476475	0.250455672	0.080035951	0.007853749
29 Mamuju	0.084406102	0.075808056	0.005389293	0.063920329	0.088621382	0.178064834	0.075389399	0.463120883	0.422913073	0.135446373	0.145395966	1.000000000	0.046002079	0.040951598	0.013086548	0.001284154
30 Ambon	0.021661426	0.033885760	0.000441487	0.005236311	0.007259805	0.014586953	0.160280875	0.035303259	0.106745380	0.157465516	0.074476475	0.046002079	1.000000000	0.293762987	0.173778411	0.017280644
31 Temate	0.004280363	0.003840088	0.001093628	0.012971105	0.017983594	0.036134007	0.539005828	0.087451313	0.021422833	0.024011621	0.250455672	0.040951598	0.293762987	1.000000000	0.316041479	0.031046813
32 Sorong	0.001366325	0.001227144	0.000349481	0.004145064	0.005746861	0.011547032	0.172245427	0.027946059	0.006845909	0.066964040	0.080035951	0.013086548	0.173778411	0.316041479	1.000000000	0.097693994
33 Jayapura	0.000134223	0.000120417	0.000034294	0.000406746	0.000563927	0.001133084	0.016902059	0.002742284	0.000671774	0.006658950	0.007853749	0.001284154	0.017280644	0.031046813	0.097693994	1.000000000

- Impedance function for 75% response of β (1 of 2)

Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	1.000000000	0.455490302	0.210947071	0.223989931	0.109945172	0.070464172	0.076285345	0.041830236	0.009013288	0.143291025	0.028677696	0.022768412	0.029838751	0.013921364	0.012461785	0.008511984	0.004395669
2 Medan	0.455490302	1.000000000	0.301509454	0.345960887	0.168876645	0.108233519	0.103543101	0.060398625	0.013002270	0.302066544	0.041369489	0.032844952	0.043044388	0.020082495	0.017976955	0.012279105	0.006341046
3 Padang	0.210947071	0.301509454	1.000000000	0.594186537	0.376969043	0.286850259	0.419956860	0.177999106	0.038354010	0.092005305	0.122031450	0.096885827	0.126972056	0.059239214	0.053028306	0.036220824	0.018704777
4 Pekanbaru	0.223989931	0.345960887	0.594186537	1.000000000	0.488588722	0.313427047	0.298739379	0.174743447	0.037617767	0.104889741	0.119688935	0.095026007	0.124534702	0.058102058	0.052058402	0.035525529	0.018362660
5 Jambi	0.109945172	0.168876645	0.376969043	0.488588722	1.000000000	0.641494641	0.489943472	0.357979623	0.077063800	0.051532537	0.245194888	0.194670386	0.255121931	0.119027943	0.106548514	0.072777639	0.037583062
6 Palembang	0.070464172	0.108233519	0.286850259	0.313427047	0.641494641	1.000000000	0.496773782	0.552402922	0.118918133	0.033180119	0.378363359	0.300121221	0.393681905	0.183673536	0.164416370	0.112200496	0.057994903
7 Bengkulu	0.076285345	0.103543101	0.419956860	0.298739379	0.489943472	0.496773782	1.000000000	0.395502911	0.085220219	0.031132899	0.271146270	0.215075662	0.282123990	0.131504406	0.117825589	0.080406163	0.041560847
8 Bandar Lampung	0.041830236	0.060398625	0.177999106	0.174743447	0.357979623	0.552402922	0.395502911	1.000000000	0.214877242	0.106745380	0.683677697	0.542299302	0.711357303	0.331579812	0.297089565	0.202738915	0.104792974
9 Pangkal Pinang	0.009013288	0.013002270	0.038354010	0.037617767	0.077063800	0.118918133	0.085220219	0.214877242	1.000000000	0.051059090	0.312560384	0.250224613	0.299567719	0.152995643	0.137081352	0.093546620	0.048352969
10 Batam	0.143291025	0.302066544	0.092005305	0.104889741	0.051532537	0.033180119	0.031132899	0.106745380	0.051059090	1.000000000	0.155415183	0.124534702	0.148954808	0.076144655	0.068161304	0.046557372	0.024042668
11 Jakarta	0.028677696	0.041369489	0.122031450	0.119688935	0.245194888	0.378363359	0.271146270	0.683677697	0.312560384	0.155415183	1.000000000	0.782302902	0.867500438	0.478325988	0.428176125	0.292464403	0.151031389
12 Bandung	0.022768412	0.032844952	0.096885827	0.095026007	0.194670386	0.300121221	0.215075662	0.542299302	0.250224613	0.124534702	0.782302902	1.000000000	0.754643688	0.481870951	0.525060602	0.294631911	0.152150711
13 Tangerang	0.029838751	0.043044388	0.126972056	0.124534702	0.255121931	0.393681905	0.282123990	0.711357303	0.299567719	0.148954808	0.867500438	0.754643688	1.000000000	0.460988545	0.413037468	0.281863714	0.145691502
14 Semarang	0.013921364	0.020082495	0.059239214	0.058102058	0.119027943	0.183673536	0.131504406	0.331579812	0.152995643	0.076144655	0.478325988	0.481870951	0.460988545	1.000000000	0.820765206	0.602470101	0.311408561
15 Yogyakarta	0.012461785	0.017976955	0.053028306	0.052058402	0.106548514	0.164416370	0.117825589	0.297089565	0.137081352	0.068161304	0.428176125	0.525060602	0.413037468	0.820765206	1.000000000	0.582780538	0.325515115
16 Surabaya	0.008511984	0.012279105	0.036220824	0.035525529	0.072777639	0.112200496	0.080406163	0.202738915	0.093546620	0.046557372	0.292464403	0.294631911	0.281863714	0.602470101	0.582780538	1.000000000	0.511665037
17 Denpasar	0.004395669	0.006341046	0.018704777	0.018362660	0.037583062	0.057994903	0.041560847	0.104792974	0.048352969	0.024042668	0.151031389	0.152150711	0.145691502	0.311408561	0.325515115	0.511665037	1.000000000
18 Mataram	0.003601159	0.005194912	0.015323916	0.015043637	0.030789980	0.047512411	0.034048786	0.085851801	0.039613243	0.019696992	0.123732692	0.124649698	0.119357981	0.255121931	0.266678747	0.419182349	0.806497196
19 Kupang	0.000401079	0.000578584	0.001706702	0.001673940	0.003429236	0.005286816	0.003788688	0.009552930	0.004407858	0.002193754	0.013780738	0.013882869	0.013281240	0.028388010	0.029673964	0.046643395	0.089740818
20 Pontianak	0.007986793	0.011521482	0.033985991	0.033333597	0.068287244	0.105374916	0.075445086	0.190229882	0.090991896	0.045244129	0.276708340	0.221522754	0.264472664	0.248383794	0.204053027	0.099514138	0.050730266
21 Palangkaraya	0.003033087	0.004375430	0.012906616	0.012670550	0.025932957	0.040017477	0.028677696	0.072308948	0.033364377	0.016589853	0.104214246	0.104986597	0.100529632	0.214877242	0.176526620	0.293004781	0.149367827
22 Banjarmasin	0.002224337	0.003208755	0.009465163	0.009283470	0.019018127	0.029347115	0.021011600	0.052979385	0.024445442	0.012166292	0.076426295	0.076992704	0.073656141	0.157436451	0.129457114	0.214679006	0.109540011
23 Samarinda	0.000870845	0.001256252	0.003705685	0.003634551	0.007445745	0.011489623	0.008226205	0.020760994	0.009579418	0.004763198	0.029921488	0.030143241	0.028836951	0.061694509	0.050683465	0.084048497	0.042885764
24 Manado	0.000158335	0.000228409	0.000673761	0.000660827	0.001353772	0.002089022	0.001495673	0.003771243	0.001740105	0.000866036	0.005440270	0.005480589	0.005243082	0.011206834	0.010840579	0.018396589	0.014458275
25 Palu	0.000617199	0.000890351	0.002626352	0.002575936	0.005277066	0.008135596	0.005830206	0.014700486	0.006783013	0.003375849	0.021206431	0.021363596	0.020437781	0.043684772	0.042257093	0.071644619	0.056359041
26 Makassar	0.002291014	0.003304940	0.009748890	0.009561751	0.019588214	0.030226822	0.021641443	0.054567491	0.025178217	0.012530988	0.078717244	0.079300632	0.075864052	0.162155754	0.156856278	0.266186921	0.209202025
27 Kendari	0.000472695	0.000681894	0.002011446	0.001972834	0.004041551	0.006236568	0.004465184	0.011269069	0.005199709	0.002585464	0.016241385	0.016361753	0.015652699	0.033487784	0.032393356	0.054921186	0.043163741
28 Gorontalo	0.000274209	0.000395565	0.001166834	0.001144436	0.002344492	0.003614479	0.002590241	0.006531125	0.003013554	0.001499821	0.009421583	0.009491408	0.009080088	0.019408250	0.018773961	0.031830237	0.025039168
29 Mamuju	0.001139166	0.001643324	0.004847465	0.004754413	0.009739897	0.015029759	0.010760829	0.027132730	0.012519428	0.006230815	0.039140773	0.039430852	0.037722073	0.080629112	0.077994040	0.132356790	0.104022048
30 Ambon	0.000366731	0.000529035	0.001560543	0.001530587	0.003135562	0.004834061	0.003464230	0.008734831	0.004030375	0.002005884	0.012600576	0.012693961	0.012143855	0.025955694	0.025108596	0.042570268	0.033487784
31 Ternate	0.000094866	0.000136976	0.000403679	0.000396296	0.000811103	0.001251623	0.000896950	0.002261600	0.001043535	0.000518879	0.003259499	0.003283656	0.003144256	0.006720695	0.006501054	0.011022186	0.008670572
32 Sorong	0.000036664	0.000052890	0.000156014	0.000153020	0.000313476	0.000483729	0.000346334	0.000873260	0.000403307	0.000200537	0.001259736	0.001269072	0.001214075	0.002595027	0.002510218	0.004259869	0.003347923
33 Jayapura	0.000005297	0.000007642	0.000022542	0.000022130	0.000045293	0.000069892	0.000050087	0.000126291	0.000058272	0.000028975	0.000182015	0.000183363	0.000175579	0.000375292	0.000363027	0.000615493	0.000484176

Impedance function for 75% response of β (2 of 2)

Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Origin	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura
1 Banda Aceh	0.003601159	0.000401079	0.007986793	0.003033087	0.002224337	0.000870845	0.000158335	0.000617199	0.002291014	0.000472695	0.000274209	0.001139166	0.000366731	0.000094866	0.000036664	0.000005297
2 Medan	0.005194912	0.000578584	0.011521482	0.004375430	0.003208755	0.001256252	0.000228409	0.000890351	0.003304940	0.000681894	0.000395565	0.001643324	0.000529035	0.000136976	0.000052890	0.000007642
3 Padang	0.015323916	0.001706702	0.033985991	0.012906616	0.009465163	0.003705685	0.000673761	0.002626352	0.009748890	0.002011446	0.001166834	0.004847465	0.001560543	0.000403679	0.000156014	0.000022542
4 Pekanbaru	0.015043637	0.001673940	0.033333597	0.012670550	0.009283470	0.003634551	0.000660827	0.002575936	0.009561751	0.001972834	0.001144436	0.004754413	0.001530587	0.000396296	0.000153020	0.000022130
5 Jambi	0.030789980	0.003429236	0.068287244	0.025932957	0.019018127	0.007445745	0.001353772	0.005277066	0.019588214	0.004041551	0.002344492	0.009739897	0.003135562	0.000811103	0.000313476	0.000045293
6 Palembang	0.047512411	0.005286816	0.105374916	0.040017477	0.029347115	0.011489623	0.002089022	0.008135596	0.030226822	0.006236568	0.003614479	0.015029759	0.004834061	0.001251623	0.000483729	0.000069892
7 Bengkulu	0.034048786	0.003788688	0.075445086	0.028677696	0.021011600	0.008226205	0.001495673	0.005830206	0.021641443	0.004465184	0.002590241	0.010760829	0.003464230	0.000896950	0.000346334	0.000050087
8 Bandar Lampung	0.085851801	0.009552930	0.190229882	0.072308948	0.052979385	0.020760994	0.003771243	0.014700486	0.054567491	0.011269069	0.006531125	0.027132730	0.008734831	0.002261600	0.000873260	0.000126291
9 Pangkal Pinang	0.039613243	0.004407858	0.090991896	0.033364377	0.024445442	0.009579418	0.001740105	0.006783013	0.025178217	0.005199709	0.003013554	0.012519428	0.004030375	0.001043535	0.000403307	0.000058272
10 Batam	0.019696992	0.002193754	0.045244129	0.016589853	0.012166292	0.004763198	0.000866036	0.003375849	0.012530988	0.002585464	0.001499821	0.006230815	0.002005884	0.000518879	0.000200537	0.000028975
11 Jakarta	0.123732692	0.013780738	0.276708340	0.104214246	0.076426295	0.029921488	0.005440270	0.021206431	0.078717244	0.016241385	0.009421583	0.039140773	0.012600576	0.000325949	0.0001259736	0.000182015
12 Bandung	0.124649698	0.013882869	0.221522754	0.104986597	0.076992704	0.030143241	0.005480589	0.021363596	0.079300632	0.016361753	0.009491408	0.039430852	0.012693961	0.003283656	0.001269072	0.000183363
13 Tangerang	0.119357981	0.013281240	0.264472664	0.100529632	0.073656141	0.028836951	0.005243082	0.020437781	0.075864052	0.015652699	0.009080088	0.037722703	0.012143855	0.003144256	0.001214075	0.000175579
14 Semarang	0.255121931	0.028388010	0.248383794	0.214877242	0.157436451	0.061694509	0.011206834	0.043684772	0.162155754	0.033487784	0.019408250	0.080629112	0.025956904	0.006720695	0.002595027	0.000375292
15 Yogyakarta	0.266678747	0.029673964	0.204053027	0.176526620	0.129457114	0.050683465	0.010840579	0.042257093	0.156856278	0.032393356	0.018773961	0.077994040	0.025108596	0.006501054	0.002510218	0.000363027
16 Surabaya	0.419182349	0.046643395	0.099514138	0.293004781	0.214679006	0.084048497	0.018396589	0.071644619	0.266186921	0.054922186	0.031830237	0.132356790	0.042570268	0.011022186	0.004259869	0.000615493
17 Denpasar	0.806497196	0.089740818	0.050730266	0.149367827	0.109540011	0.042885764	0.014458275	0.056359041	0.209202025	0.043163741	0.025039168	0.104022048	0.033487784	0.008670572	0.003347923	0.000484176
18 Mataram	1.000000000	0.109945172	0.041369489	0.121806392	0.089327626	0.081301675	0.017713428	0.069047783	0.256302017	0.052881677	0.030676515	0.127441694	0.041027263	0.010622675	0.004101678	0.000593183
19 Kupang	0.109945172	1.000000000	0.004004419	0.031625249	0.041984955	0.074339121	0.016196476	0.063076389	0.234352696	0.048352969	0.028023547	0.116527778	0.059568184	0.009704004	0.003750416	0.000541884
20 Pontianak	0.041369489	0.004004419	1.000000000	0.127206659	0.093287952	0.036522957	0.005686710	0.024220853	0.016852212	0.007329827	0.009839287	0.012870928	0.001599921	0.003407152	0.001316801	0.000190260
21 Palangkaraya	0.121806392	0.031625249	0.127206659	1.000000000	0.732680898	0.286850259	0.044663256	0.190405542	0.132356790	0.057568254	0.077348840	0.101087899	0.012565734	0.026759673	0.010342114	0.001494294
22 Banjarmasin	0.089327626	0.041984955	0.093287952	0.732680898	1.000000000	0.376621268	0.058640812	0.249993766	0.173778411	0.075584484	0.101555489	0.132723787	0.016498234	0.035134227	0.013578723	0.001961939
23 Samarinda	0.081301675	0.074339121	0.036522957	0.286850259	0.376621268	1.000000000	0.104889741	0.446746715	0.310834242	0.135196574	0.181482849	0.237400593	0.029510087	0.062843944	0.024288012	0.003509284
24 Manado	0.017713428	0.016196476	0.005686710	0.044663256	0.058640812	0.104889741	1.000000000	0.218275406	0.067535082	0.075584484	0.527002671	0.115991252	0.217471035	0.597486207	0.230917271	0.033364377
25 Palu	0.069047783	0.063076389	0.024220853	0.190405542	0.249993766	0.446746715	0.218275406	1.000000000	0.263984908	0.282384505	0.379062449	0.526516482	0.061637593	0.131261877	0.050730266	0.007329827
26 Makassar	0.256302017	0.234352696	0.016852212	0.132356790	0.173778411	0.310834242	0.067535082	0.263984908	1.000000000	0.202551877	0.117391387	0.488137971	0.154985442	0.040650331	0.015710594	0.002269965
27 Kendari	0.052881677	0.048352969	0.007329827	0.057568254	0.075584484	0.135196574	0.075584484	0.282384505	0.202551877	1.000000000	0.129099150	0.189004792	0.214283082	0.044704499	0.105083543	0.015352230
28 Gorontalo	0.030676515	0.028023547	0.009839287	0.077348840	0.101555489	0.181482849	0.527002671	0.379062449	0.117391387	0.129099150	1.000000000	0.200505812	0.114819573	0.315458616	0.121918869	0.017615604
29 Mamuju	0.127441694	0.116527778	0.012870928	0.101087899	0.132723787	0.237400593	0.115991252	0.526516482	0.488137971	0.189004792	0.200505812	1.000000000	0.076850710	0.069752382	0.026957994	0.003895060
30 Ambon	0.041027263	0.059568184	0.001599921	0.012565734	0.016498234	0.029510087	0.217471035	0.061637593	0.154985442	0.214283082	0.114819573	0.076850710	1.000000000	0.360299973	0.232628642	0.033985991
31 Temate	0.010622675	0.009704004	0.003407152	0.026759673	0.035134227	0.062843944	0.597486207	0.131261877	0.040650331	0.044704499	0.315458616	0.069752382	0.360299973	1.000000000	0.382930599	0.055379308
32 Sorong	0.004101678	0.003750416	0.001316801	0.010342114	0.013578723	0.024288012	0.230917271	0.050730266	0.015710594	0.105083543	0.121918869	0.026957994	0.232628642	0.382930599	1.000000000	0.143953829
33 Jayapura	0.000593183	0.000541884	0.000190260	0.001494294	0.001961939	0.003509284	0.033364377	0.007329827	0.002269965	0.015352230	0.017615604	0.003895060	0.033985991	0.055379308	0.143953829	1.000000000

- Weighted opportunities (W_i) is calculated using equation (4)

Year : 2010		Wij
No.	Province	
1	Aceh	67,027,178
2	Sumatera Utara	218,464,862
3	Sumatera Barat	74,563,734
4	Riau	100,103,952
5	Jambi	48,117,732
6	Sumatera Selatan	135,821,331
7	Bengkulu	22,888,895
8	Lampung	120,999,611
9	Kepulauan Bangka Belitung	24,438,862
10	Kepulauan Riau	54,828,898
11	DKI Jakarta	440,027,654
12	Jawa Barat	799,859,925
13	Banten	233,848,479
14	Jawa Tengah	636,667,525
15	DI Yogyakarta	66,605,577
16	Jawa Timur	708,942,179
17	Bali	80,579,765
18	Nusa Tenggara Barat	67,509,224
19	Nusa Tenggara Timur	50,487,761
20	Kalimantan Barat	64,548,446
21	Kalimantan Tengah	33,672,948
22	Kalimantan Selatan	56,591,596
23	Kalimantan Timur	66,795,645
24	Sulawesi Utara	32,592,816
25	Sulawesi Tengah	37,923,682
26	Sulawesi Selatan	114,761,524
27	Sulawesi Tenggara	31,782,108
28	Gorontalo	14,195,400
29	Sulawesi Barat	13,713,116
30	Maluku	17,525,441
31	Maluku Utara	11,729,076
32	Papua Barat	12,190,168
33	Papua	35,915,121
	INDONESIA	4,495,720,232

Source: (BPS, 2016)

Finally, accessibility measures are calculated by using equation (1) for three scenarios of the response of cost sensitivity parameter (β).

- Accessibility measures for 95% response of β (1 of 2)

Origin \ Destination		Destination																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	67,027,178	80,684,200	10,386,776	15,045,524	2,936,263	4,717,674	879,124	2,171,059	62,748	4,679,724	4,894,437	6,642,049	2,735,206	2,835,152	257,778	1,692,972	83,315
2	Sumatera Utara	Medan	24,754,710	218,464,862	16,329,598	26,094,687	5,057,004	8,125,054	1,294,529	3,457,416	99,810	12,035,741	7,785,291	10,565,115	4,350,730	4,509,708	410,032	2,692,911	132,525
3	Sumatera Barat	Padang	9,336,929	47,844,216	74,563,734	51,771,027	13,983,816	27,925,307	7,626,947	13,592,934	392,863	2,669,967	30,643,913	41,585,659	17,125,038	17,750,794	1,613,939	10,599,646	521,634
4	Riau	Pekanbaru	10,074,118	56,948,523	38,562,325	100,103,952	19,422,278	31,242,145	4,954,448	13,278,788	383,335	3,152,134	29,900,724	40,577,107	16,709,715	17,320,295	1,576,639	10,342,579	509,578
5	Jambi	Jambi	4,090,164	22,959,887	21,669,465	40,406,036	48,117,732	77,400,866	9,271,352	32,936,023	950,805	1,281,286	74,164,219	100,645,370	41,445,917	42,960,369	3,906,046	25,653,201	1,262,455
6	Sumatera Selatan	Palembang	2,328,149	13,068,925	15,330,546	23,026,296	27,420,981	135,821,331	9,435,374	57,056,903	1,647,133	733,593	128,478,797	174,149,847	71,799,065	74,422,635	6,766,660	44,388,541	2,187,022
7	Bengkulu	Bengkulu	2,574,402	12,355,730	24,845,834	21,668,143	19,490,518	55,988,946	22,888,895	37,368,607	1,080,028	676,739	84,243,792	114,190,387	47,078,784	48,742,045	4,436,912	29,105,651	1,434,034
8	Lampung	Bandar Lampung	1,202,648	6,242,366	8,376,390	10,985,648	13,097,619	64,046,029	7,068,834	120,999,611	3,484,888	3,222,936	271,826,479	368,454,102	151,907,455	157,274,242	14,316,427	93,914,179	4,627,148
9	Kepulauan Bangka Belitung	Pangkal Pinang	172,096	892,221	1,198,638	1,570,179	1,872,042	9,154,098	1,011,530	17,254,081	24,438,862	1,266,394	100,862,474	138,324,350	50,795,850	59,043,602	5,374,646	35,257,085	1,737,115
10	Kepulauan Riau	Batam	5,720,864	47,956,218	3,630,981	5,755,014	1,124,454	1,817,245	282,512	7,112,563	564,469	54,828,898	41,626,670	57,154,236	20,963,813	24,396,225	2,218,155	14,567,875	716,920
11	DKI Jakarta	Jakarta	745,545	3,865,240	5,192,684	6,802,256	8,109,977	39,656,965	4,382,105	74,747,344	5,601,839	5,186,820	440,027,654	586,078,150	195,318,257	250,166,836	22,745,686	149,383,730	7,351,531
12	Jawa Barat	Bandung	556,595	2,885,638	3,876,656	5,078,300	6,054,594	29,571,758	3,267,687	55,738,263	4,226,352	3,917,816	322,419,695	799,859,925	163,709,674	252,517,594	29,451,622	150,787,454	7,420,612
13	Banten	Tangerang	783,983	4,064,520	5,460,402	7,152,959	8,528,101	41,701,552	4,608,032	78,601,080	5,308,535	4,915,246	367,526,163	559,955,783	233,848,479	238,737,258	21,731,877	142,558,713	7,023,863
14	Jawa Tengah	Semarang	298,480	1,547,452	2,078,896	2,723,290	3,246,837	15,876,703	1,752,330	29,890,204	2,266,424	2,100,968	172,900,803	317,243,610	87,688,381	636,667,525	51,862,636	373,131,959	18,384,198
15	DI Yogyakarta	Yogyakarta	259,410	1,344,896	1,806,775	2,369,589	2,821,837	13,798,495	1,524,737	26,008,063	1,972,061	1,825,958	150,268,657	353,681,670	76,299,411	495,743,108	66,605,577	357,753,480	19,445,366
16	Jawa Timur	Surabaya	160,063	829,837	1,114,829	1,460,391	1,741,149	8,504,094	939,705	16,028,922	1,215,393	1,126,665	92,719,793	170,125,075	47,023,776	335,092,209	33,611,171	708,942,179	34,483,230
17	Bali	Denpasar	69,303	359,296	482,689	633,048	753,868	3,686,337	407,341	6,948,185	526,846	487,814	40,145,029	73,659,311	20,383,772	145,255,101	16,073,140	303,384,058	80,579,765
18	Nusa Tenggara Barat	Mataram	53,837	279,113	374,970	491,773	585,631	2,863,674	316,437	5,397,590	409,272	378,951	31,186,044	57,221,095	15,834,818	112,839,175	12,486,170	235,679,206	61,365,313
19	Nusa Tenggara Timur	Kupang	3,339	17,313	23,259	30,469	36,326	177,425	19,605	334,419	25,357	23,506	1,934,454	3,549,395	981,078	6,991,177	773,606	14,601,977	3,802,011
20	Kalimantan Barat	Pontianak	147,658	765,524	1,028,429	1,347,210	1,606,209	7,854,198	866,877	14,786,670	1,173,504	1,086,563	86,438,685	118,543,343	43,379,401	109,077,579	8,895,802	38,129,831	1,845,997
21	Kalimantan Tengah	Palangkaraya	43,315	224,565	301,687	395,663	471,177	2,304,010	254,594	4,342,707	329,286	304,890	25,091,172	46,038,040	12,740,126	90,786,352	7,404,064	149,733,431	7,249,114
22	Kalimantan Selatan	Banjarmasin	29,244	151,615	203,684	266,820	318,115	1,555,551	171,688	2,928,551	222,057	205,846	16,940,291	31,082,557	8,591,439	61,222,736	4,998,850	100,974,322	4,894,235
23	Kalimantan Timur	Samarinda	8,916	46,225	62,100	81,350	96,989	474,266	52,345	893,919	67,781	62,760	5,164,861	9,476,643	2,619,411	18,687,804	1,524,081	30,785,680	1,492,185
24	Sulawesi Utara	Manado	1,029	5,334	7,166	9,388	11,193	54,730	6,041	103,038	7,813	7,242	596,027	1,093,608	302,281	2,154,060	216,061	4,493,776	376,450
25	Sulawesi Tengah	Palu	5,765	29,888	40,152	52,598	62,710	306,286	33,845	577,303	43,774	40,578	3,339,429	6,127,286	1,693,625	12,068,801	1,210,552	25,148,380	2,109,178
26	Sulawesi Selatan	Makassar	30,359	157,394	211,448	276,991	330,242	1,614,849	178,233	3,040,187	230,522	213,693	17,586,057	32,267,429	8,918,946	63,556,557	6,374,993	132,590,982	11,107,324
27	Sulawesi Tenggara	Kendari	4,112	21,318	28,640	37,517	44,730	218,725	24,141	412,264	31,260	28,944	2,381,968	4,370,506	1,208,039	8,618,575	864,480	17,958,968	1,504,447
28	Gorontalo	Gorontalo	2,063	10,695	14,368	18,822	22,441	109,604	12,111	206,587	15,664	14,521	1,195,006	2,192,634	606,060	4,318,790	433,193	8,999,285	754,764
29	Sulawesi Barat	Mamuju	12,529	64,958	87,266	114,316	136,293	666,460	73,558	1,254,707	95,138	88,193	7,257,893	13,317,000	3,680,913	26,230,249	2,631,005	54,721,253	4,584,073
30	Maluku	Ambon	2,981	15,457	20,766	27,202	32,432	158,403	17,504	298,566	22,639	20,986	1,727,062	3,168,865	875,897	6,241,654	626,064	13,006,055	1,090,809
31	Maluku Utara	Terate	538	2,791	3,745	4,912	5,850	28,605	3,161	53,915	4,088	3,785	311,509	571,567	158,170	1,127,121	113,055	2,348,641	196,979
32	Papua Barat	Sorong	161	836	1,123	1,472	1,755	8,580	947	16,152	1,226	1,135	93,433	171,434	47,386	337,670	33,870	704,443	59,012
33	Papua	Jayapura	14	72	97	127	151	740	82	1,395	106	98	8,059	14,787	4,092	29,160	2,925	60,761	5,096

Accessibility measures for 95% response of β (2 of 2)

Origin	Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Ai (Million Rupiahs)	Ai (Billion Rupiahs)
		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura		
1 Aceh	Banda Aceh	54,224	2,515	142,197	21,760	24,691	8,885	500	3,262	51,979	1,950	437	2,563	780	94	29	7	208,047,054	208,047
2 Sumatera Utara	Medan	86,251	4,001	226,185	34,613	39,275	14,133	796	5,188	82,681	3,101	695	4,077	1,240	150	47	12	346,662,165	346,662
3 Sumatera Barat	Padang	339,494	15,749	890,292	136,242	154,590	55,631	3,133	20,422	325,441	12,207	2,735	16,049	4,881	589	184	47	371,526,048	371,526
4 Riau	Pekanbaru	331,647	15,367	868,700	133,093	150,841	54,282	3,057	19,926	317,549	11,911	2,669	15,660	4,762	576	179	46	396,988,950	396,989
5 Jambi	Jambi	821,640	38,116	2,154,679	329,731	374,137	134,637	7,581	49,424	787,632	29,545	6,620	38,842	11,812	1,426	444	113	553,907,575	553,908
6 Sumatera Selatan	Palembang	1,423,373	65,953	3,732,670	571,212	648,139	233,240	13,134	85,521	1,364,458	51,182	11,455	67,289	20,439	2,470	770	196	796,353,297	796,353
7 Bengkulu	Bengkulu	933,308	43,245	2,444,659	374,545	424,489	152,757	8,602	56,076	893,632	33,521	7,511	44,070	13,402	1,620	504	128	533,601,517	533,602
8 Lampung	Bandar Lampung	3,011,473	139,538	7,888,096	1,208,531	1,369,685	493,472	27,755	180,938	2,883,452	108,286	24,236	142,198	43,244	5,226	1,627	414	1,318,575,173	1,318,575
9 Kepulauan Bangka Belitung	Pangkal Pinang	1,130,562	52,385	3,099,483	453,704	514,205	185,258	10,420	67,928	1,082,500	40,653	9,099	53,384	16,235	1,962	612	155	456,943,806	456,944
10 Kepulauan Riau	Batam	466,591	21,645	1,279,179	187,247	212,464	76,457	4,305	28,067	447,278	16,778	3,760	22,058	6,708	810	252	64	293,210,775	293,211
11 DKI Jakarta	Jakarta	4,784,576	221,955	12,679,846	1,920,092	2,178,677	784,019	44,148	287,808	4,586,536	172,044	38,551	226,187	68,785	8,303	2,588	658	1,833,367,391	1,833,367
12 Jawa Barat	Bandung	4,829,535	224,040	9,566,411	1,938,135	2,199,149	791,387	44,563	290,512	4,629,635	173,660	38,913	228,312	69,432	8,381	2,613	664	1,866,375,578	1,866,376
13 Banten	Tangerang	4,571,320	211,814	11,973,877	1,834,511	2,079,138	748,199	42,131	274,659	4,376,987	164,183	36,790	215,853	65,643	7,933	2,470	628	1,759,112,681	1,759,113
14 Jawa Tengah	Semarang	11,964,934	554,401	11,058,815	4,801,633	5,441,918	1,960,621	110,272	718,889	11,456,289	430,235	96,294	564,971	171,813	20,765	6,465	1,645	1,769,020,654	1,769,021
15 DI Yogyakarta	Yogyakarta	12,655,572	586,402	8,621,053	3,743,180	4,247,285	1,528,430	105,728	689,260	10,984,123	412,503	92,325	541,686	164,732	19,909	1,577	1,617,929,052	1,617,929	
16 Jawa Timur	Surabaya	22,442,621	1,039,889	3,471,681	7,111,957	8,060,316	2,900,588	206,596	1,345,271	21,463,447	805,106	180,196	1,058,477	321,517	38,857	12,113	3,078	1,525,580,190	1,525,580
17 Bali	Denpasar	51,411,476	2,382,174	1,478,737	3,029,285	3,437,247	1,236,929	152,266	992,654	15,819,027	593,381	132,964	780,120	237,242	28,672	8,927	2,271	775,558,275	775,558
18 Nusa Tenggara Barat	Mataram	67,509,224	3,080,888	1,142,038	2,339,537	2,654,609	2,781,042	196,927	1,283,808	20,458,896	767,425	171,963	1,008,937	306,827	37,082	11,546	2,938	641,516,756	641,517
19 Nusa Tenggara Timur	Kupang	4,119,580	50,487,761	59,307	423,959	1,020,165	2,482,887	175,814	1,144,832	18,265,501	685,150	153,348	900,769	492,063	33,068	10,308	2,620	113,781,847	113,782
20 Kalimantan Barat	Pontianak	1,194,423	46,388	64,548,446	2,471,688	2,804,557	1,009,249	46,696	340,578	650,971	62,801	40,729	55,289	5,037	8,783	2,738	696	510,262,548	510,263
21 Kalimantan Tengah	Palangkaraya	4,690,422	635,666	4,738,035	33,672,948	38,163,141	13,733,402	635,417	4,639,857	8,858,119	854,571	554,867	752,353	68,545	119,511	37,255	9,467	460,177,769	460,178
22 Kalimantan Selatan	Banjarmasin	3,166,735	910,133	3,198,882	22,707,708	56,591,596	19,389,247	897,102	6,550,696	12,506,171	1,206,509	783,379	1,062,196	96,773	168,729	52,597	13,366	364,059,419	364,059
23 Kalimantan Timur	Samarinda	2,810,752	1,876,700	975,295	6,923,268	16,427,245	66,795,645	1,873,773	13,666,424	26,121,585	2,520,031	1,634,329	2,218,604	202,130	352,423	109,860	27,918	216,133,300	216,133
24 Sulawesi Utara	Manado	407,893	272,345	92,479	656,475	1,557,657	3,840,107	32,592,816	5,516,326	3,777,463	1,206,509	6,306,337	895,519	2,537,333	6,108,657	1,904,238	483,915	77,601,307	77,601
25 Sulawesi Tengah	Palu	2,285,350	1,524,114	579,685	4,119,792	9,775,273	24,070,912	4,740,905	37,923,682	21,238,793	6,405,914	4,154,460	6,084,963	513,815	895,858	279,264	70,968	177,553,901	177,554
26 Sulawesi Selatan	Makassar	12,035,081	8,035,657	366,143	2,599,120	6,167,086	15,203,773	1,072,817	7,018,495	114,761,524	4,205,284	941,211	5,528,705	1,652,104	202,961	63,268	16,078	458,555,513	458,556
27 Sulawesi Tenggara	Kendari	1,630,108	1,088,401	127,547	905,412	2,148,325	5,296,285	1,237,285	7,643,793	15,184,795	31,782,108	1,061,656	1,662,143	2,490,311	228,933	702,458	181,034	111,129,229	111,129
28 Gorontalo	Gorontalo	817,807	545,400	185,199	1,316,202	3,123,031	7,690,240	14,479,429	11,098,837	7,609,139	2,376,944	14,195,400	1,791,281	1,129,854	2,720,137	847,942	215,484	89,068,935	89,069
29 Sulawesi Barat	Mamuju	4,966,965	3,316,373	260,251	1,847,425	4,383,494	10,806,667	2,128,436	16,827,993	46,268,305	3,852,254	1,854,279	13,713,116	679,448	402,197	125,376	31,861	226,480,243	226,480
30 Maluku	Ambon	1,181,921	1,417,548	18,553	131,700	312,492	770,390	4,718,787	1,111,855	10,818,444	4,516,140	915,169	531,647	17,525,441	3,218,883	1,922,131	495,363	76,959,803	76,960
31 Maluku Utara	Ternate	213,432	142,339	48,334	343,102	814,099	2,007,005	16,974,769	2,896,584	1,985,840	620,337	3,292,112	470,231	4,809,615	11,729,076	3,613,781	919,428	55,818,514	55,819
32 Papua Barat	Sorong	63,941	42,693	14,497	102,909	244,178	601,974	5,091,355	868,791	595,626	1,831,443	987,425	141,039	2,763,391	3,477,090	12,190,168	3,083,378	33,580,533	33,581
33 Papua	Jayapura	5,522	3,682	1,250	8,876	21,061	51,923	439,151	74,937	51,375	160,201	85,170	12,165	241,722	300,264	1,046,548	35,915,121	38,546,731	38,547

- Accessibility measures for 90% response of β (1 of 2)

Destination		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1	Aceh	67,027.178	85,026,942	11,522,212	16,623,613	3,401,861	5,630,280	1,043,648	2,682,701	85,890	5,326,873	6,202,019	8,546,991	3,456,777	3,769,909	345,308	2,326,204	119,634
2	Sumatera Utara	26,087,106	218,464,862	17,688,409	28,008,099	5,693,622	9,423,280	1,505,810	4,168,852	133,323	13,035,649	9,627,115	13,267,109	5,365,799	5,851,860	536,006	3,610,862	185,703
3	Sumatera Barat	10,357,600	51,825,406	74,563,734	53,599,235	14,923,544	30,349,691	8,081,099	15,250,545	488,263	3,130,293	35,257,060	48,587,688	19,650,985	21,431,069	1,962,998	13,223,938	680,094
4	Riau	11,130,768	61,124,314	39,924,089	100,103,952	20,372,169	33,754,505	5,370,019	14,916,435	477,038	3,663,440	34,446,474	47,470,621	19,199,195	20,938,353	1,919,993	12,919,910	665,195
5	Jambi	4,738,734	25,850,271	23,125,678	42,382,186	48,117,732	79,725,935	9,722,994	35,270,689	1,127,980	1,561,375	81,450,483	112,246,758	45,397,496	49,509,827	4,534,897	30,549,800	1,571,146
6	Sumatera Selatan	2,778,516	15,157,087	16,661,494	24,877,973	28,244,689	135,821,331	9,885,878	59,359,623	1,898,360	920,583	137,078,978	188,699,167	76,402,768	83,323,711	7,632,111	51,357,580	2,644,197
7	Bengkulu	3,056,189	14,372,324	26,325,296	23,485,629	20,439,973	58,662,205	22,888,895	39,752,422	1,272,718	852,851	91,901,867	126,509,593	51,222,712	55,800,882	5,116,796	34,431,665	1,772,749
8	Lampung	1,486,070	7,526,864	9,397,861	12,340,487	14,026,042	66,630,817	7,519,768	120,999,611	3,861,086	3,741,351	278,805,711	383,796,308	155,396,024	169,284,968	15,522,993	104,456,473	5,378,047
9	Kepulauan Bangka Belitung	235,565	1,191,803	1,489,706	1,953,992	2,220,883	10,550,321	1,191,999	19,116,680	24,438,862	1,544,177	108,993,523	151,708,519	55,046,355	66,915,630	6,135,990	41,289,967	2,125,856
10	Kepulauan Riau	6,511,990	51,940,335	4,256,995	6,688,532	1,370,260	2,280,455	356,031	8,256,631	688,286	54,828,898	47,127,251	65,669,302	23,801,262	28,965,432	2,653,115	17,872,980	919,190
11	DKI Jakarta	944,722	4,779,669	5,974,393	7,836,390	8,906,741	42,311,543	4,780,454	76,666,506	6,053,432	5,872,211	440,027,654	595,749,749	197,177,880	262,773,443	24,068,972	162,143,085	8,338,859
12	Jawa Barat	716,226	3,623,631	4,529,392	5,941,036	6,752,507	32,042,325	3,620,215	58,059,171	4,635,291	4,501,508	327,740,340	799,859,925	166,811,075	265,112,127	30,744,109	163,586,159	8,413,075
13	Banten	990,804	5,012,812	6,265,813	8,218,635	9,341,196	44,375,425	5,013,637	80,406,161	5,752,743	5,580,524	371,025,376	570,563,875	233,848,479	251,385,868	23,051,433	155,116,437	7,986,326
14	Jawa Tengah	396,889	2,007,996	2,509,914	3,292,161	3,741,828	17,775,584	2,006,103	32,172,860	2,568,596	2,494,462	181,613,758	333,066,408	92,334,225	636,667,525	52,550,073	385,952,106	19,871,134
15	DI Yogyakarta	347,494	1,758,089	2,197,541	2,885,627	3,276,137	15,563,313	1,758,379	28,199,983	2,251,412	2,184,012	159,010,904	369,203,030	80,932,301	502,314,162	66,605,577	370,865,867	20,956,145
16	Jawa Timur	219,932	1,112,709	1,390,841	1,824,315	2,073,494	9,839,244	1,111,660	17,828,242	1,423,360	1,382,279	100,639,295	184,565,140	51,166,010	346,605,378	34,843,089	708,942,179	36,058,602
17	Bali	99,513	503,471	629,319	826,369	938,201	4,456,930	503,554	8,075,745	644,746	625,444	45,536,603	83,510,815	23,176,914	157,003,508	17,321,918	317,244,211	80,579,765
18	Nusa Tenggara Barat	78,340	396,347	495,418	650,541	738,578	3,508,621	396,412	6,357,455	507,562	492,368	35,847,702	65,742,076	18,245,523	123,597,603	13,636,304	249,743,619	62,251,444
19	Nusa Tenggara Timur	5,625	28,459	35,573	46,659	53,032	251,652	28,432	455,982	36,404	35,354	2,573,990	4,720,511	1,308,642	8,864,916	978,050	17,912,615	4,464,924
20	Kalimantan Barat	203,750	1,030,841	1,288,509	1,690,090	1,920,935	9,125,416	1,029,869	16,516,517	1,376,842	1,335,624	94,168,720	131,073,818	47,401,436	119,690,755	9,890,136	44,470,556	2,251,887
21	Kalimantan Tengah	63,755	322,557	403,183	529,427	601,074	2,855,404	322,610	5,173,857	413,067	400,701	29,173,765	53,502,561	14,848,667	100,586,849	8,311,566	162,502,656	8,228,761
22	Kalimantan Selatan	43,943	222,324	277,895	364,505	414,292	1,968,097	222,114	3,562,151	284,393	276,185	20,108,114	36,876,817	10,223,163	69,253,073	5,728,774	111,881,507	5,671,701
23	Kalimantan Timur	14,262	72,156	90,192	118,302	134,461	638,756	72,088	1,157,395	92,403	89,637	6,526,191	11,968,559	3,317,980	22,501,347	1,859,303	36,311,715	1,840,780
24	Sulawesi Utara	1,844	9,329	11,661	15,295	17,384	82,585	9,320	149,474	11,934	11,589	843,771	1,547,414	428,981	2,905,977	292,128	5,865,372	499,305
25	Sulawesi Tengah	9,435	47,737	59,669	78,266	88,956	422,119	47,692	764,860	61,064	59,302	4,317,587	7,918,140	2,195,104	14,869,925	1,494,824	29,979,964	2,554,949
26	Sulawesi Selatan	45,529	230,345	287,921	377,656	429,239	2,039,102	230,127	3,690,666	294,653	286,149	20,833,576	38,207,262	10,591,996	71,751,591	7,212,949	144,822,110	12,328,353
27	Sulawesi Tenggara	6,851	34,661	43,325	56,828	64,590	306,834	34,628	555,968	44,387	43,058	3,134,929	5,749,231	1,593,829	10,808,773	1,086,570	21,792,081	1,855,107
28	Gorontalo	3,564	18,032	22,539	29,564	33,602	159,449	18,015	288,915	23,066	22,400	1,630,905	2,990,961	829,168	5,616,895	564,648	11,324,490	965,095
29	Sulawesi Barat	19,686	99,598	124,493	163,293	185,597	881,679	99,504	1,595,792	127,404	123,727	9,008,142	16,520,277	4,579,828	31,024,369	3,118,777	62,619,023	5,330,605
30	Maluku	5,052	25,560	31,949	41,906	47,630	226,018	25,536	409,533	32,696	31,752	2,311,790	4,239,655	1,175,337	7,961,890	800,382	16,052,345	1,368,011
31	Maluku Utara	997	5,051	6,306	8,281	9,401	44,662	5,046	80,925	6,461	6,267	456,311	836,841	232,250	1,573,294	158,158	3,171,992	270,323
32	Papua Barat	319	1,612	2,015	2,643	3,004	14,272	1,611	25,832	2,065	2,003	145,819	267,422	74,136	502,207	50,485	1,013,646	86,289
33	Papua	31	158	198	260	295	1,400	158	2,538	203	197	14,309	26,242	7,283	49,335	4,959	99,467	8,477

Accessibility measures for 90% response of β (2 of 2)

Origin	Destination		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Ai (Million Rupiahs)	Ai (Billion Rupiahs)
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamaju	Ambon	Ternate	Sorong	Jayapura				
1 Aceh	Banda Aceh	78,903	4,237	196,215	32,029	37,102	14,213	897	5,339	77,952	3,248	755	4,028	1,321	174	58	17	223,594,526	223,595	
2 Sumatera Utara	Medan	122,478	6,577	304,576	49,717	57,591	22,062	1,392	8,287	121,002	5,042	1,172	6,252	2,050	271	90	26	363,362,051	363,362	
3 Sumatera Barat	Padang	448,546	24,087	1,115,439	182,077	210,914	80,796	5,097	30,348	443,142	18,467	4,291	22,896	7,509	992	329	95	405,958,270	405,958	
4 Riau	Pekanbaru	438,719	23,533	1,089,794	178,088	206,065	78,939	4,980	29,651	432,953	18,042	4,192	22,369	7,337	970	322	93	430,932,518	430,933	
5 Jambi	Jambi	1,036,226	55,645	2,576,875	420,633	487,252	186,654	11,775	70,110	1,023,741	42,662	9,913	52,893	17,348	2,292	761	220	602,878,982	602,879	
6 Sumatera Selatan	Palembang	1,743,940	93,545	4,336,811	707,914	820,031	314,134	19,818	117,863	1,722,929	71,799	16,665	89,018	29,164	3,857	1,281	370	852,833,183	852,833	
7 Bengkulu	Bengkulu	1,169,190	62,715	2,904,310	474,607	549,165	210,372	13,272	79,019	1,153,824	48,083	11,173	59,614	19,552	2,586	858	248	584,623,354	584,623	
8 Lampung	Bandar Lampung	3,547,010	190,261	8,810,900	1,439,831	1,666,020	638,919	40,263	239,722	3,500,395	146,032	33,895	180,854	59,316	7,844	2,602	753	1,380,675,101	1,380,675	
9 Kepulauan Bangka Belitung	Pangkal Pinang	1,402,076	75,207	3,636,546	569,142	658,551	252,554	15,915	94,758	1,383,650	57,724	13,398	71,489	23,447	3,101	1,030	298	504,408,715	504,409	
10 Kepulauan Riau	Batam	606,238	32,555	1,572,391	246,089	285,064	109,201	6,889	41,018	598,934	24,959	5,800	30,945	10,149	1,341	445	129	327,759,089	327,759	
11 DKI Jakarta	Jakarta	5,499,769	295,334	13,813,779	2,232,511	2,586,088	990,668	62,498	372,110	5,433,506	226,428	52,613	280,732	92,074	12,163	4,040	1,168	1,886,361,184	1,886,361	
12 Jawa Barat	Bandung	5,548,717	297,962	10,577,616	2,252,381	2,609,104	999,485	63,054	375,422	5,481,864	228,443	53,082	283,230	92,894	12,271	4,076	1,178	1,915,568,893	1,915,569	
13 Banten	Tangerang	5,267,261	282,535	13,084,066	2,138,130	2,474,017	947,736	59,790	355,984	5,198,039	216,616	50,333	268,566	88,084	11,649	3,865	1,119	1,814,383,334	1,814,383	
14 Jawa Tengah	Semarang	13,105,707	702,988	12,134,830	5,319,976	6,155,712	2,360,717	148,765	885,741	12,933,473	539,568	125,237	668,231	219,166	28,984	9,616	2,783	1,826,363,115	1,826,363	
15 DI Yogyakarta	Yogyakarta	13,821,310	741,373	9,584,676	4,201,974	4,867,467	1,864,609	142,950	851,119	12,427,924	518,477	120,341	642,111	210,599	27,851	9,240	2,674	1,680,344,669	1,680,345	
16 Jawa Timur	Surabaya	23,781,908	1,275,658	4,048,998	7,718,462	8,930,986	3,421,244	269,654	1,603,728	23,443,387	976,646	226,754	1,211,244	396,823	52,479	17,430	5,039	1,578,406,510	1,578,407	
17 Bali	Denpasar	52,153,871	2,797,526	1,803,875	3,438,663	3,983,266	1,525,892	201,958	1,202,449	17,558,013	731,687	170,017	907,166	297,531	39,348	13,054	3,778	828,505,120	828,505	
18 Nusa Tenggara Barat	Mataram	67,509,224	3,569,419	1,412,219	2,692,063	3,118,422	3,287,513	257,683	1,534,229	22,402,616	933,574	216,928	1,157,471	379,626	50,205	16,656	4,821	691,228,580	691,229	
19 Nusa Tenggara Timur	Kupang	4,772,814	50,487,761	85,691	533,730	1,260,272	2,952,630	231,434	1,376,419	20,120,569	838,476	194,615	1,039,565	593,863	45,041	14,959	4,325	126,352,985	126,353	
20 Kalimantan Barat	Pontianak	1,476,996	67,025	64,548,446	2,835,913	3,285,055	1,258,425	65,911	436,453	854,643	87,156	55,425	73,904	7,737	12,827	4,260	1,232	559,537,108	559,537	
21 Kalimantan Tengah	Palangkaraya	5,397,184	800,252	5,436,227	33,672,948	38,962,766	14,925,691	781,740	5,182,341	10,136,588	1,033,719	658,100	876,547	91,769	152,139	50,529	14,608	506,413,608	506,414	
22 Kalimantan Selatan	Banjarmasin	3,720,027	1,124,342	3,746,938	23,183,499	56,591,596	20,693,500	1,083,832	7,184,979	14,053,720	1,433,184	912,414	1,215,275	127,231	210,931	70,055	20,253	402,750,823	402,751	
23 Kalimantan Timur	Samarinda	3,322,634	2,231,758	1,216,088	7,524,323	17,532,254	66,795,645	2,177,717	14,420,627	28,237,805	2,879,662	1,831,261	2,441,824	255,643	423,818	140,760	40,695	238,278,042	238,278	
24 Sulawesi Utara	Manado	533,736	358,501	130,533	807,647	1,881,880	4,463,009	32,592,816	6,105,430	4,520,970	1,433,184	6,581,472	1,033,824	2,808,993	6,322,040	2,099,701	607,040	84,984,138	84,984	
25 Sulawesi Tengah	Palu	2,731,133	1,832,425	742,870	4,601,470	10,721,782	25,399,302	5,247,200	37,923,682	23,210,860	6,969,341	4,432,008	6,350,830	618,705	1,025,723	340,667	98,489	197,216,085	197,216	
26 Sulawesi Selatan	Makassar	13,178,487	8,851,769	480,700	2,974,244	6,930,219	16,435,495	1,283,977	7,670,177	114,761,524	4,677,634	1,085,703	5,799,456	1,870,760	251,270	83,453	24,127	500,018,218	500,018	
27 Sulawesi Tenggara	Kendari	1,983,030	1,331,968	177,010	1,095,219	2,551,944	6,052,112	1,469,742	8,316,097	16,890,396	31,782,108	1,216,902	1,857,392	2,759,653	281,634	816,303	239,157	126,032,315	126,032	
28 Gorontalo	Gorontalo	1,031,645	692,172	252,024	1,561,082	3,637,442	8,616,896	15,111,141	11,840,319	8,777,277	2,724,525	14,195,400	1,993,832	1,305,233	2,937,614	975,652	282,068	100,475,629	100,476	
29 Sulawesi Barat	Mamuju	5,698,190	3,827,379	347,871	2,152,386	5,015,225	11,893,955	2,457,153	17,563,249	48,534,149	4,304,771	2,063,954	13,713,116	806,207	480,324	159,527	46,121	254,685,370	254,685	
30 Maluku	Ambon	1,462,346	1,710,816	28,497	176,322	410,844	974,345	5,224,005	1,338,830	12,250,263	5,004,586	1,057,223	630,832	17,525,441	3,445,568	2,118,388	620,636	88,765,987	88,766	
31 Maluku Utara	Ternate	288,964	193,877	70,592	436,775	1,017,720	2,413,594	17,567,718	3,316,476	2,458,517	763,140	3,555,318	561,574	5,148,326	11,729,076	3,852,599	1,115,050	61,361,883	61,362	
32 Papua Barat	Sorong	92,240	61,956	22,558	139,577	325,224	771,291	5,613,963	1,059,817	785,647	2,128,258	1,136,142	179,457	3,045,543	3,706,874	12,190,168	3,508,692	36,962,791	36,963	
33 Papua	Jayapura	9,061	6,080	2,214	13,696	31,914	75,685	550,886	103,998	77,094	211,635	111,487	17,610	302,851	364,150	1,190,906	35,915,121	39,199,896	39,200	

- Accessibility measures for 75% response of β (1 of 2)

Destination		Origin																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1	Aceh	67,027,178	99,508,626	15,729,001	22,422,277	5,290,312	9,570,538	1,746,087	5,061,442	220,275	7,856,489	12,618,979	18,211,540	6,977,747	8,863,280	830,024	6,034,505	354,202
2	Sumatera Utara	30,530,230	218,464,862	22,481,671	34,632,052	8,125,961	14,700,421	2,369,987	7,308,210	317,761	16,561,976	18,203,719	26,271,361	10,065,865	12,785,873	1,197,366	8,705,175	510,960
3	Sumatera Barat	14,139,187	65,869,221	74,563,734	59,480,421	18,138,896	38,960,384	9,612,348	21,537,822	937,328	5,044,549	53,697,213	77,495,090	29,692,222	37,715,684	3,531,981	25,678,470	1,507,226
4	Riau	15,013,413	75,580,297	44,304,767	100,103,952	23,509,781	42,570,079	6,837,814	21,143,889	919,335	5,750,989	52,666,441	76,007,495	29,122,251	36,991,694	3,467,380	25,185,546	1,479,659
5	Jambi	7,369,315	36,893,613	28,108,220	48,909,662	48,117,732	87,128,656	11,214,265	43,315,395	1,883,352	2,825,472	107,892,531	155,709,040	59,659,875	75,781,226	7,096,725	51,595,138	3,028,434
6	Sumatera Selatan	4,723,015	23,645,221	21,388,626	31,375,286	30,867,268	135,821,331	11,370,603	66,840,539	2,906,224	1,819,229	166,490,341	240,054,937	92,061,915	116,938,975	10,951,047	79,543,664	4,673,216
7	Bengkulu	5,113,191	22,620,529	31,313,552	29,904,992	23,574,969	67,472,476	22,888,895	47,855,698	2,082,685	1,706,983	119,311,857	172,030,403	65,974,266	83,724,585	7,847,841	57,003,321	3,348,963
8	Lampung	2,803,763	13,194,977	13,272,278	17,492,510	17,225,168	75,028,100	9,052,625	120,999,611	5,251,355	5,852,732	300,837,093	433,763,479	166,349,823	211,106,098	19,787,822	143,730,168	8,444,193
9	Kepulauan Bangka Belitung	604,135	2,840,539	2,859,818	3,765,687	3,708,135	16,151,619	1,950,597	26,000,063	24,438,862	2,799,514	137,535,213	200,144,640	70,053,455	97,407,357	9,130,383	66,319,144	3,896,271
10	Kepulauan Riau	9,604,393	65,990,926	6,860,259	10,499,878	2,479,629	4,506,568	712,598	12,916,149	1,247,826	54,828,898	68,386,979	99,610,317	34,832,855	48,478,829	4,539,923	33,006,485	1,937,353
11	DKI Jakarta	1,922,185	9,037,780	9,099,121	11,981,335	11,798,222	51,389,815	6,206,239	82,724,735	7,638,620	8,521,243	440,027,654	625,732,741	202,863,658	304,534,623	28,518,918	207,340,351	12,170,074
12	Jawa Barat	1,526,102	7,175,468	7,224,169	9,512,479	9,367,098	40,762,864	4,922,844	65,618,004	6,115,205	6,828,100	344,234,910	799,859,925	176,472,278	306,791,586	34,971,965	208,876,989	12,260,268
13	Banten	2,000,007	9,403,686	9,467,511	12,466,416	12,275,889	53,470,400	6,457,506	86,073,957	7,321,094	8,167,028	381,724,182	603,609,244	233,848,479	293,496,436	27,510,599	199,825,076	11,739,787
14	Jawa Tengah	933,110	4,387,320	4,417,097	5,816,246	5,727,355	24,946,784	3,009,991	40,121,028	3,739,039	4,174,928	210,476,662	385,429,263	107,801,470	636,667,525	54,667,540	427,116,466	25,093,229
15	DI Yogyakarta	835,278	3,927,333	3,953,989	5,211,252	5,126,873	22,331,250	2,696,898	35,947,722	3,350,112	3,737,209	188,409,336	419,974,934	96,588,184	522,554,552	66,605,577	413,157,705	26,229,931
16	Jawa Timur	570,534	2,682,553	2,700,760	3,556,246	3,501,895	15,239,221	1,840,408	24,531,330	2,286,173	2,552,689	128,692,425	235,664,258	65,913,401	383,573,148	38,816,434	708,942,179	41,229,848
17	Bali	294,629	1,385,296	1,394,698	1,838,175	1,808,412	7,876,945	951,282	12,679,909	1,181,692	1,318,233	66,457,988	121,699,256	34,069,736	198,263,718	21,681,122	362,740,926	80,579,765
18	Nusa Tenggara Barat	241,376	1,134,906	1,142,608	1,505,928	1,481,544	6,453,199	779,339	10,388,035	968,103	1,079,964	54,445,806	99,702,298	27,911,682	162,427,848	17,762,292	297,176,048	64,987,354
19	Nusa Tenggara Timur	26,883	126,400	127,258	167,568	165,007	718,062	86,719	1,155,901	107,723	120,281	6,063,906	11,104,351	3,105,798	18,073,724	1,976,452	33,067,470	7,231,294
20	Kalimantan Barat	535,332	2,517,039	2,534,122	3,336,825	3,285,827	14,312,161	1,726,855	23,017,742	2,223,738	2,480,686	121,759,322	177,187,174	61,846,530	158,137,895	13,591,070	70,549,770	4,087,833
21	Kalimantan Tengah	203,299	955,878	962,366	1,268,372	1,247,835	5,435,227	656,401	8,749,355	815,387	909,603	45,857,150	83,974,572	23,508,702	136,805,362	11,757,657	207,723,448	12,036,024
22	Kalimantan Selatan	149,091	701,000	705,758	929,312	915,109	3,985,964	480,932	6,410,485	597,419	667,064	33,629,683	61,583,379	17,224,377	100,234,675	8,622,566	152,195,002	8,826,708
23	Kalimantan Timur	58,370	274,447	276,310	363,833	358,272	1,560,536	188,289	2,512,072	234,110	261,161	13,166,282	24,110,371	6,743,477	39,278,890	3,375,801	59,585,525	3,455,725
24	Sulawesi Utara	10,613	49,899	50,238	66,151	65,140	283,734	34,234	456,319	42,526	47,484	2,393,869	4,383,703	1,226,087	7,135,027	722,043	13,042,118	1,165,044
25	Sulawesi Tengah	41,369	194,510	195,831	257,861	253,920	1,104,987	133,447	1,778,753	165,769	185,094	9,331,416	17,087,884	4,779,344	27,812,676	2,814,558	50,791,893	4,541,398
26	Sulawesi Selatan	153,560	722,013	726,914	957,169	942,540	4,105,447	495,349	6,602,645	615,327	687,060	34,637,764	63,429,398	17,740,693	103,239,303	10,447,503	188,711,136	16,857,450
27	Sulawesi Tenggara	31,683	148,970	149,981	197,489	194,470	847,059	102,203	1,363,553	127,075	141,758	7,146,659	13,087,111	3,660,360	21,320,584	2,157,578	38,935,945	3,478,124
28	Gorontalo	18,379	86,417	87,004	114,563	112,812	490,923	59,288	790,264	73,648	82,234	4,145,757	7,591,797	2,123,365	12,356,602	1,250,451	22,565,797	2,017,650
29	Sulawesi Barat	76,355	359,008	361,445	475,936	468,662	2,041,362	246,303	3,283,050	305,961	341,629	17,223,022	31,539,158	8,821,249	51,333,937	5,194,838	93,833,311	8,382,072
30	Mahuku	24,581	115,575	116,360	153,218	150,876	656,569	79,292	1,056,911	98,498	109,980	5,544,602	10,153,391	2,839,822	16,525,918	1,672,373	30,179,859	2,698,438
31	Mahuku Utara	6,359	29,925	30,100	39,671	39,028	169,997	20,530	273,653	25,503	28,450	1,434,270	2,626,465	735,279	4,278,849	433,006	7,814,902	698,673
32	Papua Barat	2,457	11,555	11,633	15,318	15,084	65,701	7,927	105,664	9,856	10,995	554,319	1,015,080	283,910	1,652,169	167,195	3,020,001	269,775
33	Papua	355	1,669	1,681	2,215	2,179	9,493	1,146	15,281	1,424	1,589	80,091	146,665	41,059	238,936	24,180	436,349	39,015

Accessibility measures for 75% response of β (2 of 2)

Origin	Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Ai (Million Rupiahs)	Ai (Billion Rupiahs)
		Mataram	Kupang	Pontianak	Pangkalayara	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura		
1 Aceh	Banda Aceh	243,111	20,250	515,535	102,133	125,879	58,169	5,161	23,406	262,920	15,023	3,893	15,622	6,427	1,113	447	190	289,721,782	289,722
2 Sumatera Utara	Medan	350,704	29,211	743,694	147,334	181,589	83,912	7,445	33,765	379,280	21,672	5,615	22,535	9,272	1,607	645	274	435,252,003	435,252
3 Sumatera Barat	Padang	1,034,506	86,168	2,193,743	434,604	535,649	247,524	21,960	99,601	1,118,798	63,928	16,564	66,474	27,349	4,735	1,902	810	543,556,089	543,556
4 Riau	Pekanbaru	1,015,584	84,514	2,151,632	426,655	525,366	242,772	21,538	97,689	1,097,321	62,701	16,246	65,198	26,824	4,648	1,865	795	566,496,131	566,496
5 Jambi	Jambi	2,078,608	173,134	4,407,835	873,239	1,076,266	497,343	44,123	200,126	2,247,973	128,449	33,281	133,564	54,952	9,513	3,821	1,627	788,492,508	788,493
6 Sumatera Selatan	Palembang	3,207,526	266,920	6,801,787	1,347,506	1,660,800	767,457	68,087	308,532	3,468,876	198,211	51,309	206,105	84,719	14,680	5,897	2,510	1,059,932,359	1,059,932
7 Bengkulu	Bengkulu	2,298,607	191,282	4,869,863	965,663	1,189,080	549,475	48,748	221,103	2,483,605	141,913	36,770	147,564	60,712	10,520	4,222	1,799	776,996,133	776,996
8 Lampung	Bandar Lampung	5,795,788	482,306	12,279,043	2,434,855	2,998,188	1,386,744	122,915	557,497	6,262,248	358,155	92,712	372,074	153,082	26,526	10,645	4,536	1,597,529,110	1,597,529
9 Kepulauan Bangka Belitung	Pangkal Pinang	2,674,259	222,543	5,873,386	1,123,477	1,383,407	639,863	56,715	257,237	2,889,491	165,258	42,779	171,680	70,634	12,240	4,916	2,093	685,195,408	685,195
10 Kepulauan Riau	Batam	1,329,729	110,758	2,920,438	558,629	688,510	318,161	28,227	128,025	1,438,075	82,172	21,291	85,444	35,154	6,086	2,445	1,041	468,194,046	468,194
11 DKI Jakarta	Jakarta	8,353,098	695,759	17,861,093	3,509,201	4,325,086	1,998,625	177,314	804,226	9,033,711	516,185	133,743	536,742	220,831	38,231	15,356	6,537	2,069,733,051	2,069,733
12 Jawa Barat	Bandung	8,415,004	700,915	14,298,950	3,535,208	4,357,140	2,013,437	178,628	810,186	9,100,661	520,011	134,734	540,720	222,467	38,514	15,470	6,586	2,087,408,888	2,087,409
13 Banten	Tangerang	8,057,765	670,540	17,071,300	3,385,129	4,168,319	1,926,183	170,887	775,076	8,706,274	497,476	128,895	517,287	212,826	36,879	14,800	6,306	2,005,203,239	2,005,203
14 Jawa Tengah	Semarang	17,223,084	1,433,247	16,032,788	7,235,550	8,909,580	4,120,925	365,262	1,656,687	18,609,242	1,064,312	275,508	1,105,676	454,906	78,828	31,634	13,479	2,023,135,759	2,023,136
15 DI Yogyakarta	Yogyakarta	18,003,275	1,498,172	13,171,306	5,944,172	7,326,185	3,385,435	353,325	1,602,545	18,001,066	1,029,529	266,504	1,069,541	440,039	76,251	30,600	13,038	1,892,849,117	1,892,849
16 Jawa Timur	Surabaya	28,298,675	2,354,921	6,423,483	9,866,335	12,149,028	5,614,074	599,597	2,717,028	30,548,017	1,745,511	451,843	1,815,024	746,063	129,280	51,929	22,105	1,765,826,413	1,765,826
17 Bali	Denpasar	54,446,000	4,530,813	3,274,560	5,029,655	6,199,044	2,864,582	471,236	2,137,342	24,008,343	1,371,835	355,441	1,426,466	586,888	101,698	40,812	17,389	1,023,083,886	1,023,084
18 Nusa Tenggara Barat	Mataram	67,509,224	5,550,886	2,670,336	4,101,580	5,055,193	5,430,598	577,330	2,618,546	29,413,610	1,680,691	435,465	1,747,623	719,021	124,594	50,000	21,304	877,294,332	877,294
19 Nusa Tenggara Timur	Kupang	7,422,313	50,487,761	258,479	1,064,915	2,375,996	4,965,530	527,889	2,392,089	26,894,673	1,536,759	397,805	1,597,959	1,043,959	113,819	45,718	19,462	184,569,922	184,570
20 Kalimantan Barat	Pontianak	2,792,822	202,174	64,548,446	4,283,423	5,279,314	2,439,575	185,346	918,544	1,933,986	232,957	139,673	176,501	28,039	39,963	16,052	6,833	746,353,568	746,354
21 Kalimantan Tengah	Pangkalayara	8,223,055	1,596,688	8,210,992	33,672,948	41,463,581	19,160,348	1,455,701	7,220,879	15,189,467	1,829,640	1,097,998	1,386,230	220,220	313,866	126,072	53,668	684,087,992	684,088
22 Kalimantan Selatan	Banjarmasin	6,030,439	2,119,726	6,021,592	24,671,526	56,591,596	25,156,661	1,911,269	9,480,684	19,943,075	2,402,234	1,441,621	1,820,057	289,139	412,092	165,527	70,463	556,386,226	556,386
23 Kalimantan Timur	Samarinda	5,488,613	3,753,216	2,357,500	9,659,094	21,313,599	66,795,645	3,418,652	16,942,280	35,671,811	4,296,832	2,576,222	3,255,502	517,177	737,101	296,075	126,036	333,008,827	333,009
24 Sulawesi Utara	Manado	1,195,820	817,724	367,068	1,503,944	3,318,577	7,006,178	32,592,816	8,277,807	7,750,429	2,402,234	7,481,014	1,590,601	3,811,276	7,007,961	2,814,920	1,198,286	120,310,885	120,311
25 Sulawesi Tengah	Palu	4,661,362	3,184,586	1,563,418	6,411,516	14,147,546	29,840,735	7,114,210	37,923,682	30,295,310	8,974,775	5,380,943	7,220,182	1,080,226	1,539,580	618,410	263,252	281,690,446	281,690
26 Sulawesi Selatan	Makassar	17,302,750	11,831,943	1,087,784	4,456,843	9,834,398	20,762,374	2,201,158	10,011,280	114,761,524	6,437,526	1,666,418	6,693,893	2,716,188	476,791	191,515	81,526	661,585,182	661,585
27 Sulawesi Tenggara	Kendari	3,570,001	2,441,233	473,129	1,938,493	4,277,447	9,030,542	2,463,511	10,709,060	23,245,162	31,782,108	1,832,614	2,591,845	3,755,405	524,342	1,280,986	551,377	193,557,859	193,558
28 Gorontalo	Gorontalo	2,070,948	1,414,846	635,111	2,604,563	5,747,187	12,122,264	17,176,501	14,375,444	13,472,015	4,103,043	14,195,400	2,749,559	2,012,264	3,700,038	1,486,212	632,667	152,465,010	152,465
29 Sulawesi Barat	Mamuju	8,603,490	5,883,227	830,798	3,403,928	7,511,051	15,857,326	3,780,481	19,967,443	56,019,458	6,006,971	2,846,260	13,713,116	1,346,843	818,131	328,622	139,892	371,344,335	371,344
30 Maluku	Ambon	2,769,719	3,007,464	103,272	423,125	933,661	1,971,145	7,087,993	2,337,524	17,786,366	6,810,368	1,629,910	1,053,863	17,525,441	4,225,986	2,835,782	1,220,611	143,898,493	143,898
31 Maluku Utara	Temate	717,129	489,933	219,926	901,077	1,988,302	4,197,702	19,473,758	4,977,934	4,665,094	1,420,803	4,478,061	956,522	6,314,416	11,729,076	4,667,988	1,988,955	87,870,524	87,871
32 Papua Barat	Sorong	276,901	189,350	84,997	348,249	768,442	1,622,333	7,526,244	1,923,878	1,802,972	3,339,777	1,730,687	369,678	4,076,919	4,491,422	12,190,168	5,170,119	53,130,776	53,131
33 Papua	Jayapura	40,045	27,358	12,281	50,317	111,029	234,405	1,087,439	277,974	260,505	487,926	250,061	53,413	595,619	649,548	1,754,821	35,915,121	42,851,193	42,851

Appendix 4: Accessibility measures of transport changes (the year 2019)

- Travel cost

Adjusted with the inflation period 2011-2015 as below and as impact of “maritime highway” policy, travel costs was lower 10% of the adjusted travel cost by inflation in 2019.

Year	Inflation	Inflation+ 1
2017	0.042	1.042
2018	0.042	1.042
2019	0.042	1.042
Total Inflation		1.131

Source: (ADB, 2016)

We could obtain travel cost per tonnage in Rupiah in 2019 (1 of 2)

Origin \ Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	-	336,187	1,178,941	1,133,490	1,672,614	2,009,654	1,949,518	2,404,732	3,567,591	1,471,928	2,690,727	2,865,540	3,238,242	3,322,153	3,610,944	4,111,610	
2 Medan	536,187	-	817,497	723,727	1,212,715	1,684,501	1,546,259	2,126,430	2,960,988	816,238	2,171,811	2,329,143	2,144,750	2,960,639	3,044,549	3,333,341	3,834,006
3 Padang	1,178,941	817,497	-	394,379	739,111	946,090	657,298	1,307,604	2,470,462	1,807,570	1,768,412	1,563,531	2,141,114	2,225,024	2,513,816	3,014,481	
4 Pekanbaru	1,133,490	723,727	394,379	-	542,621	878,961	915,323	1,321,589	2,485,146	1,708,276	1,608,283	1,783,096	1,578,215	2,155,798	2,239,009	2,528,500	3,028,466
5 Jambi	1,672,614	1,212,715	739,111	542,621	-	336,341	540,523	778,269	1,941,827	2,246,701	1,064,963	1,239,776	1,034,895	1,612,478	1,696,389	1,985,180	2,485,846
6 Palembang	2,009,654	1,684,501	946,090	878,961	336,341	-	530,034	449,620	1,613,178	2,580,245	662,682	820,644	635,621	1,283,829	1,367,740	1,657,230	2,157,197
7 Bengkulu	1,949,518	1,546,259	657,298	915,323	540,523	530,034	-	702,750	1,865,608	2,628,493	889,870	1,047,831	862,809	1,536,959	1,620,170	1,909,661	2,409,627
8 Bandar Lampung	2,404,732	2,126,430	1,307,604	1,321,589	778,269	449,620	702,750	-	1,164,956	1,694,990	259,283	417,244	232,222	836,307	919,518	1,209,009	1,708,975
9 Pangkal Pinang	3,567,591	2,960,988	2,470,462	2,485,146	1,941,827	1,613,178	1,865,608	1,164,956	-	2,253,694	881,059	1,049,579	913,225	1,422,281	1,505,493	1,794,983	2,294,950
10 Batam	1,471,928	816,238	1,807,570	1,708,276	2,246,701	2,580,245	2,628,493	1,694,990	2,253,694	-	1,410,394	1,578,215	1,442,560	1,950,917	2,034,827	2,323,619	2,824,284
11 Jakarta	2,690,727	2,171,811	1,593,598	1,608,283	1,064,963	662,682	889,870	259,283	881,059	1,410,394	-	186,001	107,685	502,833	642,614	838,265	1,288,864
12 Bandung	2,865,540	2,329,143	1,768,412	1,783,096	1,239,776	820,644	1,047,831	417,244	1,049,579	1,578,215	186,001	-	213,272	497,798	488,079	833,230	1,283,829
13 Tangerang	2,660,659	2,144,750	1,563,531	1,578,215	1,034,895	635,621	862,809	232,222	913,225	1,442,560	107,685	213,272	-	528,006	669,885	863,438	1,313,408
14 Semarang	3,238,242	2,960,639	2,141,114	2,155,798	1,612,478	1,283,829	1,536,959	836,307	1,422,281	1,950,917	502,833	497,798	528,006	-	149,640	345,501	795,471
15 Yogyakarta	3,322,153	3,044,549	2,225,024	2,239,009	1,696,389	1,367,740	1,620,170	919,518	1,505,493	2,034,827	642,614	488,079	669,885	149,640	-	409,063	850,292
16 Surabaya	3,610,944	3,333,341	2,513,816	2,528,500	1,985,180	1,657,230	1,909,661	1,209,009	1,794,983	2,323,619	838,265	833,230	863,438	345,501	409,063	-	507,658
17 Denpasar	4,111,610	3,834,006	3,014,481	3,028,466	2,485,846	2,157,197	2,409,627	1,708,975	2,294,950	2,824,284	1,288,864	1,283,829	1,313,408	795,471	850,292	507,658	-
18 Mataram	4,262,649	3,985,045	3,165,520	3,179,055	2,636,884	2,308,235	2,560,666	1,860,014	2,445,988	2,975,323	1,424,799	1,419,764	1,449,342	931,405	1,001,331	658,697	1,622,962
19 Kupang	5,925,473	5,647,869	4,828,345	4,843,029	4,299,709	3,971,759	4,224,190	3,523,538	4,109,512	4,638,148	3,245,934	3,240,340	3,273,904	2,698,419	2,664,855	2,089,998	1,643,805
20 Pontianak	3,659,193	3,381,589	2,562,064	2,576,749	2,033,429	1,704,780	1,957,909	1,257,258	1,815,961	2,345,296	876,025	1,027,693	906,862	1,055,173	1,204,114	1,748,133	2,258,588
21 Palangkaraya	4,392,710	4,115,106	3,295,581	3,309,566	2,766,946	2,438,297	2,690,727	1,990,075	2,576,049	3,105,384	1,713,171	1,707,577	1,740,442	1,164,956	1,313,897	837,006	1,296,416
22 Banjarmasin	4,627,659	4,350,055	3,530,530	3,545,215	3,001,895	2,673,246	2,926,375	2,225,723	2,811,698	3,340,333	1,948,120	1,942,526	1,976,090	1,400,605	1,548,846	1,049,090	1,507,870
23 Samarinda	5,338,100	5,060,497	4,240,972	4,255,656	3,712,336	3,383,687	3,636,817	2,935,466	3,521,440	4,050,775	2,658,561	2,652,967	2,686,531	2,110,347	2,259,288	1,688,487	2,147,267
24 Manado	6,629,621	6,352,018	5,532,493	5,547,177	5,003,857	4,675,208	4,928,338	4,227,686	4,813,660	5,342,296	3,950,082	3,944,488	3,978,052	3,402,567	3,427,740	3,027,068	3,209,573
25 Palu	5,998,922	5,321,318	4,501,793	4,516,478	3,973,158	3,645,208	3,897,638	3,196,986	3,782,961	4,311,596	2,919,383	2,913,789	2,947,353	2,371,867	2,397,041	1,997,068	2,178,874
26 Makassar	4,605,283	4,327,679	3,508,154	3,522,838	2,979,519	2,650,870	2,903,999	2,203,347	2,789,922	3,317,957	1,925,744	1,920,150	1,378,228	1,403,402	1,902,456	1,066,711	
27 Kendari	5,801,006	5,523,402	4,703,877	4,718,562	4,175,242	3,846,593	4,099,723	3,398,371	3,984,346	4,513,681	3,121,467	3,115,873	3,149,437	2,573,252	2,598,426	2,198,453	2,380,958
28 Gorontalo	6,213,565	5,935,962	5,116,437	5,131,121	4,587,801	4,259,852	4,512,282	3,811,630	4,397,604	4,926,240	3,534,027	3,528,433	3,561,997	2,986,511	3,011,684	2,611,711	2,793,517
29 Mamuju	5,134,618	4,857,014	4,037,489	4,052,173	3,508,853	3,180,204	3,433,334	2,732,682	3,318,656	3,847,292	2,455,079	2,449,485	2,483,049	1,907,563	1,932,736	1,532,064	1,714,569
30 Ambon	5,993,301	5,715,697	4,896,172	4,910,856	4,367,537	4,039,587	4,292,017	3,591,365	4,177,340	4,705,975	3,313,762	3,308,168	3,341,732	2,766,246	2,791,419	2,391,447	2,573,252
31 Ternate	7,017,707	6,739,404	5,920,758	5,934,563	5,391,943	5,063,294	5,315,724	4,615,072	5,201,047	5,730,381	4,338,168	4,332,574	4,365,439	3,789,953	3,815,126	3,415,153	3,596,959
32 Sorong	7,737,938	7,460,334	6,640,809	6,655,494	6,112,174	5,783,525	6,036,654	5,336,002	5,926,127	6,450,612	5,058,399	5,052,805	5,086,369	4,510,883	4,536,057	4,135,384	4,317,890
33 Jayapura	9,203,573	8,925,969	8,106,444	8,120,429	7,577,809	7,249,160	7,501,590	6,800,938	7,598,913	7,916,247	6,524,034	6,518,440	6,551,305	5,975,819	6,000,992	5,601,020	5,782,825
Total	130,565,848	119,941,742	99,726,187	99,844,291	87,259,339	80,487,070	86,530,717	71,239,654	93,238,794	102,290,489	65,805,686	67,476,762	66,215,798	62,981,611	65,091,399	62,546,676	72,540,964

Travel cost per tonnage in Rupiah in 2019 (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Total
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura	
1 Banda Aceh	4,262,649	5,925,473	3,659,193	4,392,710	4,627,659	5,338,100	6,629,621	5,598,922	4,605,283	5,801,006	6,213,565	5,134,618	5,993,301	7,017,707	7,737,938	9,203,573	130,565,848
2 Medan	3,985,045	5,647,869	3,381,589	4,115,106	4,350,055	5,060,497	6,352,018	5,321,318	4,327,679	5,523,402	5,935,962	4,857,014	5,715,697	6,739,404	7,460,334	8,925,969	119,941,742
3 Padang	3,165,520	4,828,345	2,562,064	3,295,581	3,530,530	4,240,972	5,532,493	4,501,793	3,508,154	4,703,877	5,116,437	4,037,489	4,896,172	5,920,578	6,640,809	8,106,444	99,726,187
4 Pekanbaru	3,179,505	4,843,029	2,576,749	3,309,566	3,545,215	4,255,656	5,547,177	4,516,478	3,522,838	4,718,562	5,131,121	4,052,173	4,910,856	5,934,563	6,655,494	8,120,429	99,844,291
5 Jambi	2,636,884	4,299,709	2,033,429	2,766,946	3,001,895	3,712,336	5,003,857	3,973,158	2,979,519	4,175,242	4,587,801	3,508,853	4,367,537	5,391,943	6,112,174	7,577,809	87,259,339
6 Palembang	2,308,235	3,971,759	1,704,780	2,438,297	2,673,246	3,383,687	4,675,208	3,645,208	2,650,870	3,846,593	4,259,852	3,180,204	4,039,587	5,063,294	5,783,525	7,249,160	80,487,070
7 Bengkulu	2,560,666	4,224,190	1,957,909	2,690,727	2,926,375	3,636,817	4,928,338	3,897,638	2,903,999	4,099,723	4,512,282	3,433,334	4,292,017	5,315,724	6,036,654	7,501,590	86,530,717
8 Bandar Lampung	1,860,014	3,523,538	1,257,258	1,990,075	2,225,723	2,935,466	4,227,686	3,196,986	2,203,347	3,398,371	3,811,630	2,732,682	3,591,365	4,615,072	5,336,002	6,800,938	71,239,654
9 Pangkal Pinang	2,445,988	4,109,512	1,815,961	2,576,049	2,811,698	3,521,440	4,813,660	3,782,961	2,789,322	3,984,346	4,397,604	3,318,656	4,177,340	5,201,047	5,921,278	7,386,913	93,238,794
10 Batam	2,975,323	4,638,148	2,345,296	3,105,384	3,340,333	4,050,775	5,342,296	4,311,596	3,317,957	4,513,681	4,926,240	3,847,292	4,705,975	5,730,381	6,450,612	7,916,247	102,290,489
11 Jakarta	1,424,799	3,245,934	876,025	1,713,171	1,948,120	2,658,561	3,950,082	2,919,383	1,925,744	3,121,467	3,534,027	2,455,079	3,313,762	4,338,168	5,058,399	6,524,034	65,805,686
12 Bandung	1,419,764	3,240,340	1,027,693	1,707,577	1,942,526	2,652,967	3,944,488	2,913,789	1,920,150	3,115,873	3,528,433	2,449,485	3,308,168	4,332,574	5,052,805	6,518,440	67,476,762
13 Tangerang	1,449,342	3,273,904	906,862	1,740,442	1,976,090	2,686,531	3,978,052	2,947,353	1,953,714	3,149,437	3,561,997	2,483,049	3,341,732	4,365,439	5,086,369	6,551,305	66,215,798
14 Semarang	931,405	2,698,419	1,055,173	1,164,956	1,400,605	2,110,347	3,402,567	2,371,867	1,378,228	2,573,252	2,986,511	1,907,563	2,766,246	3,789,953	4,510,883	5,975,819	62,981,611
15 Yogyakarta	1,001,331	2,664,855	1,204,114	1,313,897	1,548,846	2,259,288	3,427,740	2,397,041	1,403,402	2,598,426	3,011,684	1,932,736	2,791,419	3,815,126	4,536,057	6,000,992	65,091,399
16 Surabaya	658,697	2,089,998	1,748,133	837,006	1,049,090	1,688,487	3,027,068	1,997,068	902,456	2,198,453	2,611,711	1,532,064	2,391,447	3,415,153	4,135,384	5,601,020	62,546,676
17 Denpasar	162,926	1,643,805	2,258,588	1,296,416	1,507,870	2,147,267	3,209,573	2,178,874	1,066,711	2,380,958	2,793,517	1,714,569	2,573,252	3,596,959	4,317,890	5,782,825	72,540,964
18 Mataram	1,505,353	1,505,353	2,413,123	1,435,497	1,646,951	1,711,143	3,055,737	2,025,038	928,259	2,227,122	2,639,681	1,560,734	2,419,417	3,443,124	4,164,054	5,628,990	73,332,316
19 Kupang	1,505,353	-	4,182,234	2,616,006	2,401,935	1,969,097	3,123,565	2,093,565	989,304	2,294,950	2,708,208	1,628,561	2,136,918	3,511,650	4,231,881	5,697,516	105,960,171
20 Pontianak	2,413,123	4,182,234	-	1,562,132	1,797,081	2,507,523	3,916,518	2,818,690	3,093,497	3,724,223	3,501,162	3,297,679	4,877,292	4,304,604	5,024,835	6,490,470	85,881,879
21 Palangkaraya	1,435,497	2,616,006	1,562,132	-	235,648	946,090	2,355,085	1,256,558	1,532,064	2,162,791	1,939,030	1,736,246	3,315,859	2,743,171	3,463,402	4,929,037	72,683,122
22 Banjarmasin	1,646,951	2,401,935	1,797,081	235,648	-	739,810	2,148,806	1,050,279	1,193,206	1,956,511	1,732,750	1,529,966	3,109,580	2,536,891	3,257,122	4,722,757	74,465,170
23 Samarinda	1,711,143	1,969,097	2,507,523	946,090	739,810	-	1,708,276	610,448	796,729	1,515,981	1,292,919	1,089,437	2,669,050	2,096,362	2,816,593	4,282,228	83,090,880
24 Manado	3,055,737	3,123,565	3,916,518	2,355,085	2,148,806	1,708,276	-	1,153,069	1,837,638	1,760,860	485,282	1,632,057	1,040,279	351,165	999,373	2,318,444	105,878,078
25 Palu	2,025,038	2,093,565	2,818,690	1,256,558	1,050,279	610,448	1,153,069	-	908,120	957,977	734,915	485,981	2,111,046	1,538,357	2,258,588	3,724,223	84,198,287
26 Makassar	928,259	989,304	3,093,497	1,532,064	1,193,206	796,729	1,837,638	908,120	-	1,088,737	1,460,670	488,988	1,412,492	2,426,409	2,831,976	4,612,275	68,959,738
27 Kendari	2,227,122	2,294,950	3,724,223	2,162,791	1,956,511	1,515,981	1,760,860	957,977	1,088,737	-	1,395,850	1,262,152	1,167,054	2,354,386	1,706,877	3,164,122	92,642,261
28 Gorontalo	2,639,681	2,708,208	3,501,162	1,939,030	1,732,750	1,292,919	485,282	734,915	1,460,670	1,395,850	-	1,217,400	1,475,774	786,660	1,434,868	2,753,939	96,479,484
29 Mamuju	1,560,734	1,628,561	3,297,679	1,736,246	1,529,966	1,089,437	1,632,057	485,981	488,988	1,262,152	1,217,400	-	1,943,924	2,017,346	2,737,577	4,203,212	79,408,122
30 Ambon	2,419,417	2,136,918	4,877,292	3,315,859	3,109,580	2,669,050	1,040,279	2,111,046	1,412,492	1,167,054	1,475,774	1,943,924	-	773,374	994,338	2,562,064	99,184,336
31 Ternate	3,443,124	3,511,650	4,304,604	2,743,171	2,536,891	2,096,362	351,165	1,538,357	2,426,409	2,354,386	786,660	2,017,346	773,374	-	654,501	2,192,159	116,313,246
32 Sorong	4,164,054	4,231,881	5,024,835	3,463,402	3,257,122	2,816,593	999,373	2,258,588	2,831,976	1,706,877	1,434,868	2,737,577	994,338	654,501	-	1,321,589	134,730,182
33 Jayapura	5,628,990	5,697,516	6,490,470	4,929,037	4,722,757	4,282,228	2,318,444	3,724,223	4,612,275	3,164,122	2,753,939	4,203,212	2,562,064	2,192,159	1,321,589	-	180,346,535
Total	73,232,316	105,960,171	85,881,879	72,683,122	74,465,170	83,090,880	105,878,078	84,198,287	68,959,738	92,642,261	96,479,484	79,408,122	99,184,336	116,313,246	134,730,182	180,346,535	2,987,236,832

- OD demand

To determine OD demand in 2019, we used growth factor to adjust the OD demand in 2011.

No.	Province	PDRB								(1+growth)								
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019	Total
1	Aceh	3.85%	2.83%	1.65%	5.60%	5.80%	6.00%	6.20%	6.20%	1.039	1.028	1.017	1.056	1.058	1.060	1.062	1.062	1.450
2	Sumatera Utara	6.45%	6.08%	5.23%	6.10%	6.70%	7.20%	7.60%	8.10%	1.065	1.061	1.052	1.061	1.067	1.072	1.076	1.081	1.677
3	Sumatera Barat	6.31%	6.02%	5.85%	5.40%	6.00%	6.40%	7.00%	7.80%	1.063	1.060	1.059	1.054	1.060	1.064	1.070	1.078	1.636
4	Riau	3.76%	2.49%	2.62%	4.60%	5.10%	5.10%	5.80%	6.80%	1.038	1.025	1.026	1.046	1.051	1.051	1.058	1.068	1.425
5	Jambi	7.03%	7.07%	7.76%	6.50%	7.40%	7.40%	8.10%	8.90%	1.070	1.071	1.078	1.065	1.074	1.074	1.081	1.089	1.786
6	Sumatera Selatan	6.83%	5.40%	4.68%	5.80%	6.20%	6.20%	6.70%	7.50%	1.068	1.054	1.047	1.058	1.062	1.062	1.067	1.075	1.613
7	Bengkulu	6.83%	6.08%	5.49%	5.90%	7.30%	7.30%	7.70%	8.40%	1.068	1.061	1.055	1.059	1.073	1.073	1.077	1.084	1.702
8	Lampung	6.44%	5.78%	5.08%	6.20%	7.20%	7.20%	7.70%	8.20%	1.064	1.058	1.051	1.062	1.072	1.072	1.077	1.082	1.683
9	Kepulauan Bangka Belitung	5.50%	5.22%	4.68%	5.50%	6.80%	6.80%	7.10%	7.50%	1.055	1.052	1.047	1.055	1.068	1.068	1.071	1.075	1.610
10	Kepulauan Riau	7.63%	7.11%	7.32%	6.70%	7.00%	7.00%	7.50%	7.50%	1.076	1.071	1.073	1.067	1.070	1.070	1.075	1.075	1.747
11	DKI Jakarta	6.53%	6.11%	5.95%	5.40%	7.20%	7.20%	7.30%	7.90%	1.065	1.061	1.060	1.054	1.072	1.072	1.073	1.079	1.680
12	Jawa Barat	6.50%	6.34%	5.06%	5.50%	7.10%	7.10%	7.80%	7.70%	1.065	1.063	1.051	1.055	1.071	1.071	1.078	1.077	1.672
13	Banten	6.83%	7.13%	5.47%	4.90%	6.40%	6.40%	6.80%	7.70%	1.068	1.071	1.055	1.049	1.064	1.064	1.068	1.077	1.649
14	Jawa Tengah	5.34%	5.14%	5.42%	5.70%	7.10%	7.10%	7.50%	7.70%	1.053	1.051	1.054	1.057	1.071	1.071	1.075	1.077	1.639
15	DI Yogyakarta	5.37%	5.49%	5.18%	5.30%	6.10%	6.10%	6.40%	6.50%	1.054	1.055	1.052	1.053	1.061	1.061	1.064	1.065	1.570
16	Jawa Timur	6.64%	6.08%	5.86%	6.20%	7.10%	7.10%	7.30%	7.90%	1.066	1.061	1.059	1.062	1.071	1.071	1.073	1.079	1.689
17	Bali	6.96%	6.69%	6.72%	7.50%	7.80%	7.80%	8.30%	8.60%	1.070	1.067	1.067	1.075	1.078	1.078	1.083	1.086	1.789
18	Nusa Tenggara Barat	-1.54%	5.15%	5.06%	3.70%	8.30%	8.30%	8.70%	9.00%	0.985	1.052	1.051	1.037	1.083	1.083	1.087	1.090	1.567
19	Nusa Tenggara Timur	5.46%	5.42%	5.04%	6.00%	6.80%	6.80%	7.60%	9.50%	1.055	1.054	1.050	1.060	1.068	1.068	1.076	1.095	1.664
20	Kalimantan Barat	5.91%	6.04%	5.02%	5.90%	6.00%	6.20%	7.20%	7.90%	1.059	1.060	1.050	1.059	1.060	1.062	1.072	1.079	1.626
21	Kalimantan Tengah	6.87%	7.38%	6.21%	6.10%	7.00%	7.50%	8.20%	8.70%	1.069	1.074	1.062	1.061	1.070	1.075	1.082	1.087	1.749
22	Kalimantan Selatan	5.97%	5.36%	4.85%	5.00%	6.20%	6.80%	7.60%	8.60%	1.060	1.054	1.049	1.050	1.062	1.068	1.076	1.086	1.629
23	Kalimantan Timur	5.48%	2.72%	1.40%	4.50%	5.60%	5.60%	6.40%	7.00%	1.055	1.027	1.014	1.045	1.056	1.056	1.064	1.070	1.458
24	Sulawesi Utara	6.86%	6.38%	6.31%	7.10%	7.20%	7.80%	7.80%	8.30%	1.069	1.064	1.063	1.071	1.072	1.078	1.078	1.083	1.746
25	Sulawesi Tengah	9.53%	9.55%	5.11%	7.60%	7.70%	8.10%	8.30%	8.90%	1.095	1.096	1.051	1.076	1.077	1.081	1.083	1.089	1.863
26	Sulawesi Selatan	8.87%	7.63%	7.57%	7.40%	7.40%	8.30%	9.10%	9.10%	1.089	1.076	1.076	1.074	1.074	1.083	1.091	1.091	1.874
27	Sulawesi Tenggara	11.65%	7.51%	6.26%	7.80%	8.00%	8.20%	10.10%	10.30%	1.117	1.075	1.063	1.078	1.080	1.082	1.101	1.103	1.951
28	Gorontalo	7.91%	7.68%	7.29%	6.70%	7.20%	8.40%	8.60%	8.90%	1.079	1.077	1.073	1.067	1.072	1.084	1.086	1.089	1.828
29	Sulawesi Barat	9.25%	6.94%	8.73%	8.10%	9.80%	10.10%	10.20%	11.04%	1.093	1.069	1.087	1.081	1.098	1.101	1.102	1.110	2.031
30	Maluku	7.16%	5.26%	6.70%	6.90%	7.30%	8.30%	8.40%	8.60%	1.072	1.053	1.067	1.069	1.073	1.083	1.084	1.086	1.760
31	Maluku Utara	6.98%	6.37%	5.49%	5.90%	6.30%	7.00%	7.50%	7.80%	1.070	1.064	1.055	1.059	1.063	1.070	1.075	1.078	1.676
32	Papua Barat	3.63%	7.39%	5.38%	14.10%	11.50%	11.67%	11.76%	11.77%	1.036	1.074	1.054	1.141	1.115	1.117	1.118	1.118	2.081
33	Papua	1.72%	7.91%	3.25%	7.90%	10.30%	11.47%	11.64%	11.66%	1.017	1.079	1.033	1.079	1.103	1.115	1.116	1.117	1.874

Source:(Indonesia Ministry of National Development Planning, 2014)

Thus, we could get OD demand 2019 (1 of 2)

Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1 Banda Aceh	56,090,679	68,204,490	12,927,364	10,057,763	4,195,357	8,676,364	2,943,002	7,735,973	1,171,847	1,742,817	7,837,034	34,800,967	30,082,614	25,562,774	2,576,818	25,850,091	1,972,083
2 Medan	145,726,533	489,699,722	58,230,978	54,670,968	17,950,794	34,659,552	11,884,771	27,486,144	4,414,557	7,583,667	28,258,937	124,271,940	31,867,663	87,534,020	8,508,632	86,187,472	6,717,825
3 Padang	17,241,992	35,468,564	91,573,195	27,913,285	12,720,841	17,431,255	7,152,418	12,951,420	1,969,566	3,057,473	10,961,670	48,937,530	13,341,993	33,482,573	2,984,048	30,824,498	2,271,748
4 Pekanbaru	17,848,205	45,011,753	36,652,191	18,760,047	7,497,321	9,534,633	3,153,308	7,083,416	1,270,309	2,810,934	6,048,352	27,114,699	7,381,945	18,537,788	1,818,162	17,524,994	1,296,970
5 Jambi	6,086,385	12,170,220	13,683,330	5,969,476	5,996,096	10,228,938	3,360,661	5,737,898	1,049,058	1,244,452	4,472,090	18,775,939	5,357,430	12,009,224	1,179,227	10,765,732	791,042
6 Palembang	10,741,043	19,131,000	16,285,514	6,490,866	8,832,070	71,793,081	10,165,088	28,805,678	3,570,038	1,966,888	16,490,371	66,989,002	20,532,878	34,733,079	3,613,622	31,411,255	2,152,613
7 Bengkulu	3,923,578	6,943,003	7,217,618	2,348,661	3,152,813	10,814,277	4,063,962	5,067,270	516,752	428,062	3,308,849	14,183,048	4,521,358	8,192,436	817,696	7,205,403	512,485
8 Bandar Lampung	15,805,989	27,980,286	19,787,098	7,962,093	8,036,486	49,925,538	7,980,932	41,789,556	2,139,885	1,074,759	26,707,462	85,256,405	38,056,673	38,159,903	3,478,329	29,238,874	1,868,419
9 Pangkal Pinang	1,408,572	2,535,417	1,749,525	821,600	837,817	3,483,847	447,324	1,184,250	1,221,314	352,549	2,931,810	11,855,946	3,264,262	7,583,548	699,796	6,393,095	416,949
10 Batam	3,648,534	7,379,649	4,683,056	3,296,501	1,798,002	3,494,470	633,759	1,072,782	663,074	6,762,387	2,037,831	7,974,338	2,069,897	5,782,581	572,586	5,551,775	396,007
11 Jakarta	17,857,189	28,013,722	18,870,564	7,736,138	6,997,004	30,987,265	5,541,649	26,763,041	5,356,822	1,841,546	423,825,588	652,637,353	181,178,191	83,332,794	7,570,481	56,733,130	2,992,477
12 Bandung	77,119,679	122,382,873	82,336,950	33,916,059	29,608,019	118,966,105	23,466,705	91,457,864	21,698,518	6,068,562	570,936,559	3,279,046,613	399,684,658	719,589,505	58,858,638	372,650,611	20,296,180
13 Tangerang	55,572,366	33,783,676	23,482,264	9,351,893	8,722,437	38,904,026	7,588,528	43,953,126	6,587,714	2,442,808	182,965,425	390,394,037	301,401,987	199,250,314	17,583,303	90,162,037	3,897,040
14 Semarang	53,073,935	83,837,335	52,782,543	20,879,162	17,346,031	62,035,420	12,715,392	37,672,026	13,152,500	4,792,070	78,164,402	677,855,839	163,909,861	2,420,520,694	279,306,006	1,155,099,944	42,655,792
15 Yogyakarta	7,392,024	11,029,437	6,586,168	2,777,378	2,425,221	8,110,385	1,719,500	4,722,530	1,668,966	730,407	9,108,512	72,526,820	22,705,497	401,305,184	129,454,901	109,439,231	7,061,885
16 Surabaya	58,038,128	88,910,597	52,187,106	21,542,733	17,091,904	57,385,226	12,306,448	31,462,834	12,037,775	4,976,583	54,526,488	371,572,187	89,393,140	1,300,235,566	142,964,217	2,803,462,757	109,190,300
17 Denpasar	912,012	2,408,255	1,063,000	1,040,653	666,615	1,435,040	503,569	1,382,332	299,227	280,069	618,068	4,772,583	1,096,885	8,321,627	779,035	23,234,788	63,593,895
18 Mataram	877,997	2,340,163	1,035,364	1,056,362	623,586	1,358,364	478,351	1,264,738	263,245	261,146	544,957	4,020,304	1,067,094	6,546,363	607,371	13,382,611	25,241,365
19 Kupang	844,835	2,084,434	886,874	869,537	514,895	1,074,885	399,292	962,411	206,405	229,009	400,192	2,874,770	684,441	4,017,133	435,091	6,131,877	5,269,601
20 Pontianak	1,583,556	4,419,131	2,031,951	2,193,331	1,383,665	2,729,605	871,494	2,243,859	776,154	777,027	840,257	5,599,255	1,405,775	6,295,846	538,248	6,734,538	3,313,621
21 Palangkaraya	1,002,812	2,803,487	1,214,801	1,265,749	792,468	1,751,382	551,273	1,535,206	421,990	381,258	614,237	4,591,076	1,066,464	6,507,445	557,134	8,394,088	4,519,875
22 Banjarmasin	1,573,098	4,241,996	1,867,583	1,860,138	1,135,524	2,409,584	822,054	2,182,706	551,590	523,467	1,127,909	6,745,694	1,552,575	10,062,668	910,153	15,240,253	8,573,648
23 Samarinda	596,537	1,586,906	664,552	675,799	382,294	784,879	275,208	681,670	172,010	198,265	329,420	2,008,627	490,614	2,572,008	227,287	4,891,608	2,222,929
24 Manado	489,219	1,233,820	507,768	496,109	289,855	560,498	199,840	478,028	113,952	137,285	221,760	1,346,642	323,476	1,720,220	155,016	2,253,434	1,556,568
25 Palu	635,473	1,654,077	671,894	677,765	381,954	780,251	276,123	696,556	162,707	178,338	350,075	1,953,882	461,785	2,541,418	233,334	3,553,810	2,478,700
26 Makassar	3,135,742	8,182,148	3,467,518	3,416,933	2,003,348	4,158,564	1,514,246	3,752,893	895,178	924,204	1,756,220	11,249,122	2,507,193	15,815,618	1,417,563	24,828,176	19,485,568
27 Kendari	727,287	1,936,158	796,069	785,449	450,393	941,042	333,455	864,843	186,169	209,860	340,649	2,444,699	600,489	3,299,529	302,379	4,975,810	3,747,507
28 Gorontalo	279,771	697,251	286,654	282,844	156,585	316,069	120,068	291,196	66,082	75,257	111,764	807,259	188,365	988,293	91,257	1,403,949	948,970
29 Mamuju	327,037	874,043	361,378	372,374	209,454	428,643	163,848	399,605	91,790	96,172	155,952	1,188,922	261,542	1,667,970	141,923	2,444,171	1,705,693
30 Ambon	232,062	573,858	230,414	226,949	132,365	257,183	96,685	228,713	51,627	60,072	88,874	637,216	151,155	829,460	76,422	1,124,132	795,720
31 Ternate	190,634	459,822	183,361	193,783	107,384	208,356	78,953	188,193	42,012	50,689	70,572	504,446	123,207	647,286	57,750	865,586	612,772
32 Sorong	146,547	351,909	140,084	139,523	78,827	157,380	57,428	140,256	31,543	34,799	53,936	368,190	87,622	461,880	42,257	627,175	427,545
33 Jayapura	274,043	660,759	268,786	257,762	150,630	291,583	104,519	256,038	54,397	68,696	103,017	692,009	193,534	839,855	76,729	1,145,374	765,053

OD demand 2019 (2 of 2)

Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Origin	Mataran	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura
1 Banda Aceh	2,385,046	2,161,611	4,076,802	1,485,182	2,522,700	1,888,011	1,067,945	1,287,549	4,060,039	1,353,383	599,757	611,103	539,744	463,463	253,942	611,625
2 Medan	8,205,852	6,700,617	14,419,686	5,119,049	7,884,519	5,773,767	3,330,749	3,905,432	13,137,692	4,209,571	1,879,622	1,913,111	1,704,172	1,421,809	763,134	1,823,570
3 Padang	2,717,301	2,198,228	5,167,501	1,693,470	3,076,196	1,901,864	998,831	1,348,881	4,560,687	1,378,367	580,843	606,790	533,519	434,939	240,664	581,192
4 Pekanbaru	1,571,058	1,238,706	3,239,609	1,013,251	1,624,302	1,194,548	637,566	804,737	2,636,922	798,610	337,818	376,576	307,804	251,848	137,054	336,713
5 Jambi	895,902	696,881	1,917,528	609,084	984,134	642,173	354,633	439,971	1,479,696	445,708	189,481	210,889	170,789	142,745	74,426	184,427
6 Palembang	2,460,390	1,863,227	5,034,607	1,675,401	2,597,039	1,675,678	840,698	1,218,458	3,897,871	1,183,187	459,751	535,922	430,531	353,152	182,026	452,234
7 Bengkulu	579,824	459,892	1,024,278	364,270	586,021	384,743	208,640	271,939	914,439	276,899	111,143	128,345	107,917	85,888	46,122	114,824
8 Bandar Lampung	2,152,917	1,552,382	3,685,774	1,395,294	2,216,576	1,365,368	684,223	888,736	3,169,179	975,420	384,734	443,262	351,421	283,099	147,720	382,245
9 Pangkal Pinang	474,786	354,748	1,334,147	382,537	565,284	357,512	172,017	219,313	778,525	221,465	93,227	107,175	82,764	66,306	35,984	85,238
10 Batam	475,735	374,466	1,310,800	362,390	560,193	383,623	193,914	256,616	846,804	257,945	112,260	124,985	92,086	82,874	41,279	99,555
11 Jakarta	3,384,772	2,128,941	4,707,726	2,040,919	3,269,936	1,934,026	893,159	1,292,288	4,775,307	1,412,396	528,349	661,128	484,973	383,893	208,621	502,377
12 Bandung	22,308,192	14,689,737	27,825,527	13,016,279	20,639,585	11,826,371	5,945,450	8,090,199	29,935,322	8,816,430	3,420,520	4,070,908	3,005,659	2,426,609	1,257,655	3,169,965
13 Tangerang	5,427,379	2,913,685	6,514,488	2,536,314	4,117,263	2,507,977	1,266,456	1,651,362	6,281,884	1,819,802	698,744	811,222	647,113	495,875	265,184	649,372
14 Semarang	41,423,470	23,787,938	37,520,229	22,100,194	37,015,580	18,604,391	8,702,437	12,739,648	50,423,277	13,709,732	5,176,948	6,752,724	4,683,819	3,664,014	1,927,652	4,589,103
15 Yogyakarta	6,956,387	4,533,065	5,660,767	3,183,342	5,362,818	2,878,802	1,345,925	2,034,482	7,804,344	2,168,048	826,248	1,040,267	746,968	574,370	296,071	706,325
16 Surabaya	71,049,118	29,851,316	32,357,212	22,467,219	44,550,571	21,159,555	9,541,572	14,084,707	63,341,127	16,510,433	5,700,244	8,079,837	4,954,147	3,939,895	2,036,223	4,659,776
17 Denpasar	30,722,826	6,122,776	3,971,438	2,964,305	6,303,462	3,171,555	1,558,417	2,368,962	11,989,594	3,190,241	913,756	1,352,235	861,841	651,386	335,440	796,084
18 Mataran	27,720,275	4,335,440	1,623,146	1,191,097	2,613,473	1,421,126	803,456	1,171,926	6,743,184	1,739,095	467,386	441,915	326,423	171,285	391,335	391,335
19 Kupang	4,253,230	8,662,463	915,642	586,615	1,276,167	894,419	679,901	916,649	4,802,805	1,830,644	393,411	481,418	537,444	321,360	174,766	405,740
20 Pontianak	1,619,222	900,257	5,792,435	888,602	1,149,689	761,260	290,240	421,240	1,343,892	381,755	170,530	126,252	112,828	56,280	131,463	131,463
21 Palangkaraya	2,092,274	1,037,794	1,550,172	1,946,302	1,600,676	544,180	133,762	219,250	794,777	196,955	83,795	125,178	59,578	51,523	23,445	54,144
22 Banjarmasin	4,417,401	2,102,383	1,856,881	1,492,106	34,259,990	7,794,012	1,884,030	3,574,822	13,697,554	3,177,187	1,274,416	2,286,485	827,367	725,855	342,280	733,535
23 Samarinda	1,188,376	715,391	626,176	239,146	3,890,867	10,401,107	445,982	850,378	2,087,683	545,789	273,768	365,964	152,003	142,837	60,020	133,618
24 Manado	943,521	808,911	339,935	84,862	1,288,869	626,776	35,568,980	3,939,343	7,224,985	2,994,567	4,084,620	1,024,517	1,407,892	2,440,407	596,553	998,597
25 Palu	1,424,182	1,108,307	496,971	149,834	2,546,391	1,247,099	4,426,279	1,634,405	1,798,265	577,707	450,938	299,278	137,234	139,444	48,673	97,673
26 Makassar	12,822,288	8,686,848	2,567,216	887,335	14,986,390	5,055,685	12,324,510	3,027,195	293,567,032	33,289,217	7,671,248	22,745,255	4,629,388	3,937,800	1,779,272	3,493,534
27 Kendari	2,430,247	2,545,341	537,305	161,929	2,766,720	939,137	3,578,979	654,956	25,097,561	2,607,201	234,995	284,112	195,427	152,338	62,760	123,841
28 Gorontalo	564,720	467,110	208,203	55,301	851,762	416,218	3,938,767	401,091	4,380,128	185,620	7,438,699	954,517	776,242	1,016,843	322,158	562,106
29 Mamuju	1,018,847	686,091	288,251	99,568	2,038,234	709,020	1,304,508	376,836	16,549,087	293,248	1,151,888	4,058,655	574,293	537,534	213,185	451,752
30 Ambon	473,842	556,270	140,372	35,397	551,656	208,512	1,407,767	119,178	2,640,896	153,539	740,155	429,719	648,873	196,884	137,037	219,667
31 Ternate	356,306	345,893	121,361	31,018	448,835	189,426	2,306,916	121,962	2,168,060	121,215	919,747	372,092	210,099	906,435	81,937	107,465
32 Sorong	258,290	260,970	84,407	19,890	302,589	112,408	785,398	60,279	1,313,689	68,172	384,316	210,722	182,514	107,848	559,468	362,225
33 Jayapura	434,797	438,716	141,988	34,020	509,920	178,481	983,243	87,523	2,034,830	98,580	545,795	335,905	215,293	109,202	251,005	2,552,424

Applying the equation (7), (8), (9), (10), we obtained the value of β .

Beta	0.000017967
95%	0.000017069
90%	0.000016171
75%	0.000013476

Then, we use the value of beta to calculate the impedance function with three scenarios of the response of cost sensitivity parameter (β) by applying equation (6).

- Impedance function for 95% response of β (1 of 2)

Destination		Origin																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1	Banda Aceh	1.000000000	0.400426640	0.133674369	0.144457942	0.057555560	0.032377152	0.035877110	0.016495531	0.002266401	0.081069235	0.010124132	0.007512219	0.010657300	0.003976339	0.003445723	0.002104740	0.000895476
2	Medan	0.400426640	1.000000000	0.247735061	0.290736330	0.126186078	0.056399492	0.071409271	0.026526065	0.006382817	0.248267871	0.024548863	0.018767257	0.025709395	0.006386627	0.005534375	0.003380544	0.001438276
3	Padang	0.133674369	0.247735061	1.000000000	0.510089046	0.283201419	0.198912195	0.325644187	0.107317424	0.014744859	0.045713467	0.065866070	0.048873362	0.069334782	0.025869457	0.022417353	0.013693120	0.005825832
4	Pekanbaru	0.144457942	0.290736330	0.510089046	1.000000000	0.396053693	0.223061076	0.209637595	0.104785955	0.014379875	0.054156553	0.064235666	0.047663584	0.067618516	0.025229102	0.021888559	0.013354170	0.005688409
5	Jambi	0.057555560	0.126186078	0.283201419	0.396053693	1.000000000	0.563209180	0.397474381	0.264891101	0.036351253	0.021603058	0.162382986	0.120489994	0.170934578	0.063777293	0.055266645	0.033758348	0.014362722
6	Palembang	0.032377152	0.056399492	0.198912195	0.223061076	0.563209180	1.000000000	0.404654631	0.464189917	0.063701216	0.012225268	0.322665083	0.246408034	0.337918861	0.111762065	0.096848174	0.059086894	0.025168949
7	Bengkulu	0.035877110	0.071409271	0.325644187	0.209637595	0.397474381	0.404654631	1.000000000	0.301335327	0.041401915	0.011258789	0.218946197	0.167201549	0.229296733	0.072551896	0.062945421	0.038402886	0.016358285
8	Bandar Lampung	0.016495531	0.026526065	0.107317424	0.104785955	0.264891101	0.464189917	0.301335327	1.000000000	0.136903738	0.055398731	0.642381158	0.490564013	0.672749301	0.239907398	0.208141663	0.126986847	0.054091952
9	Pangkal Pinang	0.002266401	0.006382817	0.014744859	0.014379875	0.036351253	0.063701216	0.041401915	0.136903738	1.000000000	0.021346744	0.222263791	0.166703379	0.210389588	0.088238781	0.076555233	0.046706207	0.019895210
10	Batam	0.081069235	0.248267871	0.045713467	0.054156553	0.021603058	0.012225268	0.011258789	0.055398731	0.021346744	1.000000000	0.090047486	0.067618516	0.085236796	0.035791569	0.031015426	0.018945053	0.008060303
11	Jakarta	0.010124132	0.024548863	0.065866070	0.064235666	0.162382986	0.322665083	0.218946197	0.642381158	0.222263791	0.090047486	1.000000000	0.727975443	0.832094868	0.423885584	0.333909558	0.239106971	0.118085735
12	Bandung	0.007512219	0.018767257	0.048873362	0.047663584	0.120489994	0.246408034	0.167201549	0.490564013	0.166703379	0.067618516	0.727975443	1.000000000	0.694865519	0.427544010	0.434696361	0.241170629	0.111762065
13	Tangerang	0.010657300	0.025709395	0.069334782	0.067618516	0.170934578	0.337918861	0.229296733	0.672749301	0.210389588	0.085236796	0.832094868	0.694865519	1.000000000	0.406057703	0.318722617	0.229050553	0.106259524
14	Semarang	0.003976339	0.006386627	0.025869457	0.025229102	0.063777293	0.111762065	0.072551896	0.239907398	0.088238781	0.035791569	0.423885584	0.427544010	0.406057703	1.000000000	0.774589051	0.554471506	0.257226529
15	Yogyakarta	0.003445723	0.005534375	0.022417353	0.021888559	0.055266645	0.096848174	0.062945421	0.208141663	0.076555233	0.031015426	0.333909558	0.434696361	0.318722617	0.774589051	1.000000000	0.497462647	0.234248316
16	Surabaya	0.002104740	0.003380544	0.013693120	0.013354170	0.033758348	0.059086894	0.038402886	0.126986847	0.046706207	0.018945053	0.239106971	0.241170629	0.229050553	0.554471506	0.497462647	1.000000000	0.420408972
17	Denpasar	0.000895476	0.001438276	0.005825832	0.005688409	0.014362722	0.025168949	0.016358285	0.054091952	0.019895210	0.008060303	0.110805735	0.111762065	0.106259524	0.257226529	0.234248316	0.420408972	1.000000000
18	Mataram	0.000691972	0.001111417	0.004501866	0.004395674	0.011098681	0.019449109	0.012640738	0.041799135	0.015373868	0.006228537	0.087860448	0.088618744	0.084255652	0.203960905	0.181013562	0.324867759	0.757220824
19	Kupang	0.000040498	0.000065046	0.000263473	0.000256952	0.000649555	0.001136909	0.000738922	0.002443392	0.000898688	0.000364528	0.003924474	0.003962126	0.003741512	0.009992079	0.010581252	0.028227947	0.060456589
20	Pontianak	0.001938348	0.003113293	0.012610599	0.012298444	0.031089552	0.054480716	0.035366913	0.116947792	0.045063390	0.018256887	0.224182081	0.173048967	0.212687175	0.165119185	0.128052260	0.050594650	0.021169136
21	Palangkaraya	0.000554210	0.000890148	0.003605604	0.003520553	0.008889079	0.015577046	0.010124132	0.033477474	0.012313132	0.004988516	0.053705963	0.054221231	0.051263298	0.136903738	0.106170782	0.239621224	0.109386562
22	Banjarmasin	0.000371113	0.000596065	0.002414402	0.002354638	0.005952349	0.010430779	0.006771285	0.022390613	0.008235346	0.003340435	0.035962855	0.036307892	0.034286238	0.091564811	0.071094610	0.166842716	0.076245192
23	Samarinda	0.000110371	0.000177273	0.000718055	0.000700281	0.001770258	0.003102165	0.002013813	0.006667031	0.002452157	0.000993462	0.010695529	0.010798145	0.010196895	0.027264345	0.021143885	0.056017091	0.025599163
24	Manado	0.000012174	0.000019554	0.000079205	0.000072244	0.000195267	0.000342182	0.000221232	0.000734525	0.000270161	0.000109583	0.001179763	0.001191082	0.001124761	0.003003787	0.002877453	0.005702004	0.004175765
25	Palu	0.000070714	0.000113578	0.000460055	0.000448668	0.001134198	0.001985176	0.001290243	0.004266448	0.001569215	0.000636508	0.006852589	0.006918334	0.006533116	0.017447336	0.016713532	0.033080274	0.024254704
26	Makassar	0.000385561	0.000619272	0.002508402	0.002446311	0.006184091	0.010836879	0.007034910	0.023262342	0.008555974	0.003470488	0.037362990	0.037721460	0.035621098	0.095129687	0.091128700	0.214292494	0.161899172
27	Kendari	0.000050084	0.000080443	0.000317775	0.000303310	0.001407705	0.000913831	0.000425376	0.001112744	0.000450815	0.000485345	0.004900000	0.004627164	0.012372059	0.011851712	0.023457512	0.017178707	
28	Gorontalo	0.000024767	0.000039779	0.000161129	0.000157140	0.000397239	0.000695284	0.000451892	0.001494272	0.000549598	0.000222929	0.002400037	0.002423063	0.002288145	0.006110719	0.005853713	0.011585967	0.008494917
29	Manuju	0.000156205	0.000250891	0.001016249	0.000991093	0.002505410	0.004390430	0.002850109	0.009424456	0.003466348	0.001406026	0.015137163	0.015282393	0.014431457	0.038540641	0.036919690	0.073160602	0.053577913
30	Ambon	0.000036071	0.000057935	0.000234669	0.000228860	0.000578542	0.001012616	0.000658139	0.002176269	0.000800439	0.000324676	0.003495431	0.003528967	0.003332471	0.008896965	0.008525389	0.016873885	0.012372059
31	Termate	0.000006277	0.000010094	0.000040838	0.000039874	0.000100679	0.000176428	0.000114668	0.000379172	0.000139461	0.000056501	0.000608283	0.000614119	0.000580617	0.001550596	0.001485381	0.002939942	0.002155587
32	Sorong	0.000001836	0.000002949	0.000011944	0.000011648	0.000029446	0.000051601	0.000033498	0.000110767	0.000040789	0.000016525	0.000177909	0.000179616	0.000169614	0.000452972	0.000433921	0.000859864	0.000629707
33	Jayapura	0.000000150	0.000000242	0.000000979	0.000000956	0.000002413	0.000004228	0.000002748	0.000009088	0.000003342	0.000001354	0.000014579	0.000014719	0.000013916	0.000037163	0.000035600	0.000070461	0.000051663

Impedance function for 95% response of β (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Terate	Sorong	Jayapura
1 Banda Aceh	0.000691972	0.000040498	0.001938348	0.000554210	0.000371113	0.000110371	0.000012174	0.000070714	0.000385561	0.000050084	0.000024767	0.000156205	0.000036071	0.000006277	0.000001836	0.000000150
2 Medan	0.001111417	0.000065046	0.003113293	0.000890148	0.000596065	0.000177273	0.000019554	0.000113578	0.000619272	0.000080443	0.000039779	0.000250891	0.000057935	0.000010094	0.000002949	0.000000242
3 Padang	0.004501866	0.000263473	0.012610599	0.003605604	0.002414402	0.000718055	0.000079205	0.000460055	0.002508402	0.000325840	0.000161129	0.001016249	0.000234669	0.000040838	0.000011944	0.000000979
4 Pekanbaru	0.004395674	0.000256952	0.012298444	0.003520553	0.002354638	0.000700281	0.000077244	0.000448668	0.002446311	0.000317775	0.000157140	0.000991093	0.000228860	0.000039874	0.000011648	0.000000956
5 Jambi	0.011098681	0.000649555	0.031089552	0.008889079	0.005952349	0.001770258	0.000195267	0.001134198	0.006184091	0.000803310	0.000397239	0.002505410	0.000578542	0.000100679	0.000029446	0.000002413
6 Palembang	0.019449109	0.001136909	0.054480716	0.015577046	0.010430779	0.003102165	0.000342182	0.001985176	0.010836879	0.001407705	0.000695284	0.004390430	0.001012616	0.000176428	0.000051601	0.000004228
7 Bengkulu	0.012640738	0.000738922	0.035366913	0.010124132	0.006771285	0.002013813	0.000222132	0.001290243	0.007034910	0.000913831	0.000451892	0.002850109	0.000658139	0.000114668	0.000033498	0.000002748
8 Bandar Lampung	0.041799135	0.002443392	0.116947792	0.033477474	0.022390613	0.006667031	0.000734525	0.004266448	0.023262342	0.003025376	0.001494272	0.009424456	0.002176269	0.000379172	0.000110767	0.000009088
9 Pangkal Pinang	0.015373868	0.000898688	0.045063390	0.012313132	0.008235346	0.002452157	0.000270161	0.001569215	0.008555971	0.001112744	0.000549598	0.003466348	0.000800439	0.000139461	0.000040789	0.000003342
10 Batam	0.006228537	0.000364528	0.018256887	0.004988516	0.003340435	0.000993462	0.000109583	0.000636508	0.003470488	0.000450815	0.000222929	0.001406026	0.000324676	0.000056501	0.000016525	0.000001354
11 Jakarta	0.087860448	0.003924474	0.224182081	0.053705963	0.035962855	0.010695529	0.001179763	0.000685289	0.037362990	0.004853435	0.002400037	0.015137163	0.003495431	0.000608283	0.000177909	0.000004579
12 Bandung	0.088618744	0.003962126	0.173048967	0.054221231	0.036307892	0.010798145	0.001191082	0.006918334	0.037721460	0.004900000	0.002423063	0.015282393	0.003528967	0.000614119	0.000179616	0.000014719
13 Tangerang	0.084255652	0.003741512	0.212687175	0.051263298	0.034286238	0.010196895	0.001124761	0.006533116	0.035621098	0.004627164	0.002288145	0.014431457	0.003332471	0.000580617	0.000169614	0.000013916
14 Semarang	0.203960905	0.00992079	0.165119185	0.136903738	0.091564811	0.027264345	0.003003787	0.017447336	0.095129687	0.012372059	0.006110719	0.038540641	0.008899695	0.001550596	0.000452972	0.000037163
15 Yogyakarta	0.181013562	0.010581252	0.128052260	0.106170782	0.071094610	0.021143885	0.002877453	0.016713532	0.091128700	0.011851712	0.005853713	0.036919690	0.008525389	0.001485381	0.000433921	0.000035600
16 Surabaya	0.324867759	0.028227947	0.050594650	0.239621224	0.166842716	0.056017091	0.005702004	0.033080274	0.214292494	0.023457512	0.011585967	0.073160602	0.016873885	0.002939942	0.000859864	0.000070461
17 Denpasar	0.757220824	0.060456589	0.021169136	0.109386562	0.076245192	0.025599163	0.004175765	0.024254704	0.161899172	0.017178707	0.008494917	0.053577913	0.012372059	0.002155587	0.000629707	0.000051663
18 Mataram	1.000000000	0.076573510	0.016260953	0.086270543	0.060132744	0.053892179	0.005429688	0.031538045	0.205059334	0.022337227	0.011045820	0.069666595	0.016087211	0.002802879	0.000818799	0.000067176
19 Kupang	0.076573510	1.000000000	0.000793779	0.011489570	0.016574473	0.034697918	0.004836087	0.028056641	0.184768050	0.019895210	0.009826500	0.062050294	0.026055383	0.002493477	0.000729284	0.000059761
20 Pontianak	0.016260953	0.000793779	1.000000000	0.069500491	0.046539266	0.013841005	0.001249326	0.008137636	0.005090770	0.001734700	0.002538521	0.003592716	0.000242355	0.000644150	0.000188399	0.000015438
21 Palangkaraya	0.086270543	0.011489570	0.069500491	1.000000000	0.668826235	0.198912195	0.017954351	0.117087460	0.073160602	0.024929766	0.036525218	0.051631731	0.003482937	0.009257228	0.002707522	0.000221867
22 Banjarmasin	0.060132744	0.016574473	0.046539266	0.668826235	1.000000000	0.282863601	0.025532032	0.166504526	0.130458877	0.035451439	0.051940781	0.073423037	0.004952919	0.013164264	0.003850239	0.000315507
23 Samarinda	0.053892179	0.034697918	0.013841005	0.198912195	0.282863601	1.000000000	0.054156553	0.352755120	0.256674493	0.075196826	0.110041313	0.155739217	0.010505746	0.027923010	0.008166827	0.000669229
24 Manado	0.005429688	0.004836087	0.001249326	0.017954351	0.025532032	0.054156553	1.000000000	0.139709968	0.043426493	0.049507441	0.436776674	0.061681092	0.169370810	0.549136779	0.181619517	0.019113124
25 Palu	0.031538045	0.028056641	0.008137636	0.117087460	0.166504526	0.352755120	0.139709968	1.000000000	0.212230725	0.194916821	0.285236812	0.436255664	0.027231823	0.027378912	0.021169136	0.001734700
26 Makassar	0.205059334	0.184768050	0.005090770	0.073160602	0.130458877	0.256674493	0.043426493	0.212230725	1.000000000	1.55925213	0.082642156	0.434022394	0.089725630	0.015896342	0.007955170	0.000380986
27 Kendari	0.022337227	0.019895210	0.001734700	0.024929766	0.035451439	0.075196826	0.049507441	0.194916821	0.155925213	1.000000000	0.092310997	0.115974770	0.017975794	0.054285986	0.004512626	
28 Gorontalo	0.011045820	0.009826500	0.002538521	0.036525218	0.051940781	0.110041313	0.436776674	0.285236812	0.082642156	0.092310997	1.000000000	0.125181008	0.080538790	0.261124168	0.086363266	0.009088626
29 Mamuju	0.069666595	0.062050294	0.003592716	0.051631731	0.073423037	0.155739217	0.061681092	0.436255664	0.434022394	0.115974770	0.125181008	1.000000000	0.036221323	0.031954844	0.009346044	0.000765859
30 Ambon	0.016087211	0.026055383	0.000242355	0.003482937	0.004952919	0.010505746	0.169370810	0.027231823	0.089725630	0.136414404	0.080538790	0.036221323	1.000000000	0.267113523	0.183187019	0.012610599
31 Ternate	0.002802879	0.002493477	0.000644150	0.009257228	0.013164264	0.027923010	0.549136779	0.072378912	0.015896342	0.017975794	0.261124168	0.031954844	0.267113523	1.000000000	0.327202612	0.023710852
32 Sorong	0.000818799	0.000729284	0.000188399	0.002707522	0.003850239	0.008166827	0.181619517	0.021169136	0.007955170	0.054285986	0.086363266	0.009346044	0.183187019	0.327202612	1.000000000	0.104785955
33 Jayapura	0.000067176	0.000059761	0.000015438	0.000221867	0.000315507	0.000669229	0.019113124	0.001734700	0.000380986	0.004512626	0.009088626	0.000765859	0.012610599	0.023710852	0.104785955	1.000000000

- Impedance function for 90% response of β (1 of 2)

Origin \ Destination	Destination																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Origin	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar
1	1.00000000	0.420187189	0.148609170	0.159943118	0.066887636	0.038783513	0.042744446	0.020473360	0.003122694	0.092530456	0.012892554	0.009717844	0.013534906	0.005318955	0.004644053	0.002911272	0.001295604
2	0.420187189	1.00000000	0.266613951	0.310267426	0.140710540	0.065614157	0.082050892	0.032109787	0.008327949	0.267157154	0.029837785	0.023135263	0.031172471	0.008332658	0.007275359	0.004560789	0.002029689
3	0.148609170	0.266613951	1.00000000	0.528485469	0.302644306	0.216557868	0.345452562	0.120694532	0.018408905	0.053773481	0.076004175	0.057288627	0.079790966	0.031356301	0.027377620	0.017162527	0.007637843
4	0.159943118	0.310267426	0.528485469	1.00000000	0.415838702	0.241388890	0.227604748	0.117995671	0.017976923	0.063139474	0.074220667	0.055944296	0.077918597	0.030620496	0.026765426	0.016759792	0.007467052
5	0.066887636	0.140710540	0.302644306	0.415838702	1.00000000	0.580486830	0.417251719	0.284074495	0.043279429	0.026434575	0.178686203	0.134685854	0.187588969	0.073718823	0.064364923	0.040349189	0.017956607
6	0.038783513	0.065614157	0.216557868	0.241388890	0.580486830	1.00000000	0.424389155	0.483323636	0.073635513	0.015414484	0.342457854	0.265260771	0.357776473	0.125425022	0.109510320	0.068572427	0.030513227
7	0.042744446	0.082050892	0.345452562	0.227604748	0.417251719	0.424389155	1.00000000	0.320972975	0.048956327	0.014257545	0.237168217	0.183705596	0.247777083	0.083294173	0.072807573	0.045590151	0.020311948
8	0.020473360	0.032109787	0.120694532	0.117995671	0.284074495	0.483323636	0.320972975	1.00000000	0.152008240	0.064510649	0.657519993	0.509301389	0.686931782	0.258626440	0.226065797	0.141556343	0.063068120
9	0.003122694	0.008327949	0.018408905	0.017976923	0.043279429	0.073635513	0.048956327	0.152008240	1.00000000	0.026137351	0.240571429	0.183187019	0.228378147	0.100265404	0.087642155	0.054879168	0.024450518
10	0.092530456	0.267157154	0.053773481	0.063139474	0.026434575	0.015414484	0.014257545	0.064510649	0.026137351	1.00000000	0.102211415	0.077918597	0.097030864	0.042647889	0.037236461	0.023342854	0.010388275
11	0.012892554	0.029837785	0.076004175	0.074220667	0.178686203	0.342457854	0.237168217	0.657519993	0.240571429	0.102211415	1.00000000	0.740242036	0.840183740	0.443472955	0.353753721	0.257808902	0.124408037
12	0.009717844	0.023135263	0.057288627	0.055944296	0.134685854	0.265260771	0.183705596	0.509301389	0.183187019	0.077918597	0.740242036	1.00000000	0.708307391	0.447098165	0.454180879	0.259916385	0.125425022
13	0.013534906	0.031172471	0.079790966	0.077918597	0.187588969	0.357776473	0.247777083	0.686931782	0.228378147	0.097030864	0.840183740	0.708307391	1.00000000	0.425783079	0.338492497	0.247525056	0.119567091
14	0.005318955	0.008332658	0.031356301	0.030620496	0.073718823	0.125425022	0.083294173	0.258626440	0.100265404	0.042647889	0.443472955	0.447098165	0.425783079	1.00000000	0.785072389	0.571951592	0.276281477
15	0.004644053	0.007275359	0.027377620	0.026765426	0.064364923	0.109510320	0.072807573	0.226065797	0.087642155	0.037236461	0.353753721	0.454180879	0.338492497	0.785072389	1.00000000	0.516084067	0.252843271
16	0.002911272	0.004560789	0.017162527	0.016759792	0.040349189	0.068572427	0.045590151	0.141556343	0.054879168	0.023342854	0.257808902	0.259916385	0.247525056	0.571951592	0.516084067	1.00000000	0.440026380
17	0.001295604	0.002029689	0.007637843	0.007467052	0.017956607	0.030513227	0.020311948	0.063068120	0.024450518	0.010388275	0.124408037	0.125425022	0.119567091	0.276281477	0.252843271	0.440026380	1.00000000
18	0.001014845	0.001589853	0.005982714	0.005848934	0.014065392	0.023930822	0.015910328	0.049401193	0.019152066	0.008137125	0.099858085	0.100674384	0.095972423	0.221761712	0.198051872	0.344672207	0.768385670
19	0.00068964	0.000108038	0.000406555	0.000397015	0.000955813	0.001624379	0.001079963	0.003353260	0.001300006	0.000552958	0.005253207	0.005300943	0.005020899	0.012733187	0.013443390	0.034058263	0.070077433
20	0.002692765	0.004218477	0.015874388	0.015501880	0.037320766	0.063497458	0.042168366	0.130931782	0.053048760	0.022538789	0.242538003	0.189786528	0.230740239	0.181537390	0.142681237	0.059198353	0.025931284
21	0.000822356	0.001288300	0.004847950	0.004739544	0.011397554	0.019391770	0.012892554	0.040031077	0.015519419	0.006593725	0.062641685	0.063210909	0.059939271	0.152008240	0.119472489	0.258334165	0.122898000
22	0.000562416	0.000881080	0.003315557	0.003237754	0.007794892	0.013262209	0.008807371	0.027346680	0.010601878	0.004509509	0.042841221	0.043230519	0.040946689	0.103842340	0.081708328	0.183332073	0.087305858
23	0.000178289	0.000279307	0.001051049	0.001026386	0.002471023	0.004204192	0.002791984	0.008678853	0.003364655	0.001429538	0.013580897	0.013704307	0.012980321	0.032955824	0.025901979	0.065192617	0.031045836
24	0.00022085	0.000034599	0.000130198	0.000127143	0.000306097	0.000520793	0.000345856	0.001073875	0.000416324	0.000177084	0.001682329	0.001697616	0.001607932	0.004077777	0.003915117	0.007483958	0.005571350
25	0.000116937	0.000183194	0.000689369	0.000673192	0.001620710	0.002754356	0.001831224	0.005689908	0.002204337	0.000937615	0.008097525	0.008988468	0.008513615	0.021590848	0.020729601	0.039580977	0.029498960
26	0.000583140	0.000913544	0.003437724	0.003357054	0.008082106	0.013750874	0.009131891	0.028354308	0.010992519	0.004675668	0.044419767	0.044823409	0.042455429	0.107668560	0.103373724	0.232389830	0.178181795
27	0.000084340	0.000132126	0.000497200	0.000485532	0.001168919	0.001988795	0.001320750	0.004105536	0.001591652	0.000676244	0.006424452	0.006482831	0.006140348	0.015589772	0.014967905	0.028579628	0.021275790
28	0.000043281	0.000067804	0.000255150	0.000249163	0.000599859	0.001019446	0.000677775	0.002104476	0.000815872	0.000347031	0.003296865	0.003326823	0.003151070	0.007991232	0.007672467	0.014649762	0.010918193
29	0.000247758	0.000388137	0.001460583	0.001426309	0.003433839	0.005842324	0.003879860	0.012046875	0.004670384	0.001986548	0.018872595	0.019044091	0.018038008	0.045745066	0.043920322	0.083956080	0.062500181
30	0.000061800	0.000096815	0.000364321	0.000355772	0.000856522	0.001455637	0.000967775	0.003004920	0.001164960	0.000495516	0.004707498	0.004750275	0.004499322	0.011410449	0.010955293	0.020917971	0.015589772
31	0.000011791	0.000018493	0.000069512	0.000067957	0.000163422	0.000278047	0.000184858	0.000573981	0.000222523	0.000094543	0.000898180	0.000906342	0.000859432	0.002179552	0.002092611	0.003995619	0.002977860
32	0.000003679	0.000005764	0.000021690	0.000021181	0.000050992	0.000086758	0.000057616	0.000178895	0.000069433	0.000029500	0.000280256	0.000282803	0.000267863	0.000679310	0.000652212	0.001246739	0.000928121
33	0.000000344	0.000000539	0.000002027	0.000001982	0.000004767	0.000008110	0.000005392	0.000016741	0.000006490	0.000002758	0.000026197	0.000026436	0.000025067	0.000063572	0.000061036	0.000116541	0.000086856

Impedance function for 90% response of β (2 of 2)

Origin \ Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura
1 Banda Aceh	0.001014845	0.000068964	0.002692765	0.000822356	0.000562416	0.000178289	0.000022085	0.000116937	0.000583140	0.000084340	0.000043281	0.000247758	0.000061800	0.000011791	0.000003679	0.000000344
2 Medan	0.001589853	0.000108038	0.004218477	0.001288300	0.000881080	0.000279307	0.000034599	0.000183194	0.000913544	0.000132126	0.000067804	0.000388137	0.000096815	0.000018493	0.000005764	0.000000539
3 Padang	0.005982714	0.000406555	0.015874388	0.004847950	0.003315557	0.001051049	0.000130198	0.000689369	0.003437724	0.000497200	0.000255150	0.001460583	0.000364321	0.000069512	0.000021690	0.000002027
4 Pekanbaru	0.005848934	0.000397015	0.015501880	0.004739544	0.003237754	0.001026386	0.000127143	0.000673192	0.003357054	0.000485532	0.000249163	0.001426309	0.000355772	0.000067957	0.000021181	0.000001982
5 Jambi	0.014065392	0.000955813	0.037320766	0.011397554	0.007794892	0.002471023	0.000306097	0.001620710	0.008082106	0.001168919	0.000599859	0.003433839	0.000856522	0.000163422	0.000050992	0.000004767
6 Palembang	0.023930822	0.001624379	0.063497458	0.019391770	0.013262209	0.004204192	0.000520793	0.002754356	0.013750874	0.001988795	0.001019446	0.005842324	0.001455637	0.000278047	0.000086758	0.000008110
7 Bengkulu	0.015910328	0.001079963	0.042168366	0.012892554	0.008807371	0.002791984	0.000345856	0.001831224	0.009131891	0.001320750	0.000677775	0.003879860	0.000967775	0.000184858	0.000057616	0.000005392
8 Bandar Lampung	0.049401193	0.003353260	0.130931782	0.040031077	0.027346680	0.008678853	0.001073875	0.005685908	0.028354308	0.004105536	0.002104476	0.012046875	0.003004920	0.000573981	0.000178895	0.000016741
9 Pangkal Pinang	0.019152066	0.001300006	0.053048760	0.015519419	0.010601878	0.003364655	0.000416324	0.002204337	0.010992519	0.001591652	0.000815872	0.004670384	0.001164960	0.000222523	0.000069433	0.000006490
10 Batam	0.008137125	0.000552958	0.022538789	0.006593725	0.004509509	0.001429538	0.000177084	0.000937615	0.004675668	0.000676244	0.000347031	0.001986548	0.000495516	0.000094543	0.000029500	0.000002758
11 Jakarta	0.009858085	0.005253207	0.242538003	0.062641685	0.042841221	0.013580897	0.001682329	0.008907525	0.044419767	0.006424452	0.003296865	0.018872595	0.000898180	0.000280256	0.000026197	
12 Bandung	0.100674384	0.005300943	0.189786528	0.063210909	0.043230519	0.013704307	0.001697616	0.008988468	0.044823409	0.006482831	0.003326823	0.019044091	0.004750275	0.000906342	0.000282803	0.000026436
13 Tangerang	0.095972423	0.005020899	0.230740239	0.059939271	0.040946689	0.012980321	0.001607932	0.008513615	0.042455429	0.006140348	0.003151070	0.018038008	0.004499322	0.000859432	0.000267863	0.000025067
14 Semarang	0.221761712	0.012733187	0.181537390	0.152008240	0.103842340	0.032955824	0.004077777	0.021590848	0.107668560	0.015589772	0.007991232	0.045745066	0.011410449	0.002179552	0.000679310	0.000063572
15 Yogyakarta	0.198051872	0.013443390	0.142681237	0.119472489	0.081708328	0.025901979	0.003915117	0.020729601	0.103373724	0.014967905	0.007672467	0.043920322	0.010955293	0.002092611	0.000652212	0.000061036
16 Surabaya	0.344672207	0.034058263	0.059198353	0.258334165	0.183332073	0.065192617	0.007483958	0.039580977	0.232389830	0.028579628	0.014649762	0.083956080	0.020917971	0.003995619	0.001246739	0.000116541
17 Denpasar	0.768385670	0.070077433	0.025931284	0.122898000	0.087305858	0.031045836	0.005571350	0.029498960	0.178181795	0.021275790	0.010918193	0.062500181	0.015589772	0.002977860	0.000928121	0.000086856
18 Mataram	1.000000000	0.087661977	0.020197434	0.098145359	0.069721760	0.062847434	0.007144917	0.037830620	0.222892989	0.027284906	0.014001918	0.080152677	0.019992933	0.003818924	0.001190259	0.000111388
19 Kupang	0.087661977	1.000000000	0.001155776	0.014534264	0.020566170	0.041412320	0.006402695	0.033862421	0.201941445	0.024450518	0.012533203	0.071826324	0.031569760	0.003418342	0.001066614	0.000099704
20 Pontianak	0.020197434	0.001155776	1.000000000	0.079971617	0.054693320	0.017338077	0.001776162	0.010482673	0.006721700	0.002423977	0.003476816	0.004831532	0.000375616	0.000948277	0.000295888	0.000027659
21 Palangkaraya	0.098145359	0.014534264	0.079971617	1.000000000	0.683136259	0.216557868	0.022184800	0.131079916	0.083956080	0.030276207	0.043475625	0.060347310	0.004691556	0.011844269	0.003695726	0.000345465
22 Banjarmasin	0.069721760	0.020566170	0.054693320	0.683136259	1.000000000	0.302302286	0.030968701	0.182979999	0.145220409	0.042263837	0.060689463	0.084241362	0.006549141	0.016533916	0.005159021	0.000482249
23 Samarinda	0.062847434	0.041412320	0.017338077	0.216557868	0.302302286	1.000000000	0.063139474	0.372640900	0.275719722	0.086168177	0.123594799	0.171752614	0.013352492	0.033709608	0.010518293	0.000983218
24 Manado	0.007144917	0.006402695	0.001776162	0.022184800	0.030968701	0.063139474	1.000000000	0.154958508	0.051221451	0.057992527	0.456239782	0.071421384	0.185962771	0.566736987	0.198679914	0.023538995
25 Palu	0.037830620	0.033862421	0.010482673	0.131079916	0.182979999	0.372640900	0.154958508	1.000000000	0.230271082	0.212434805	0.304704568	0.455724182	0.032918580	0.083106017	0.025931284	0.002423977
26 Makassar	0.222892989	0.201941445	0.006721700	0.083956080	0.145220409	0.275719722	0.051221451	0.230271082	1.000000000	0.171946932	0.094230398	0.453513738	0.101865278	0.019768138	0.010259864	0.000576583
27 Kendari	0.027284906	0.024450518	0.002423977	0.030276207	0.042263837	0.086168177	0.057992527	0.212434805	0.171946932	1.000000000	0.104643868	0.129899520	0.151493466	0.022209900	0.063282425	0.005996259
28 Gorontalo	0.014001918	0.012533203	0.003476816	0.043475625	0.060689463	0.123594799	0.456239782	0.304704568	0.094230398	0.104643868	1.000000000	0.139648547	0.091956786	0.280245940	0.098245289	0.011639804
29 Mamuju	0.080152677	0.071826324	0.004831532	0.060347310	0.084241362	0.171752614	0.071421384	0.455724182	0.453513738	0.129899520	0.139648547	1.000000000	0.043132864	0.038304103	0.011951898	0.001117227
30 Ambon	0.019992933	0.031569760	0.000375616	0.004691556	0.006549141	0.013352492	0.185962771	0.032918580	0.101865278	0.151493466	0.091956786	0.043132864	1.000000000	0.286331927	0.200304042	0.015874388
31 Ternate	0.003818924	0.003418342	0.000948277	0.011844269	0.016533916	0.033709608	0.566736987	0.083106017	0.019768138	0.022209900	0.280245940	0.038304103	0.286331927	1.000000000	0.347018575	0.028871960
32 Sorong	0.001190259	0.001066614	0.000295888	0.003695726	0.005159021	0.010518293	0.198679914	0.025931284	0.010259864	0.063282425	0.098245289	0.011951898	0.200304042	0.347018575	1.000000000	0.117995671
33 Jayapura	0.000111388	0.000099704	0.000027659	0.000345465	0.000482249	0.000983218	0.023538995	0.002423977	0.000576583	0.005996259	0.011639804	0.001117227	0.015874388	0.028871960	0.117995671	1.000000000

Impedance function for 75% response of β (2 of 2)

Origin \ Destination		18		19		20		21		22		23		24		25		26		27		28		29		30		31		32		33	
		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Temate	Sorong	Jayapura																
1	Banda Aceh	0.003201350	0.000340552	0.007219361	0.002686682	0.001957560	0.000751514	0.000131853	0.000528804	0.002017485	0.000402742	0.000230984	0.000988606	0.000310805	0.000078157	0.000029611	0.000004109																
2	Medan	0.004653691	0.000495049	0.010494533	0.003905537	0.002845636	0.001092450	0.000191670	0.000768703	0.002932748	0.000585452	0.000335773	0.001437102	0.000451807	0.000113721	0.000043045	0.000005973																
3	Padang	0.014041555	0.001493709	0.031665097	0.011784154	0.008586123	0.003296243	0.000578324	0.002319404	0.008848965	0.001766481	0.001013125	0.004336160	0.001363235	0.000342806	0.000129880	0.000018022																
4	Pekanbaru	0.013779410	0.001464442	0.031044665	0.011564153	0.008417890	0.003231658	0.000566993	0.002273959	0.008675582	0.001731869	0.000993275	0.004251199	0.001336524	0.000336406	0.000127335	0.000017685																
5	Jambi	0.028628144	0.003045397	0.064559297	0.024025719	0.017505522	0.006720433	0.001179096	0.004728838	0.018041408	0.003601529	0.002065576	0.008840630	0.002779384	0.000698918	0.000264801	0.000036743																
6	Palembang	0.044579106	0.004737758	0.100530294	0.037412312	0.027259208	0.010464908	0.001836062	0.007356705	0.028093677	0.005608220	0.003213439	0.013766432	0.004323919	0.001088340	0.000412342	0.000057215																
7	Bengkulu	0.031724828	0.003371637	0.071475244	0.026624562	0.019380810	0.007440363	0.001305407	0.005235417	0.019974103	0.003987345	0.002286852	0.009787687	0.003077127	0.000774520	0.000293168	0.000040717																
8	Bandar Lampung	0.081554488	0.008667411	0.183740220	0.068443319	0.049821925	0.019144848	0.003355789	0.013458599	0.051347094	0.010259864	0.005878772	0.025161044	0.007910320	0.001991045	0.000753642	0.000104671																
9	Pangkal Pinang	0.037026530	0.003935089	0.086542485	0.031073932	0.022619639	0.008691947	0.001523561	0.006110335	0.023312080	0.004658078	0.002669019	0.011423359	0.003591362	0.000903954	0.000342483	0.000047522																
10	Batam	0.018143698	0.001930086	0.042407450	0.015226813	0.011094499	0.004259218	0.000747277	0.002997002	0.011434128	0.002282546	0.001309103	0.005602938	0.001761494	0.000442954	0.000167823	0.000023287																
11	Jakarta	0.146606321	0.012599513	0.307125939	0.099399956	0.072424394	0.027803986	0.004878193	0.019564296	0.074641478	0.014900358	0.008545765	0.036575732	0.011498956	0.002891587	0.001095543	0.000152014																
12	Bandung	0.147604348	0.012694851	0.250353970	0.100152093	0.072972413	0.028014373	0.004915106	0.019712335	0.075206274	0.015013106	0.008610429	0.036852493	0.011585967	0.002913467	0.001103832	0.000153164																
13	Tangerang	0.141836732	0.012133457	0.294624901	0.095813392	0.069745415	0.026775516	0.004697749	0.018840612	0.071880490	0.014349194	0.008229657	0.035222795	0.011073610	0.002787253	0.001055018	0.000146529																
14	Semarang	0.285039778	0.026350020	0.241252454	0.208076296	0.151464919	0.058202746	0.010202021	0.040915834	0.156101624	0.031191275	0.017872205	0.076492740	0.024048369	0.006053028	0.002291165	0.000318214																
15	Yogyakarta	0.259407459	0.027569189	0.197381171	0.170238033	0.124038147	0.047618692	0.009861748	0.039551151	0.150895100	0.030150940	0.017276105	0.073941444	0.03246273	0.005851139	0.002214747	0.000307601																
16	Surabaya	0.411628296	0.059820780	0.094825400	0.323706588	0.243238346	0.102761874	0.016921653	0.067801415	0.296379116	0.051686900	0.029615937	0.126875216	0.039850426	0.010030442	0.003800258	0.000527311																
17	Denpasar	0.802877672	0.109139465	0.047663584	0.174295970	0.131079916	0.055377855	0.013232251	0.053068758	0.237530532	0.040417684	0.023180652	0.099212805	0.031191275	0.007850914	0.002971693	0.000412731																
18	Mataram	1.000000000	0.131525325	0.038703196	0.144507861	0.108677661	0.099671951	0.016280373	0.065293441	0.286250996	0.049728121	0.028520443	0.122067024	0.038376358	0.009659416	0.003656239	0.000507806																
19	Kupang	0.131525325	1.000000000	0.003567752	0.029421233	0.039291130	0.070405723	0.014858297	0.059533992	0.263646018	0.045384413	0.026004692	0.111404577	0.056155556	0.008807371	0.003336870	0.000463013																
20	Pontianak	0.038703196	0.003567752	1.000000000	0.121837197	0.088772525	0.034080093	0.005103899	0.022407498	0.015472693	0.006613637	0.008932741	0.011750889	0.001398363	0.003025376	0.001146231	0.000159047																
21	Palangkaraya	0.144507861	0.029421233	0.121837197	1.000000000	0.727929714	0.279454842	0.041851684	0.183913438	0.126875216	0.054231450	0.073317029	0.096356629	0.011466496	0.024807912	0.009399033	0.001304178																
22	Banjarmasin	0.108677661	0.039291130	0.088772525	0.727929714	1.000000000	0.369006933	0.055263174	0.242849017	0.200304042	0.071610071	0.096811678	0.127234382	0.015140968	0.032757677	0.012410980	0.001722105																
23	Samarinda	0.099671951	0.070405723	0.034080093	0.279454842	0.369006933	1.000000000	0.100057766	0.439280677	0.341761545	0.129654945	0.175119092	0.230366574	0.027413760	0.059310021	0.022470930	0.003117990																
24	Manado	0.016280373	0.014858297	0.005103899	0.041851684	0.055263174	0.100057766	1.000000000	0.211436286	0.084051066	0.093213045	0.519989162	0.110880936	0.246143483	0.622995099	0.260092784	0.043970013																
25	Palu	0.065293441	0.059533992	0.022407498	0.183913438	0.242849017	0.439280677	0.211436286	1.000000000	0.294125606	0.275013952	0.371448952	0.519499414	0.058147929	0.125803789	0.047663584	0.006613637																
26	Makassar	0.286250996	0.263646018	0.015472693	0.126875216	0.200304042	0.341761545	0.084051066	0.294125606	1.000000000	0.230583747	0.139688029	0.517398747	0.149057950	0.038016441	0.022009896	0.001998564																
27	Kendari	0.049728121	0.045384413	0.006613637	0.054231450	0.071610071	0.129654945	0.093213045	0.275013952	0.230583747	1.000000000	0.152438554	0.182532256	0.207488924	0.041891139	0.100246510	0.014068043																
28	Gorontalo	0.028520443	0.026004692	0.008932741	0.073317029	0.096811678	0.175119092	0.519989162	0.371448952	0.139688029	0.152438554	1.000000000	0.193878812	0.136873640	0.346430490	0.144630464	0.024450518																
29	Mamuju	0.122067024	0.111404577	0.011750889	0.096356629	0.127234382	0.230366574	0.110880936	0.519499414	0.517398747	0.182532256	0.193878812	1.000000000	0.072835021	0.065973737	0.024995628	0.003468308																
30	Ambon	0.038376358	0.056155556	0.001398363	0.011466496	0.015140968	0.027413760	0.246143483	0.058147929	0.149057950	0.207488924	0.136873640	0.072835021	1.000000000	0.352688647	0.261863375	0.031665097																
31	Temate	0.009659416	0.008807371	0.003025376	0.024807912	0.032757677	0.059310021	0.622995099	0.125803789	0.038016441	0.041891139	0.346430490	0.065973737	0.352688647	1.000000000	0.413962119	0.052127099																
32	Sorong	0.003656239	0.003336870	0.001146231	0.009399033	0.012410980	0.022470930	0.260092784	0.047663584	0.022009896	0.100246510	0.144630464	0.024995628	0.261863375	0.413962119	1.000000000	0.168482602																
33	Jayapura	0.000507806	0.000463013	0.000159047	0.001304178	0.001722105	0.003117990	0.043970013	0.006613637	0.001998564	0.014068043	0.024450518	0.003468308	0.031665097	0.052127099	0.168482602	1.000000000																

- Weighted opportunities are same as value in scenario 1

Finally, accessibility measures are calculated by using equation (1) for three scenarios of the response of cost sensitivity parameter (β).

- Accessibility measures for 95% response of β (1 of 2)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	67,027,178	87,479,151	9,967,260	14,460,811	2,769,443	4,397,508	821,187	1,995,953	55,388	4,444,937	4,454,898	6,008,723	2,492,193	2,531,606	229,504	1,492,139	72,157
2	Sumatera Utara	Medan	26,839,468	218,464,862	18,472,051	29,103,856	6,071,788	7,660,254	1,634,479	3,209,644	155,989	13,612,254	10,802,179	15,011,177	6,012,103	4,066,158	368,620	2,396,611	115,896
3	Sumatera Barat	Padang	8,959,816	54,121,406	74,563,734	51,061,929	13,627,010	27,016,519	7,453,636	12,985,367	360,348	2,506,419	28,982,892	39,091,843	16,213,833	16,470,243	1,493,121	9,707,630	469,444
4	Riau	Pekanbaru	9,682,608	63,515,672	38,034,144	100,103,952	19,057,206	30,296,452	4,798,373	12,679,060	351,428	2,969,344	28,265,469	38,124,190	15,812,487	16,062,550	1,457,900	9,467,334	458,371
5	Jambi	Jambi	3,857,787	27,567,224	21,116,555	39,646,540	48,117,732	76,495,820	9,097,749	32,051,720	888,383	1,184,472	71,453,004	96,375,117	39,972,791	40,604,931	3,681,067	23,932,717	1,157,345
6	Sumatera Selatan	Palembang	2,170,149	12,321,307	14,831,636	22,329,295	27,100,349	135,821,331	9,262,097	56,166,799	1,556,785	670,298	141,981,560	197,091,911	79,021,811	71,155,277	6,450,629	41,889,191	2,028,108
7	Bengkulu	Bengkulu	2,404,741	15,600,417	24,281,247	20,985,552	19,125,566	54,960,730	22,888,895	36,461,457	1,011,816	617,307	96,342,381	133,737,819	53,620,692	46,191,436	4,192,516	27,225,426	1,318,147
8	Lampung	Bandar Lampung	1,105,649	5,795,013	8,001,988	10,489,488	12,745,959	63,046,892	6,897,233	120,999,611	3,345,772	3,037,451	282,665,474	392,382,495	157,321,400	152,741,249	13,863,396	90,026,332	4,358,717
9	Kepulauan Bangka Belitung	Pangkal Pinang	151,910	1,394,421	1,099,432	1,439,482	1,749,140	8,651,984	947,644	16,565,299	24,438,862	1,170,418	97,802,215	133,339,352	49,199,285	56,178,767	5,099,005	33,112,000	1,603,151
10	Kepulauan Riau	Batam	5,433,842	54,237,806	3,408,567	5,421,285	1,039,490	1,660,452	257,701	6,703,225	521,690	54,828,898	39,623,384	54,085,341	19,932,495	22,787,329	2,065,800	13,430,947	649,497
11	DKI Jakarta	Jakarta	678,592	5,363,064	4,911,220	6,430,244	7,813,501	43,824,801	5,011,436	77,727,870	5,431,874	4,937,204	440,027,654	582,278,384	194,584,119	269,874,186	22,240,239	169,513,017	8,928,700
12	Jawa Barat	Bandung	503,523	4,099,986	3,644,180	4,771,313	5,797,705	33,467,467	3,827,059	59,358,055	4,074,041	3,707,449	320,329,326	799,859,925	162,493,244	272,203,386	28,953,202	170,976,031	9,005,761
13	Banten	Tangerang	714,329	5,616,599	5,169,860	6,768,881	8,224,984	45,896,589	5,248,349	81,402,404	5,141,682	4,673,440	366,144,752	555,795,082	233,848,479	258,523,752	21,228,704	162,383,598	8,562,367
14	Jawa Tengah	Semarang	266,523	1,395,254	1,928,923	2,525,533	3,068,819	15,179,672	1,660,633	29,028,702	2,156,455	1,962,412	186,521,379	341,975,320	94,955,976	636,667,525	51,591,951	393,088,238	20,727,253
15	DI Yogyakarta	Yogyakarta	230,957	1,209,066	1,671,522	2,191,131	2,659,306	13,154,048	1,440,751	25,185,060	1,870,923	1,700,542	146,929,439	347,696,199	74,532,799	493,155,694	66,605,577	352,672,253	18,875,674
16	Jawa Timur	Surabaya	141,075	738,530	1,021,010	1,336,805	1,624,375	8,025,261	879,000	15,365,359	1,141,447	1,038,736	105,213,679	192,902,721	53,563,123	353,014,001	33,133,787	708,942,179	33,876,456
17	Bali	Denpasar	60,021	314,213	434,396	569,432	691,102	3,418,480	374,423	6,545,105	486,216	441,938	48,757,588	89,393,997	24,848,628	163,767,777	15,602,244	298,045,653	80,579,765
18	Nusa Tenggara Barat	Mataram	46,381	242,805	335,676	440,024	534,043	2,641,604	289,333	5,057,679	375,720	341,504	38,661,027	70,882,582	19,703,056	129,855,285	12,056,513	230,312,457	61,016,676
19	Nusa Tenggara Timur	Kupang	2,714	14,210	19,646	25,722	31,255	154,416	16,913	295,650	19,987	1,726,877	3,169,146	874,947	6,361,632	704,770	20,011,982	4,871,578	4,871,578
20	Kalimantan Barat	Pontianak	129,922	680,145	940,293	1,231,123	1,495,959	7,399,643	809,510	14,150,637	1,101,298	1,001,005	98,646,315	138,414,934	49,736,572	105,126,023	8,528,995	35,868,682	1,705,804
21	Kalimantan Tengah	Palangkaraya	37,147	194,466	268,847	352,421	427,722	2,115,695	231,730	4,050,761	300,919	273,515	23,632,109	43,369,390	11,987,844	87,162,164	7,071,566	169,877,593	8,814,343
22	Kalimantan Selatan	Banjarmasin	24,875	130,219	180,027	235,709	286,414	1,416,722	154,987	2,709,255	201,262	183,152	15,824,651	29,041,228	8,017,785	58,296,342	4,735,298	118,281,839	6,143,820
23	Kalimantan Timur	Samarinda	7,398	38,728	53,541	70,101	85,181	421,340	46,094	806,708	59,928	54,470	4,706,329	8,637,003	2,384,528	17,358,323	1,408,301	39,712,878	2,062,775
24	Sulawesi Utara	Manado	816	4,272	5,906	7,732	9,396	46,476	5,084	88,877	6,602	6,008	519,128	952,699	263,024	1,912,414	191,654	4,042,391	336,482
25	Sulawesi Tengah	Pahu	4,740	24,813	34,303	44,913	54,575	269,629	29,532	516,239	38,350	34,899	3,015,329	5,533,698	1,527,759	11,108,152	1,113,214	23,452,001	1,954,438
26	Sulawesi Selatan	Makassar	25,843	135,289	187,036	244,885	297,564	1,471,879	161,021	2,814,734	209,098	190,283	16,440,749	30,171,884	8,329,940	60,565,982	6,069,680	151,920,987	13,045,797
27	Sulawesi Tenggara	Kendari	3,357	17,574	24,296	31,810	38,653	191,196	20,917	366,069	27,194	24,718	2,135,645	3,919,313	1,082,055	7,876,988	789,390	16,630,020	1,384,256
28	Gorontalo	Gorontalo	1,660	8,690	12,014	15,730	19,114	94,434	10,343	180,806	13,432	12,223	1,056,082	1,938,111	535,079	3,890,496	389,890	8,213,780	684,518
29	Sulawesi Barat	Mamuju	10,470	54,811	75,775	99,212	120,555	596,314	65,236	1,140,356	84,714	77,091	6,660,771	12,223,774	3,374,774	24,537,575	2,459,057	51,866,637	4,817,296
30	Maluku	Ambon	2,418	12,657	17,498	22,910	27,838	137,535	15,064	263,328	19,562	17,802	1,538,086	2,822,679	779,293	5,666,147	567,838	11,962,609	996,938
31	Maluku Utara	Ternte	421	2,205	3,045	3,992	4,844	23,963	2,625	45,880	3,408	3,098	267,662	491,210	135,776	987,214	98,935	2,084,249	173,697
32	Papua Barat	Sorong	123	644	891	1,166	1,417	7,009	767	13,403	997	906	78,285	143,667	39,664	288,393	28,902	609,594	50,742
33	Papua	Jayapura	10	53	73	96	116	574	63	1,100	82	74	6,415	11,773	3,254	23,660	2,371	49,953	4,163

Accessibility measures for 95% response of β (2 of 2)

Destination		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
Origin		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura	
1	Aceh	Banda Aceh	46,715	2,045	125,117	18,662	21,002	7,372	397	2,682	44,248	1,592	352	2,142	632	74	22	5
2	Sumatera Utara	Medan	75,031	3,284	200,958	29,974	33,732	11,841	637	4,307	71,069	2,557	565	3,440	1,015	118	36	9
3	Sumatera Barat	Padang	303,918	13,302	813,995	121,411	136,635	47,963	2,581	17,447	287,868	10,356	2,287	13,936	4,113	479	146	35
4	Riau	Pekanbaru	296,749	12,973	793,845	118,547	133,253	46,776	2,518	17,015	280,742	10,100	2,231	13,591	4,011	468	142	34
5	Jambi	Jambi	749,263	32,795	2,006,782	299,321	336,853	118,246	6,364	43,013	709,696	25,531	5,639	34,357	10,139	1,181	359	87
6	Sumatera Selatan	Palembang	1,312,994	57,400	3,516,646	524,525	590,294	207,211	11,153	75,285	1,243,657	44,740	9,870	60,206	17,747	2,069	629	152
7	Bengkulu	Bengkulu	853,366	37,306	2,282,879	340,909	383,198	134,514	7,240	48,931	807,337	29,043	6,415	39,084	11,534	1,345	408	99
8	Lampung	Bandar Lampung	2,821,827	123,361	7,548,798	1,127,285	1,267,121	445,329	23,940	161,799	2,669,622	96,153	21,212	129,239	38,140	4,447	1,350	326
9	Kepulauan Bangka Belitung	Pangkal Pinang	1,037,878	45,373	2,908,772	414,619	466,051	163,793	8,805	59,510	981,896	35,365	7,802	47,534	14,028	1,636	497	120
10	Kepulauan Riau	Batam	420,484	18,404	1,178,454	167,978	189,041	66,359	3,572	24,139	398,278	14,328	3,165	19,281	5,690	663	201	49
11	DKI Jakarta	Jakarta	5,931,391	198,138	14,470,605	1,808,438	2,035,195	714,415	38,452	259,875	4,287,834	154,252	34,069	207,578	61,259	7,135	2,169	524
12	Jawa Barat	Bandung	5,982,583	200,039	11,170,042	1,825,789	2,054,722	721,269	38,821	262,369	4,328,972	155,732	34,396	209,569	61,847	7,203	2,190	529
13	Banten	Tangerang	5,688,034	188,901	13,728,627	1,726,186	1,940,313	681,108	36,659	247,760	4,087,931	147,061	32,481	197,900	58,403	6,810	2,068	500
14	Jawa Tengah	Semarang	13,769,242	504,478	10,658,187	4,609,952	5,181,799	1,821,140	97,902	661,667	10,917,228	393,210	86,744	528,512	155,971	18,187	5,522	1,335
15	DI Yogyakarta	Yogyakarta	12,220,085	534,224	8,265,574	3,575,083	4,023,357	1,412,319	93,784	633,839	10,458,068	376,672	83,096	506,284	149,411	17,422	5,290	1,279
16	Jawa Timur	Surabaya	21,931,570	1,425,166	3,265,806	8,068,753	9,441,896	3,741,698	185,844	1,254,526	24,592,533	745,529	164,467	1,003,260	295,722	34,483	10,482	2,531
17	Bali	Denpasar	51,119,390	3,052,318	1,366,435	3,683,368	4,314,837	1,709,913	136,100	919,828	18,579,796	545,976	120,589	734,720	216,826	25,283	7,676	1,855
18	Nusa Tenggara Barat	Mataram	67,509,224	3,866,025	1,049,619	2,904,984	3,403,008	3,599,763	176,969	1,196,039	23,532,922	709,924	156,800	955,346	281,935	32,875	9,981	2,413
19	Nusa Tenggara Timur	Kupang	5,169,418	50,487,761	51,237	386,888	937,976	2,317,670	157,622	1,064,011	21,204,263	632,312	139,491	850,903	456,632	29,246	8,890	2,146
20	Kalimantan Barat	Pontianak	1,097,764	40,076	64,548,446	2,340,286	2,633,731	924,519	40,719	308,609	584,225	55,132	36,035	49,267	4,247	7,555	2,297	554
21	Kalimantan Tengah	Palangkaraya	5,824,057	580,083	4,486,149	33,672,948	37,849,944	13,286,468	585,183	4,440,388	8,396,022	792,321	518,490	708,032	61,040	108,579	33,005	7,968
22	Kalimantan Selatan	Banjarmasin	4,059,515	836,808	3,004,037	22,521,351	56,591,596	18,894,057	832,161	6,314,465	14,971,660	1,126,721	737,320	1,006,859	86,802	154,405	46,935	11,331
23	Kalimantan Timur	Samarinda	3,638,219	1,751,820	893,415	6,697,960	16,007,703	66,795,645	1,765,115	13,377,773	29,456,356	2,389,914	1,562,080	2,135,670	184,118	327,511	99,555	24,035
24	Sulawesi Utara	Manado	366,554	244,163	80,642	604,576	1,444,898	3,617,422	32,592,816	5,298,316	4,983,690	1,573,451	6,200,220	845,840	2,968,298	6,440,867	2,213,973	686,450
25	Sulawesi Tengah	Palu	2,129,109	1,416,517	525,272	3,942,680	9,422,757	23,562,506	4,553,541	37,923,682	24,355,922	6,194,868	4,049,051	5,982,424	477,250	848,938	258,055	62,302
26	Sulawesi Selatan	Makassar	13,843,397	9,328,525	328,601	2,463,533	7,382,876	17,144,738	1,415,392	8,048,570	114,761,524	4,955,632	1,173,138	5,951,799	1,572,481	186,449	96,975	13,683
27	Sulawesi Tenggara	Kendari	1,507,969	1,004,465	111,972	839,459	2,006,254	5,022,821	1,613,587	7,391,964	17,894,215	31,782,108	1,310,392	1,590,375	2,390,723	210,839	661,755	162,072
28	Gorontalo	Gorontalo	745,695	496,118	163,858	1,229,912	2,939,412	7,350,280	14,235,782	10,817,230	9,484,140	2,933,838	14,195,400	1,716,622	1,411,478	3,062,745	1,052,783	326,419
29	Sulawesi Barat	Mamuju	4,703,138	3,132,780	231,904	1,738,593	4,155,127	10,402,701	2,010,360	16,544,421	49,809,072	3,685,923	1,776,994	13,713,116	634,795	374,801	113,930	27,506
30	Mahuku	Ambon	1,086,035	1,315,478	15,644	117,281	280,294	701,738	5,520,272	1,032,731	10,297,050	4,335,537	1,143,280	496,707	17,525,441	3,132,995	2,233,081	452,911
31	Mahuku Utara	Ternate	189,220	125,890	41,579	311,718	744,987	1,865,135	17,897,914	2,744,875	1,824,288	571,309	3,706,762	438,200	4,681,282	11,729,076	3,988,655	851,578
32	Papua Barat	Sorong	55,276	36,820	12,161	91,170	217,891	545,508	5,919,491	802,812	912,947	1,725,323	1,225,961	128,163	3,210,433	3,837,784	12,190,168	3,763,400
33	Papua	Jayapura	4,535	3,017	997	7,471	17,855	44,702	622,951	65,786	43,723	143,421	129,017	10,502	221,006	278,106	1,277,358	35,915,121

- Accessibility measures for 90% response of β (1 of 2)

Origin	Destination																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1 Aceh	Banda Aceh	67,027.178	91,796.136	11,080.855	16,010.938	3,218.481	5,267.628	978.373	2,477.269	76.315	5,073.343	5,673.080	7,772.914	3,165.117	3,386.406	309.320	2,063.923	104.399
2 Sumatera Utara	Medan	28,163.962	218,464.862	19,879.732	31,058.996	6,770.672	8,911.802	1,878.054	3,885.272	203.526	14,647.932	13,129.451	7,289.635	5,305.133	484.579	3,233.336	163.552	
3 Sumatera Barat	Padang	9,960.853	58,245.780	74,563.734	52,903.484	14,562.558	29,413.178	7,907.027	14,603.991	449.893	2,948.341	33,443.939	45,822.877	18,658.996	19,963.538	1,823.502	12,167.239	615.456
4 Riau	Pekanbaru	10,720.536	67,782.531	39,405.850	100,103.952	20,009.215	32,785.760	5,209.621	14,277.430	439.336	3,461.868	32,659.146	44,747.600	18,221.145	19,495.076	1,782.727	11,881.724	601.693
5 Jambi	Jambi	4,483.289	30,740.309	22,566.290	41,627.097	48,117.732	78,842.494	9,550.431	34,372.903	1,057.700	1,449.379	78,626.871	107,729.817	43,867.395	46,934.381	4,287.063	28,605.242	1,446.939
6 Sumatera Selatan	Palembang	2,599.549	14,334.388	16,147.363	24,163.982	27,931.710	135,821.331	9,713.799	58,481.972	1,799.568	845.159	150,690.926	212,171.461	83,665.484	79,854.038	7,293.998	48,613.886	2,461.819
7 Bengkulu	Bengkulu	2,865.040	17,925.237	25,758.233	22,784.135	20,077.207	57,641.100	22,888.895	38,837.605	1,196.437	781.175	104,360.574	146,938.745	57,942.294	53,030.695	4,849.390	32,320.781	1,636.732
8 Lampung	Bandar Lampung	1,372.272	7,014.860	8,999.435	11,811.833	13,669.021	65,645.659	7,346.717	120,999.611	3,714.908	3,537.048	289,326.980	407,369.771	160,637.952	164,659.056	15,057.243	100,355.262	5,082.014
9 Kepulauan Bangka Belitung	Pangkal Pinang	209.305	1,819.364	1,372.637	1,799.561	2,082.508	10,001.273	1,120.556	18,392.938	24,438.862	1,433.082	105,858.082	146,523.956	53,405.882	63,835.726	5,837.456	38,906.157	1,970.217
10 Kepulauan Riau	Batam	6,202.055	58,364.451	4,009.552	6,320.511	1,271.972	2,093.616	326.339	7,805.763	638.767	54,828.898	44,975.849	62,323.963	22,690.520	27,152.526	2,480.156	16,548.734	837.085
11 DKI Jakarta	Jakarta	864.152	6,518.508	5,667.155	7,429.782	8,597.975	46,513.081	5,428.518	79,559.663	5,879.292	5,604.139	440,027.654	592,089.940	196,475.689	282,344.828	23,561.971	182,771.605	10,024.770
12 Jawa Barat	Bandung	651.360	5,054.242	4,271.654	5,600.245	6,480.778	36,028.071	4,204.818	61,625.270	4,476.882	4,272.191	325,726.966	799,859.925	165,636.606	284,652.882	30,250.980	184,265.688	10,106.719
13 Banten	Tangerang	907.207	6,810.090	5,949.512	7,799.960	9,026.356	48,593.677	5,671.344	83,118.478	5,581.302	5,320.095	369,704.080	566,546.697	233,848.479	271,082.259	22,545.488	175,480.953	9,634.688
14 Jawa Tengah	Semarang	356.515	1,820.393	2,338.043	3,065.233	3,547.183	17,035.393	1,906.512	31,293.699	2,450.372	2,338.337	195,140.364	357,615.905	99,568.725	636,667.525	52,290.200	405,480.608	22,262.696
15 DI Yogyakarta	Yogyakarta	311.278	1,589.410	2,041.378	2,679.325	3,097.094	14,873.837	1,666.485	27,353.873	2,141.875	2,041.634	155,661.420	363,281.084	79,155.955	499,830.095	66,605.577	365,873.763	20,374.051
16 Jawa Timur	Surabaya	195.134	996.372	1,279.702	1,677.721	1,941.511	9,313.598	1,043.508	17,128.262	1,341.184	1,279.863	113,443.046	207,896.700	57,883.358	364,143.004	34,374.077	708,942.179	35,457.222
17 Bali	Denpasar	86.841	443.416	569.506	747.481	864.031	4,149.522	464.918	7,631.218	597.543	569.578	54,742.977	100,322.449	27,960.582	175,899.444	16,840.772	311,953.261	80,579.765
18 Nusa Tenggara Barat	Mataram	68.022	347.327	446.094	585.501	676.795	3,250.316	364.170	5,977.525	468.055	446.150	43,940.319	80,525.405	22,443.005	141,188.480	13,191.359	244,352.666	61,916.336
19 Nusa Tenggara Timur	Kupang	4.622	23.603	30.314	39.743	45.992	220.625	24.719	405.743	31.771	30.318	2,311.556	4,240.012	1,174.130	8,106.807	895.405	24,145.339	5,646.823
20 Kalimantan Barat	Pontianak	180.488	921.589	1,183.654	1,551.799	1,795.791	8,624.309	965.187	15,842.695	1,296.451	1,235.777	106,723.428	151,802.638	53,958.254	115,578.961	9,503.366	41,968.209	2,089.537
21 Kalimantan Tengah	Palangkaraya	55.120	281.448	361.481	474.447	548.424	2,633.816	295.096	4,843.745	379.277	361.527	27,564.073	50,559.873	14,016.707	96,778.710	7,957.534	183,143.986	9,903.092
22 Kalimantan Selatan	Banjarmasin	37.697	192.485	247.220	324.112	375.073	1,801.291	201.591	3,308.938	259.098	247.251	18,851.322	34,578.360	9,575.321	66,113.046	5,442.230	129,971.839	7,035.086
23 Kalimantan Timur	Samarinda	11.950	61.019	78.370	102.745	118.900	571.019	63.905	1,050.138	82.228	78.380	5,975.970	10,961.526	3,035.428	20,981.903	1,725.216	46,217.796	2,501.666
24 Sulawesi Utara	Manado	1.480	7.559	9.708	12.728	14.729	70.735	7.916	129.938	10.174	9.709	740.271	1,357.855	376.013	2,596.188	260.769	5,305.693	448.938
25 Sulawesi Tengah	Pahu	7.838	40.021	51.402	67.389	77.985	374.100	41.915	687.993	53.871	51.408	3,919.557	7,189.515	1,990.896	13,746.192	1,380.707	28,060.624	2,377.019
26 Sulawesi Selatan	Makassar	39.086	199.577	256.330	336.054	388.893	1,867.662	209.019	3,430.860	268.645	256.362	19,545.926	35,852.449	9,928.137	68,549.076	6,885.267	164,750.953	14,357.847
27 Sulawesi Tenggara	Kendari	5.653	28.865	37.073	48.604	56.246	270.121	30.231	496.768	38.898	37.078	2,826.936	5,185.356	1,435.911	9,925.502	996.946	20,261.304	1,714.398
28 Gorontalo	Gorontalo	2.901	14.813	19.025	24.942	28.864	138.462	15.514	254.641	19.939	19.027	1,450.712	2,660.993	736.873	5,087.758	511.029	10,385.834	879.785
29 Sulawesi Barat	Mamuju	16.607	84.794	108.907	142.779	165.229	793.512	88.806	1,457.667	114.139	108.920	8,304.464	15,232.605	4,218.161	29,124.398	2,925.338	59,520.006	5,036.250
30 Maluku	Ambon	4.142	21.151	27.165	35.614	41.214	197.707	22.151	363.594	28.470	27.169	2,071.429	3,799.554	1,052.160	7,264.662	729.684	14,829.632	1,256.220
31 Maluku Utara	Ternate	790	4,040	5,183	6,803	7,864	37,765	4,231	69,451	5,438	5,184	395.224	724.947	200.977	1,387.650	139.380	2,832.663	239.955
32 Papua Barat	Sorong	247	1,259	1,617	2,120	2,454	11,784	1,319	21,646	1,697	1,617	123.320	226.203	62.639	432.494	43.441	883.866	74.788
33 Papua	Jayapura	23	118	151	198	229	1,101	123	2,026	159	151	11,528	21.145	5,862	40.474	4,065	82.621	6,999

Accessibility measures for 90% response of β (2 of 2)

Destination		Origin																															
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33																
Origin	Destination	Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura																
1	Aceh	Banda Aceh	68,511	3,482	173,814	27,691	31,828	11,909	720	4,435	66,922	2,680	614	3,398	1,083	138	45	12															
2	Sumatera Utara	Medan	107,330	5,455	272,296	43,381	49,862	18,656	1,128	6,947	104,840	4,199	963	5,323	1,697	217	70	19															
3	Sumatera Barat	Padang	403,888	20,526	1,024,667	163,245	187,633	70,206	4,244	26,143	394,518	15,802	3,622	20,029	6,385	815	264	73															
4	Riau	Pekanbaru	394,857	20,044	1,000,622	159,594	183,230	68,558	4,144	25,530	385,261	15,431	3,537	19,559	6,235	797	258	71															
5	Jambi	Jambi	949,544	48,257	2,408,997	383,789	441,125	165,054	9,977	61,463	927,515	37,151	8,515	47,089	15,011	1,917	622	171															
6	Sumatera Selatan	Palembang	1,615,551	82,011	4,098,662	652,978	750,530	280,822	16,974	104,455	1,578,071	63,208	14,471	80,116	25,511	3,261	1,058	291															
7	Bengkulu	Bengkulu	1,074,094	54,525	2,721,903	434,130	498,423	186,492	11,272	69,447	1,047,990	41,976	9,621	53,205	16,961	2,168	702	194															
8	Lampung	Bandar Lampung	3,335,036	169,299	8,451,443	1,347,964	1,547,592	579,710	35,001	215,631	3,253,984	130,483	29,874	165,200	52,663	6,732	2,181	601															
9	Kepulauan Bangka Belitung	Pangkal Pinang	1,292,941	65,634	3,424,215	522,585	599,977	224,744	13,569	83,597	1,261,518	50,586	11,582	64,046	20,416	2,610	846	233															
10	Kepulauan Riau	Batam	549,331	27,918	1,454,844	222,030	255,200	95,487	5,772	35,558	536,587	21,492	4,926	27,242	8,684	1,109	360	99															
11	DKI Jakarta	Jakarta	6,741,342	265,223	15,655,451	2,109,330	2,424,453	907,145	54,832	337,806	5,097,680	204,183	46,800	258,802	82,501	10,535	3,416	941															
12	Jawa Barat	Bandung	6,796,450	267,633	12,250,425	2,128,498	2,446,484	915,388	55,330	340,876	5,144,003	206,038	47,226	261,154	83,251	10,631	3,447	949															
13	Banten	Tangerang	6,479,024	253,494	14,893,924	2,018,332	2,317,239	867,029	52,407	322,868	4,872,250	195,153	44,731	247,357	78,853	10,080	3,265	900															
14	Jawa Tengah	Semarang	14,970,961	642,870	11,717,956	5,118,566	5,876,604	2,201,306	132,906	818,804	12,356,208	495,476	113,439	627,307	199,973	25,564	8,281	2,283															
15	DI Yogyakarta	Yogyakarta	13,370,328	678,727	9,209,852	4,022,991	4,624,005	1,730,139	127,605	786,143	11,863,326	475,712	108,914	602,284	191,996	24,544	7,951	2,192															
16	Jawa Timur	Surabaya	23,268,553	1,719,525	3,821,162	8,698,873	10,375,055	4,354,583	243,923	1,501,056	26,669,411	908,321	207,959	1,151,299	366,597	46,865	15,198	4,186															
17	Bali	Denpasar	51,873,120	3,538,053	1,673,824	4,138,338	4,940,778	2,073,727	181,586	1,118,709	20,448,414	676,189	154,988	857,072	273,218	34,928	11,314	3,119															
18	Nusa Tenggara Barat	Mataram	67,509,224	4,425,857	1,303,713	3,304,844	3,945,666	4,197,935	232,873	1,434,676	25,579,539	867,172	198,763	1,099,143	350,385	44,792	14,509	4,001															
19	Nusa Tenggara Timur	Kupang	5,917,992	50,487,761	74,604	489,412	1,163,872	2,766,163	208,682	1,284,188	23,175,108	777,089	177,914	984,963	553,274	40,094	13,002	3,581															
20	Kalimantan Barat	Pontianak	1,363,513	58,353	64,548,446	2,692,880	3,095,182	1,158,108	57,890	397,542	771,393	77,039	49,355	66,255	6,583	11,122	3,607	993															
21	Kalimantan Tengah	Palangkaraya	6,625,717	733,802	5,162,044	33,672,948	38,659,771	14,465,123	723,065	4,971,033	9,634,928	962,242	617,154	827,550	82,222	138,922	45,052	12,407															
22	Kalimantan Selatan	Banjarmasin	4,706,862	1,038,340	3,530,369	23,003,212	56,591,596	20,192,476	1,009,357	6,939,275	16,665,715	1,343,234	861,511	1,155,212	114,777	193,928	62,889	17,320															
23	Kalimantan Timur	Samarinda	4,242,781	2,090,815	1,119,146	7,292,142	17,107,769	66,795,645	2,057,893	14,131,915	31,642,016	2,738,606	1,754,478	2,355,264	234,008	395,383	128,220	35,312															
24	Sulawesi Utara	Manado	482,348	323,258	114,648	747,028	1,752,568	4,217,442	32,592,816	5,876,597	5,878,252	1,843,125	6,476,506	979,410	3,259,080	6,647,301	2,421,942	845,406															
25	Sulawesi Tengah	Palu	2,553,916	1,709,638	676,640	4,413,847	10,355,130	24,890,789	5,050,534	37,923,682	26,426,260	6,751,626	4,325,403	6,249,399	576,913	974,757	316,107	87,057															
26	Sulawesi Selatan	Makassar	15,047,333	10,195,571	433,875	2,827,049	8,218,255	18,416,877	1,669,451	8,732,727	114,761,524	5,464,836	1,337,638	6,219,086	1,785,234	231,862	125,069	20,708															
27	Sulawesi Tenggara	Kendari	1,841,983	1,234,452	156,464	1,019,489	2,391,778	5,755,659	1,890,140	8,056,310	19,732,892	31,782,108	1,485,462	1,781,327	2,654,990	260,502	771,423	215,356															
28	Gorontalo	Gorontalo	945,259	632,773	224,423	1,463,952	3,434,514	8,255,594	14,870,139	11,555,519	10,814,024	3,325,803	14,195,400	1,915,017	1,611,583	3,287,026	1,197,627	418,045															
29	Sulawesi Barat	Mamuju	5,411,045	3,626,350	311,868	2,032,072	4,767,353	11,472,327	2,327,824	17,282,739	52,045,928	4,128,481	1,982,367	13,713,116	755,922	449,272	145,696	40,125															
30	Mahuku	Ambon	1,349,707	1,593,886	24,245	157,979	370,626	891,888	6,061,050	1,248,394	11,690,215	4,814,782	1,305,363	591,486	17,525,441	3,358,409	2,441,740	570,131															
31	Mahuku Utara	Ternate	257,813	172,584	61,210	398,831	935,681	2,251,655	18,471,554	3,151,686	2,268,622	705,877	3,978,203	525,269	5,018,093	11,729,076	4,230,215	1,036,940															
32	Papua Barat	Sorong	80,353	53,851	19,099	124,446	291,957	702,576	6,475,538	983,410	1,177,438	2,011,249	1,394,631	163,898	3,510,417	4,070,207	12,190,168	4,237,829															
33	Papua	Jayapura	7,520	5,034	1,785	11,633	27,291	65,675	767,202	91,926	66,170	190,574	165,232	15,321	278,206	338,641	1,438,387	35,915,121															

- Accessibility measures for 75% response of β (1 of 2)

Destination		Origin																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Origin	Destination	Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	67,027,178	106,067,891	15,225,293	21,731,474	5,051,574	9,054,002	1,654,593	4,736,326	199,613	7,543,625	11,715,544	16,826,310	6,483,566	8,105,279	757,283	5,461,934	316,193
2	Sumatera Utara	Medan	32,542,677	218,464,862	24,779,738	37,748,356	9,388,092	14,032,421	2,849,012	6,891,522	452,060	18,252,199	23,575,023	34,666,445	12,994,031	11,782,361	1,100,836	7,939,823	459,639
3	Sumatera Barat	Padang	13,686,391	72,602,346	74,563,734	58,836,311	17,772,516	37,955,928	9,439,489	20,774,168	875,530	4,798,988	51,385,965	73,802,479	28,437,799	35,550,855	3,321,546	23,956,784	1,386,867
4	Riau	Pekanbaru	14,550,868	82,381,257	43,824,993	100,103,952	23,160,214	41,549,491	6,667,186	20,386,329	858,375	5,486,057	50,379,132	72,356,427	27,880,602	34,854,288	3,259,536	23,487,386	1,360,976
5	Jambi	Jambi	7,036,756	42,623,959	27,540,474	48,182,424	48,117,732	86,323,351	11,048,160	42,394,629	1,785,044	2,655,542	104,766,513	150,469,655	57,979,433	72,481,642	6,772,021	48,843,467	2,827,567
6	Sumatera Selatan	Palembang	4,468,107	22,570,762	20,837,197	30,623,086	30,581,970	135,821,331	11,205,426	66,015,969	2,779,631	1,694,144	180,157,597	264,692,394	99,298,883	112,866,793	10,545,240	75,986,321	4,403,024
7	Bengkulu	Bengkulu	4,845,263	27,192,618	30,750,440	29,158,756	23,225,778	66,492,329	22,888,895	46,936,175	1,978,131	1,587,499	132,645,864	194,886,876	73,111,467	80,246,275	7,504,545	54,075,848	3,133,423
8	Lampung	Bandar Lampung	2,623,666	12,442,647	12,801,690	16,865,774	16,859,008	74,102,525	8,878,683	120,999,611	5,085,148	5,585,161	310,268,324	455,854,579	171,013,039	206,287,763	19,291,810	139,011,883	8,055,037
9	Kepulauan Bangka Belitung	Pangkal Pinang	547,468	4,041,072	2,671,269	3,515,988	3,514,577	15,448,065	1,852,673	25,177,151	24,438,862	2,630,636	134,230,130	194,428,318	68,309,327	93,656,650	8,758,669	63,112,747	3,657,065
10	Kepulauan Riau	Batam	9,221,924	72,725,593	6,526,311	10,016,178	2,330,498	4,196,709	662,718	12,325,659	1,172,552	54,828,898	65,775,295	95,363,360	33,472,858	45,936,790	4,291,913	30,955,591	1,792,031
11	DKI Jakarta	Jakarta	1,784,569	11,704,524	8,707,474	11,460,985	11,456,387	55,608,424	6,899,833	85,318,152	7,455,058	8,195,819	440,027,654	622,527,763	202,261,447	323,322,043	28,017,418	229,100,344	14,188,387
12	Jawa Barat	Bandung	1,410,022	9,468,408	6,879,940	9,055,541	9,051,908	44,946,461	5,576,908	68,959,858	5,940,549	6,536,979	342,471,753	799,859,925	175,436,260	325,523,069	34,503,883	230,659,952	14,284,975
13	Banten	Tangerang	1,858,362	12,139,225	9,067,532	11,934,901	11,930,113	57,673,698	7,156,090	88,486,832	7,138,820	7,848,159	380,591,015	600,065,626	233,848,479	312,538,144	27,006,490	221,459,062	13,726,792
14	Jawa Tengah	Semarang	853,309	4,042,977	4,163,562	5,480,179	5,477,980	24,078,059	2,884,941	39,205,296	3,595,066	3,956,011	223,461,437	408,962,052	114,795,504	636,667,525	54,442,160	445,051,440	27,585,814
15	DI Yogyakarta	Yogyakarta	762,077	3,610,718	3,718,411	4,898,875	4,892,298	21,503,733	2,578,924	35,046,638	3,213,724	3,533,051	185,096,192	414,353,785	94,818,283	520,400,195	66,605,577	408,517,995	25,621,359
16	Jawa Timur	Surabaya	516,400	2,446,705	2,519,680	3,316,462	3,315,132	14,557,694	1,745,892	23,726,031	2,175,641	2,394,075	142,198,461	260,240,761	73,049,490	399,679,701	38,380,531	708,942,179	40,656,026
17	Bali	Denpasar	263,013	1,246,157	1,283,325	1,690,735	1,688,465	7,421,523	890,057	12,095,548	1,109,143	1,219,352	77,479,534	141,797,125	39,836,172	217,957,845	21,178,089	357,692,426	80,579,765
18	Nusa Tenggara Barat	Mataram	214,577	1,016,668	1,046,991	1,379,373	1,377,521	6,054,793	726,146	9,868,061	904,886	994,799	64,510,835	118,062,803	33,168,304	181,475,570	17,277,984	291,820,661	64,695,694
19	Nusa Tenggara Timur	Kupang	22,826	108,151	111,377	146,596	146,538	643,489	771,173	1,048,753	96,169	105,824	5,544,134	10,154,102	2,837,390	16,776,202	1,836,262	42,409,474	8,794,432
20	Kalimantan Barat	Pontianak	483,893	2,292,687	2,361,068	3,107,694	3,106,447	13,654,158	1,635,989	22,232,495	2,115,000	2,325,154	135,143,906	200,248,108	68,897,585	153,597,603	13,146,687	67,225,726	3,840,720
21	Kalimantan Tengah	Palanganraya	180,081	853,223	878,671	1,157,617	1,156,063	5,081,390	609,407	8,281,615	759,412	834,869	43,738,729	80,107,646	22,405,816	132,475,421	11,338,802	229,489,254	14,044,728
22	Kalimantan Selatan	Banjarmasin	131,210	621,672	640,213	842,664	842,326	3,702,382	443,605	6,028,434	552,798	608,299	31,868,736	58,367,709	16,309,859	96,432,795	8,261,632	172,441,923	10,562,389
23	Kalimantan Timur	Samarinda	50,372	238,662	245,780	323,502	323,372	1,421,358	170,302	2,316,519	212,421	233,528	12,234,523	22,407,574	6,261,414	37,055,798	3,171,670	72,852,227	4,462,334
24	Sulawesi Utara	Manado	8,838	41,873	43,122	56,758	56,735	249,376	29,879	406,049	37,234	40,972	2,146,540	3,931,396	1,098,561	6,495,295	656,847	11,996,473	1,066,252
25	Sulawesi Tengah	Pahu	35,444	167,935	172,943	227,632	227,541	999,197	119,833	1,628,485	149,330	164,322	8,608,831	15,767,107	4,405,849	26,049,783	2,634,327	48,067,283	4,276,268
26	Sulawesi Selatan	Makassar	135,226	640,702	659,812	868,460	868,112	3,815,721	457,185	6,212,978	569,721	626,921	32,844,315	60,154,485	16,809,143	99,384,834	10,050,455	210,115,657	19,140,154
27	Sulawesi Tenggara	Kendari	26,995	127,901	131,715	173,367	173,297	761,716	91,266	1,241,439	113,838	125,149	6,556,570	12,008,382	3,355,537	19,858,472	2,008,221	36,643,023	3,256,847
28	Gorontalo	Gorontalo	15,482	73,355	75,542	99,431	99,391	436,454	52,344	711,329	65,228	71,777	3,760,373	6,887,137	1,924,493	11,378,652	1,150,685	20,995,987	1,867,891
29	Sulawesi Barat	Mamuju	66,263	313,956	323,320	425,562	425,391	1,869,775	224,029	3,044,477	279,174	307,203	16,094,334	29,476,832	8,236,797	48,700,443	4,924,913	89,947,192	7,994,544
30	Maluku	Ambon	20,832	98,704	101,648	133,791	133,738	587,280	70,432	957,146	87,769	96,581	5,059,859	9,267,150	2,589,547	15,310,815	1,548,331	28,251,648	2,513,386
31	Maluku Utara	Ternate	5,239	24,844	25,561	33,676	33,630	147,820	17,728	240,916	22,092	24,287	1,272,378	2,330,366	651,795	3,853,767	389,719	7,111,003	632,625
32	Papua Barat	Sorong	1,985	9,404	9,684	12,747	12,742	56,005	6,710	91,190	8,370	9,202	482,069	882,911	246,714	1,458,711	147,515	2,694,163	239,458
33	Papua	Jayapura	275	1,305	1,344	1,770	1,768	7,771	932	12,665	1,161	1,277	66,890	122,510	34,266	202,597	20,488	373,833	33,258

Accessibility measures for 75% response of β (2 of 2)

Destination		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
Origin		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura	
1	Aceh	Banda Aceh	216,121	17,194	465,999	90,469	110,781	50,198	4,297	20,054	231,530	12,800	3,279	13,557	5,447	917	361	148
2	Sumatera Utara	Medan	314,167	24,994	677,406	131,511	161,039	72,971	6,247	29,152	336,567	18,607	4,766	19,707	7,918	1,334	525	215
3	Sumatera Barat	Padang	947,935	75,414	2,043,933	396,807	485,902	220,175	18,849	87,960	1,015,521	56,142	14,382	59,462	23,891	4,021	1,583	647
4	Riau	Pekanbaru	930,237	73,936	2,003,885	389,399	476,382	215,861	18,480	86,237	995,623	55,042	14,100	58,297	23,423	3,946	1,552	635
5	Jambi	Jambi	1,932,664	153,755	4,167,202	809,017	990,665	448,896	38,430	179,335	2,070,459	114,464	29,322	121,233	48,710	8,198	3,228	1,320
6	Sumatera Selatan	Palembang	3,009,501	239,199	6,489,074	1,259,783	1,542,642	699,010	59,842	278,993	3,224,073	178,241	45,616	188,781	75,779	12,765	5,027	2,055
7	Bengkulu	Bengkulu	2,141,719	170,226	4,613,616	896,527	1,096,791	496,984	42,547	198,546	2,292,259	126,726	32,463	134,220	53,928	9,084	3,574	1,462
8	Lampung	Bandar Lampung	5,505,680	437,598	11,860,146	2,304,688	2,819,502	1,278,792	109,375	510,400	5,892,671	326,080	83,452	345,036	138,632	23,353	9,187	3,759
9	Kepulauan Bangka Belitung	Pangkal Pinang	2,499,632	198,674	5,586,183	1,046,351	1,280,081	580,584	49,657	231,726	2,675,330	148,044	37,888	156,650	62,940	10,603	4,175	1,707
10	Kepulauan Riau	Batam	1,224,867	97,446	2,737,335	512,732	627,855	284,497	24,356	113,657	1,312,198	72,544	18,583	76,834	30,871	5,195	2,046	836
11	DKI Jakarta	Jakarta	9,897,279	636,121	19,824,502	3,347,090	4,098,612	1,857,185	158,994	741,950	8,565,970	473,565	121,311	501,567	201,524	33,916	13,355	5,460
12	Jawa Barat	Bandung	9,964,655	640,935	16,159,960	3,372,416	4,129,625	1,871,238	160,197	747,564	8,630,787	477,148	122,228	505,363	203,049	34,172	13,456	5,501
13	Banten	Tangerang	9,575,288	612,591	19,017,580	3,226,319	3,947,004	1,788,488	153,113	714,505	8,249,115	456,048	116,823	483,014	194,070	32,692	12,861	5,263
14	Jawa Tengah	Semarang	19,242,814	1,330,353	15,572,471	7,006,542	8,571,641	3,887,690	332,513	1,551,679	17,914,460	991,324	253,703	1,048,954	421,458	70,996	27,930	11,429
15	DI Yogyakarta	Yogyakarta	17,512,396	1,391,907	12,740,648	5,732,416	7,019,517	3,180,721	321,422	1,499,925	17,316,952	958,260	245,241	1,013,968	407,401	68,628	26,998	11,048
16	Jawa Timur	Surabaya	27,788,707	3,020,217	6,120,832	10,900,155	13,765,246	6,864,046	551,524	2,571,279	34,012,919	1,642,719	420,410	1,739,855	698,396	117,648	46,326	18,938
17	Bali	Denpasar	54,201,649	5,510,207	3,076,610	5,869,059	7,418,022	3,699,000	431,276	2,012,563	27,259,366	1,284,559	329,059	1,360,517	546,641	92,084	36,225	14,823
18	Nusa Tenggara Barat	Mataram	67,509,224	6,640,419	2,498,231	4,866,006	6,150,242	6,657,652	530,623	2,476,168	32,850,601	1,580,465	404,859	1,673,919	672,563	113,296	44,570	18,238
19	Nusa Tenggara Timur	Kupang	8,879,173	50,487,761	230,293	990,700	2,223,548	4,702,796	484,274	2,257,748	30,256,419	1,442,412	369,147	1,527,704	984,151	103,302	40,677	16,629
20	Kalimantan Barat	Pontianak	2,612,823	180,128	64,548,446	4,102,618	5,023,779	2,276,402	166,350	849,775	1,775,670	210,195	126,804	161,141	24,507	35,485	13,973	5,712
21	Kalimantan Tengah	Palangkaraya	9,755,614	1,485,412	7,864,402	33,672,948	41,194,704	18,666,366	1,364,064	6,974,675	14,560,393	1,723,590	1,040,765	1,321,350	200,955	290,974	114,576	46,840
22	Kalimantan Selatan	Banjarmasin	7,336,745	1,983,721	5,730,129	24,511,539	56,591,596	24,648,056	1,801,182	9,209,729	22,987,197	2,275,919	1,374,280	1,744,780	265,352	384,217	151,292	61,850
23	Kalimantan Timur	Samarinda	6,728,776	3,554,627	2,199,817	9,410,068	20,882,691	66,795,645	3,261,164	16,659,141	39,221,076	4,120,708	2,485,886	3,159,044	480,438	695,652	273,924	111,983
24	Sulawesi Utara	Manado	1,099,075	750,162	329,449	1,409,270	3,127,431	6,683,423	32,592,816	8,018,442	9,645,829	2,962,507	7,381,454	1,520,523	4,313,773	7,307,157	3,170,575	1,579,188
25	Sulawesi Tengah	Palu	4,407,910	3,005,738	1,446,369	6,192,908	13,743,213	29,342,036	6,891,304	37,923,682	33,754,303	8,740,523	5,272,866	7,123,956	1,019,068	1,475,562	581,027	237,530
26	Sulawesi Selatan	Makassar	19,324,583	13,310,897	998,738	4,272,263	11,335,525	22,828,183	2,739,461	11,154,326	114,761,524	7,328,438	1,982,927	7,095,149	2,612,306	445,898	268,304	71,779
27	Sulawesi Tenggara	Kendari	3,357,107	2,291,357	426,900	1,826,133	4,052,528	8,660,386	3,038,076	10,429,542	26,462,142	31,782,108	2,163,926	2,503,086	3,636,335	491,344	1,222,022	505,255
28	Gorontalo	Gorontalo	1,925,393	1,312,919	576,595	2,468,801	5,478,727	11,697,193	16,947,911	14,086,712	16,030,811	4,844,819	14,195,400	2,658,683	2,398,771	4,063,309	1,763,070	878,143
29	Sulawesi Barat	Mamuju	8,240,650	5,624,568	758,502	3,244,612	7,200,397	15,387,484	3,613,922	19,701,330	59,377,469	5,801,260	2,752,187	13,713,116	1,276,466	773,811	304,701	124,565
30	Mahuku	Ambon	2,590,758	2,835,168	90,262	386,111	856,852	1,831,120	8,022,509	2,205,184	17,106,118	6,594,435	1,942,976	998,795	17,525,441	4,136,712	3,192,159	1,137,256
31	Mahuku Utara	Ternate	652,100	444,664	195,283	835,356	1,853,809	3,961,651	20,305,164	4,770,943	4,362,825	1,331,389	4,917,719	904,706	6,181,024	11,729,076	5,046,268	1,872,151
32	Papua Barat	Sorong	246,830	168,471	73,987	316,493	702,357	1,500,960	8,477,156	1,807,579	2,525,889	3,186,045	2,053,087	342,768	4,589,271	4,855,393	12,190,168	6,051,073
33	Papua	Jayapura	34,282	23,376	10,266	43,916	97,457	208,268	1,433,107	250,813	229,358	447,112	347,085	47,561	554,945	611,403	2,053,831	35,915,121

Appendix 5: Accessibility measures of land-use changes (the year 2019)

- Impedance function is same as value in scenario 1
- Weighted opportunities (W_i) in 2019 is calculated using equation (4) and adjusted by growth factor.

No.	Province	PDRB								(1+growth)								
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019	Total
1	Aceh	3.85%	2.83%	1.65%	5.60%	5.80%	6.00%	6.20%	6.20%	1.039	1.028	1.017	1.056	1.058	1.060	1.062	1.062	1.450
2	Sumatera Utara	6.45%	6.08%	5.23%	6.10%	6.70%	7.20%	7.60%	8.10%	1.065	1.061	1.052	1.061	1.067	1.072	1.076	1.081	1.677
3	Sumatera Barat	6.31%	6.02%	5.85%	5.40%	6.00%	6.40%	7.00%	7.80%	1.063	1.060	1.059	1.054	1.060	1.064	1.070	1.078	1.636
4	Riau	3.76%	2.49%	2.62%	4.60%	5.10%	5.10%	5.80%	6.80%	1.038	1.025	1.026	1.046	1.051	1.051	1.058	1.068	1.425
5	Jambi	7.03%	7.07%	7.76%	6.50%	7.40%	7.40%	8.10%	8.90%	1.070	1.071	1.078	1.065	1.074	1.074	1.081	1.089	1.786
6	Sumatera Selatan	6.83%	5.40%	4.68%	5.80%	6.20%	6.20%	6.70%	7.50%	1.068	1.054	1.047	1.058	1.062	1.062	1.067	1.075	1.613
7	Bengkulu	6.83%	6.08%	5.49%	5.90%	7.30%	7.30%	7.70%	8.40%	1.068	1.061	1.055	1.059	1.073	1.073	1.077	1.084	1.702
8	Lampung	6.44%	5.78%	5.08%	6.20%	7.20%	7.20%	7.70%	8.20%	1.064	1.058	1.051	1.062	1.072	1.072	1.077	1.082	1.683
9	Kepulauan Bangka Belitung	5.50%	5.22%	4.68%	5.50%	6.80%	6.80%	7.10%	7.50%	1.055	1.052	1.047	1.055	1.068	1.068	1.071	1.075	1.610
10	Kepulauan Riau	7.63%	7.11%	7.32%	6.70%	7.00%	7.00%	7.50%	7.50%	1.076	1.071	1.073	1.067	1.070	1.070	1.075	1.075	1.747
11	DKI Jakarta	6.53%	6.11%	5.95%	5.40%	7.20%	7.20%	7.30%	7.90%	1.065	1.061	1.060	1.054	1.072	1.072	1.073	1.079	1.680
12	Jawa Barat	6.50%	6.34%	5.06%	5.50%	7.10%	7.10%	7.80%	7.70%	1.065	1.063	1.051	1.055	1.071	1.071	1.078	1.077	1.672
13	Banten	6.83%	7.13%	5.47%	4.90%	6.40%	6.40%	6.80%	7.70%	1.068	1.071	1.055	1.049	1.064	1.064	1.068	1.077	1.649
14	Jawa Tengah	5.34%	5.14%	5.42%	5.70%	7.10%	7.10%	7.50%	7.70%	1.053	1.051	1.054	1.057	1.071	1.071	1.075	1.077	1.639
15	DI Yogyakarta	5.37%	5.49%	5.18%	5.30%	6.10%	6.10%	6.40%	6.50%	1.054	1.055	1.052	1.053	1.061	1.061	1.064	1.065	1.570
16	Jawa Timur	6.64%	6.08%	5.86%	6.20%	7.10%	7.10%	7.30%	7.90%	1.066	1.061	1.059	1.062	1.071	1.071	1.073	1.079	1.689
17	Bali	6.96%	6.69%	6.72%	7.50%	7.80%	7.80%	8.30%	8.60%	1.070	1.067	1.067	1.075	1.078	1.078	1.083	1.086	1.789
18	Nusa Tenggara Barat	-1.54%	5.15%	5.06%	3.70%	8.30%	8.30%	8.70%	9.00%	0.985	1.052	1.051	1.037	1.083	1.083	1.087	1.090	1.567
19	Nusa Tenggara Timur	5.46%	5.42%	5.04%	6.00%	6.80%	6.80%	7.60%	9.50%	1.055	1.054	1.050	1.060	1.068	1.068	1.076	1.095	1.664
20	Kalimantan Barat	5.91%	6.04%	5.02%	5.90%	6.00%	6.20%	7.20%	7.90%	1.059	1.060	1.050	1.059	1.060	1.062	1.072	1.079	1.626
21	Kalimantan Tengah	6.87%	7.38%	6.21%	6.10%	7.00%	7.50%	8.20%	8.70%	1.069	1.074	1.062	1.061	1.070	1.075	1.082	1.087	1.749
22	Kalimantan Selatan	5.97%	5.36%	4.85%	5.00%	6.20%	6.80%	7.60%	8.60%	1.060	1.054	1.049	1.050	1.062	1.068	1.076	1.086	1.629
23	Kalimantan Timur	5.48%	2.72%	1.40%	4.50%	5.60%	5.60%	6.40%	7.00%	1.055	1.027	1.014	1.045	1.056	1.056	1.064	1.070	1.458
24	Sulawesi Utara	6.86%	6.38%	6.31%	7.10%	7.20%	7.80%	7.80%	8.30%	1.069	1.064	1.063	1.071	1.072	1.078	1.078	1.083	1.746
25	Sulawesi Tengah	9.53%	9.55%	5.11%	7.60%	7.70%	8.10%	8.30%	8.90%	1.095	1.096	1.051	1.076	1.077	1.081	1.083	1.089	1.863
26	Sulawesi Selatan	8.87%	7.63%	7.57%	7.40%	7.40%	8.30%	9.10%	9.10%	1.089	1.076	1.076	1.074	1.074	1.083	1.091	1.091	1.874
27	Sulawesi Tenggara	11.65%	7.51%	6.26%	7.80%	8.00%	8.20%	10.10%	10.30%	1.117	1.075	1.063	1.078	1.080	1.082	1.101	1.103	1.951
28	Gorontalo	7.91%	7.68%	7.29%	6.70%	7.20%	8.40%	8.60%	8.90%	1.079	1.077	1.073	1.067	1.072	1.084	1.086	1.089	1.828
29	Sulawesi Barat	9.25%	6.94%	8.73%	8.10%	9.80%	10.10%	10.20%	11.04%	1.093	1.069	1.087	1.081	1.098	1.101	1.102	1.110	2.031
30	Maluku	7.16%	5.26%	6.70%	6.90%	7.30%	8.30%	8.40%	8.60%	1.072	1.053	1.067	1.069	1.073	1.083	1.084	1.086	1.760
31	Maluku Utara	6.98%	6.37%	5.49%	5.90%	6.30%	7.00%	7.50%	7.80%	1.070	1.064	1.055	1.059	1.063	1.070	1.075	1.078	1.676
32	Papua Barat	3.63%	7.39%	5.38%	14.10%	11.50%	11.67%	11.76%	11.77%	1.036	1.074	1.054	1.141	1.115	1.117	1.118	1.118	2.081
33	Papua	1.72%	7.91%	3.25%	7.90%	10.30%	11.47%	11.64%	11.66%	1.017	1.079	1.033	1.079	1.103	1.115	1.116	1.117	1.874

Source: (Indonesia Ministry of National Development Planning, 2014)

Thus, weighted opportunities (W_j) in 2019 is obtained.

Year : 2010		Wj
No.	Province	
1	Aceh	100,370,334
2	Sumatera Utara	390,853,924
3	Sumatera Barat	129,708,289
4	Riau	150,566,810
5	Jambi	92,684,737
6	Sumatera Selatan	233,051,256
7	Bengkulu	41,617,671
8	Lampung	216,952,036
9	Kepulauan Bangka Belitung	42,059,689
10	Kepulauan Riau	102,429,214
11	DKI Jakarta	788,763,910
12	Jawa Barat	1,424,010,107
13	Banten	412,685,351
14	Jawa Tengah	1,098,761,577
15	DI Yogyakarta	110,047,310
16	Jawa Timur	1,274,458,928
17	Bali	153,788,113
18	Nusa Tenggara Barat	101,680,934
19	Nusa Tenggara Timur	88,751,984
20	Kalimantan Barat	110,754,027
21	Kalimantan Tengah	63,039,760
22	Kalimantan Selatan	98,620,735
23	Kalimantan Timur	103,659,241
24	Sulawesi Utara	60,425,911
25	Sulawesi Tengah	77,605,311
26	Sulawesi Selatan	232,574,322
27	Sulawesi Tenggara	68,606,557
28	Gorontalo	27,951,546
29	Sulawesi Barat	30,845,290
30	Maluku	32,801,302
31	Maluku Utara	20,989,800
32	Papua Barat	26,293,798
33	Papua	64,433,325
	INDONESIA	7,971,843,098

Finally, accessibility measures are calculated by using equation (1) for three scenarios of the response of cost sensitivity parameter (β).

- Accessibility measures for 95% response of β (1 of 2)

Origin \ Destination		Destination																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	100,370,334	144,351,526	18,068,447	22,630,041	5,655,852	8,094,898	1,598,465	3,892,705	107,990	8,742,478	8,773,437	11,825,002	4,826,969	4,892,908	425,907	3,043,441	159,009
2	Sumatera Utara	Medan	37,069,120	390,853,924	28,406,360	39,249,137	9,740,839	13,941,506	2,353,773	6,199,138	171,774	22,484,704	13,955,387	18,809,331	7,677,975	7,782,859	677,465	4,841,021	252,926
3	Sumatera Barat	Padang	13,981,651	85,597,746	129,708,289	77,869,037	26,935,731	47,916,096	13,867,676	24,372,101	676,124	4,987,928	54,930,212	74,035,962	30,221,502	30,634,342	2,666,588	19,054,887	995,549
4	Riau	Pekanbaru	15,085,561	101,886,195	67,081,580	150,566,810	37,411,338	53,607,346	9,008,412	23,808,838	659,726	5,888,694	53,598,023	72,240,412	29,488,558	29,891,386	2,604,961	18,592,761	972,541
5	Jambi	Jambi	6,124,846	41,077,370	37,695,392	60,774,902	92,684,737	132,809,545	16,857,610	59,054,217	1,636,351	2,393,649	132,941,779	179,181,403	73,141,903	74,141,057	6,453,661	46,116,527	2,409,422
6	Sumatera Selatan	Palembang	3,486,304	23,381,519	26,668,446	34,633,957	52,818,500	233,051,256	17,155,844	102,302,902	2,834,743	1,370,469	230,302,431	310,043,214	126,707,784	128,438,672	11,180,035	79,796,877	4,173,975
7	Bengkulu	Bengkulu	3,855,057	22,105,548	43,220,885	32,591,152	37,542,783	96,069,551	41,617,671	67,001,830	1,858,746	1,264,257	151,009,743	203,295,927	83,082,535	84,119,080	7,330,770	52,322,964	2,736,884
8	Lampung	Bandar Lampung	1,800,915	11,168,172	14,571,255	16,523,564	25,228,731	109,894,428	12,852,888	216,952,036	5,997,551	6,020,964	487,257,823	655,967,812	268,079,493	271,424,076	23,653,939	168,828,668	8,831,006
9	Kepulauan Bangka Belitung	Pangkal Pinang	257,706	1,596,267	2,085,106	2,361,713	3,605,942	15,707,209	1,839,212	30,936,530	42,059,689	2,365,827	180,799,272	246,262,209	89,642,247	101,897,519	8,880,117	63,381,343	3,315,320
10	Kepulauan Riau	Batam	8,566,750	85,798,126	6,316,319	8,656,143	2,165,932	3,118,149	513,676	12,752,811	971,461	102,429,214	74,617,162	101,753,079	36,996,001	42,103,034	3,664,888	26,188,536	1,368,256
11	DKI Jakarta	Jakarta	1,116,421	6,915,273	9,032,999	10,231,304	15,621,498	68,046,053	7,967,750	134,021,822	9,640,858	9,689,816	788,763,910	1,043,409,205	344,688,936	431,738,226	37,580,960	268,545,778	14,030,546
12	Jawa Barat	Bandung	833,477	5,162,675	6,743,687	7,638,294	11,662,404	50,741,185	5,941,463	99,938,583	7,273,622	7,319,111	577,947,811	1,424,010,107	288,907,522	435,795,167	48,660,666	271,069,238	14,162,388
13	Banten	Tangerang	1,173,980	7,271,803	9,498,712	10,758,798	16,426,893	71,554,292	8,378,542	140,931,563	9,136,077	9,182,471	658,802,626	996,902,918	412,685,351	412,013,046	35,905,921	256,276,505	13,405,184
14	Jawa Tengah	Semarang	446,960	2,768,536	3,616,370	4,096,112	6,254,081	27,242,301	3,186,169	53,593,070	3,900,553	3,924,947	309,930,323	564,796,526	154,748,539	1,098,761,577	85,688,673	670,775,939	35,086,614
15	DI Yogyakarta	Yogyakarta	388,455	2,406,144	3,142,999	3,564,109	5,435,443	23,676,374	2,772,349	46,632,400	3,393,949	3,411,184	269,361,464	629,668,091	134,649,793	855,554,051	110,047,310	643,130,187	37,111,876
16	Jawa Timur	Surabaya	239,687	1,484,655	1,939,315	2,196,581	3,353,814	14,591,888	1,708,615	28,739,822	2,091,711	2,104,792	166,203,251	302,877,815	82,985,459	578,302,535	55,533,172	1,274,458,928	65,811,942
17	Bali	Denpasar	103,778	642,813	839,668	952,170	1,452,106	6,325,263	740,647	12,458,081	906,711	911,315	71,961,273	131,137,466	35,972,371	250,681,427	26,556,422	545,390,770	153,788,113
18	Nusa Tenggara Barat	Mataram	80,618	499,360	652,283	739,678	1,128,046	4,913,682	575,360	9,677,867	704,364	707,941	55,902,001	101,872,109	27,944,579	194,737,984	20,629,945	423,678,372	117,116,942
19	Nusa Tenggara Timur	Kupang	5,001	30,975	40,461	45,828	69,972	304,437	35,648	599,612	43,640	43,913	3,467,572	6,319,074	1,731,362	12,065,382	1,278,170	26,249,842	7,256,215
20	Kalimantan Barat	Pontianak	221,111	1,369,594	1,789,016	2,026,345	3,093,891	13,476,754	1,576,196	26,512,466	2,019,619	2,029,875	154,944,160	211,045,601	76,554,029	188,246,216	14,697,855	68,545,651	3,523,123
21	Kalimantan Tengah	Palangkaraya	64,862	401,767	524,804	595,119	907,585	3,953,372	462,914	7,786,465	566,706	569,584	44,976,744	81,962,644	22,483,206	156,679,195	12,233,170	269,174,432	13,835,081
22	Kalimantan Selatan	Banjarmasin	43,792	271,253	354,321	401,325	612,756	2,669,117	312,171	5,250,885	382,164	384,554	30,366,023	55,337,032	15,161,788	105,658,271	8,259,218	181,520,623	9,340,747
23	Kalimantan Timur	Samarinda	13,352	82,701	108,028	122,358	186,821	813,777	95,177	1,602,795	116,653	117,245	9,258,182	16,871,499	4,622,620	32,251,435	2,518,122	55,343,138	2,847,865
24	Sulawesi Utara	Manado	1,541	9,544	12,466	14,120	21,559	93,910	10,983	184,747	13,446	13,530	1,068,398	1,946,977	533,452	3,717,479	356,982	8,078,420	718,462
25	Sulawesi Tengah	Palu	8,633	53,472	69,847	79,113	120,792	525,547	61,538	1,035,104	75,336	75,807	5,986,036	10,908,556	2,988,834	20,828,351	2,000,103	45,209,015	4,025,409
26	Sulawesi Selatan	Makassar	45,461	281,593	367,828	416,623	636,114	2,770,864	324,071	5,451,049	396,732	399,214	31,523,581	57,446,489	15,739,757	109,685,982	10,532,913	238,357,606	21,198,553
27	Sulawesi Tenggara	Kendari	6,158	38,141	49,821	56,430	86,159	375,304	43,894	739,189	53,799	54,072	4,269,755	7,780,919	2,131,893	14,873,947	1,428,314	32,284,673	2,871,267
28	Gorontalo	Gorontalo	3,089	19,135	24,995	28,310	43,225	188,066	22,021	370,400	26,959	27,127	2,142,088	3,903,599	1,069,547	7,453,373	715,732	16,177,932	1,440,482
29	Sulawesi Barat	Mamuju	18,762	116,215	151,805	171,943	262,529	1,143,556	133,746	2,249,687	163,734	164,758	13,010,009	23,708,580	6,495,911	45,268,195	4,347,009	98,371,901	8,748,796
30	Maluku	Ambon	4,465	27,654	36,123	40,915	62,470	271,798	31,826	535,327	38,962	39,205	3,095,814	5,641,607	1,545,743	10,771,854	1,034,398	23,380,866	2,081,831
31	Maluku Utara	Terate	805	4,994	6,515	7,388	11,268	49,082	5,747	96,670	7,036	7,071	558,391	1,017,574	279,131	1,945,188	186,792	4,222,130	375,938
32	Papua Barat	Sorong	242	1,496	1,954	2,213	3,380	14,721	1,722	28,961	2,110	2,121	167,482	305,208	83,624	582,751	55,960	1,266,371	112,626
33	Papua	Jayapura	21	129	169	191	292	1,270	149	2,501	182	183	14,446	26,325	7,221	50,324	4,832	109,230	9,726

Accessibility measures for 95% response of β (2 of 2)

Origin	Destination	18		19		20		21		22		23		24		25		26		27		28		29		30		31		32		33		Ai (Million Rupiahs)	Ai (Billion Rupiahs)
		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura																		
1	Aceh	Banda Aceh	81,671	4,422	243,986	40,738	43,028	13,789	928	6,675	105,341	4,209	860	5,766	1,459	168	63	13	348,012,526	348,013															
2	Sumatera Utara	Medan	129,909	7,034	388,094	64,800	68,443	21,933	1,475	10,617	167,559	6,695	1,368	9,171	2,321	268	101	21	605,347,049	605,347															
3	Sumatera Barat	Padang	511,338	27,685	1,527,588	255,061	269,400	86,333	5,808	41,790	659,536	26,352	5,386	36,100	9,135	1,054	396	84	641,914,465	641,914															
4	Riau	Pekanbaru	499,520	27,014	1,490,540	249,166	262,866	84,239	5,667	40,776	643,540	25,713	5,256	35,225	8,913	1,030	387	82	675,773,076	675,773															
5	Jambi	Jambi	1,237,537	67,003	3,697,059	617,296	652,000	208,942	14,056	101,140	1,596,205	63,776	13,036	87,369	22,108	2,552	959	203	973,875,612	973,876															
6	Sumatera Selatan	Palembang	2,143,854	115,938	6,404,620	1,069,377	1,129,495	361,961	24,349	175,005	2,765,194	110,483	22,556	151,354	38,255	4,421	1,661	351	1,402,865,803	1,402,866															
7	Bengkulu	Bengkulu	1,405,729	76,020	4,194,615	701,193	739,747	237,061	15,947	114,751	1,811,024	72,359	14,790	99,127	25,084	2,899	1,088	230	940,537,048	940,537															
8	Lampung	Bandar Lampung	4,535,816	245,293	13,534,616	2,262,513	2,386,915	765,812	51,456	370,264	5,843,569	233,753	47,723	319,851	80,937	9,353	3,510	743	2,335,745,440	2,335,745															
9	Kepulauan Bangka Belitung	Pangkal Pinang	1,702,828	92,087	5,318,179	849,389	896,091	287,500	19,318	139,004	2,193,782	87,755	17,916	120,078	30,385	3,511	1,319	279	808,752,647	808,753															
10	Kepulauan Riau	Batam	702,769	38,050	2,194,851	350,549	370,256	118,653	7,982	57,435	906,449	36,217	7,403	49,615	12,555	1,449	544	115	522,834,428	522,834															
11	DKI Jakarta	Jakarta	7,206,425	390,172	21,756,434	3,594,641	3,796,725	1,216,709	81,848	588,957	9,295,019	371,383	75,909	508,768	128,742	14,859	5,583	1,180	3,250,074,710	3,250,075															
12	Jawa Barat	Bandung	7,274,142	393,839	16,414,315	3,628,419	3,832,402	1,228,142	82,617	594,491	9,382,362	374,872	76,623	513,548	129,951	14,999	5,636	1,191	3,307,754,949	3,307,755															
13	Banten	Tangerang	6,885,224	372,346	20,545,113	3,434,423	3,623,261	1,161,120	78,109	562,049	8,870,350	354,415	72,441	485,523	122,860	14,197	5,328	1,127	3,116,892,567	3,116,893															
14	Jawa Tengah	Semarang	18,021,325	974,576	18,975,023	8,989,228	9,483,492	3,042,661	204,441	1,471,102	23,217,178	928,728	189,607	1,270,804	321,572	37,159	13,945	2,951	3,115,961,086	3,115,961															
15	DI Yogyakarta	Yogyakarta	19,061,548	1,030,830	14,792,243	7,007,678	7,401,636	2,371,949	196,015	1,410,471	22,260,291	890,451	181,793	1,218,428	308,318	35,628	13,371	2,829	2,852,529,658	2,852,530															
16	Jawa Timur	Surabaya	33,802,590	1,828,012	5,956,808	13,314,428	14,046,508	4,501,383	383,022	2,752,901	43,497,564	1,737,946	354,816	2,380,861	601,763	69,537	26,127	5,522	2,709,883,771	2,709,884															
17	Bali	Denpasar	77,434,854	4,187,602	2,537,258	5,671,181	5,990,004	1,919,573	282,296	2,031,322	32,058,649	1,280,904	261,813	1,754,746	444,032	51,310	19,256	4,075	1,376,749,266	1,376,749															
18	Nusa Tenggara Barat	Mataram	101,680,934	5,415,866	1,959,541	4,379,891	4,626,120	4,315,860	365,096	2,627,127	41,461,753	1,656,605	338,605	2,269,430	574,270	66,360	24,904	5,270	1,133,328,764	1,133,329															
19	Nusa Tenggara Timur	Kupang	6,204,822	88,751,984	101,760	793,702	1,777,816	3,853,157	325,954	2,342,733	37,016,644	1,479,000	301,950	2,026,125	920,964	59,176	22,234	4,700	205,569,825	205,570															
20	Kalimantan Barat	Pontianak	1,799,013	81,545	110,754,027	4,627,293	4,887,431	1,566,240	86,573	696,944	1,319,250	135,566	80,197	124,364	9,428	15,717	5,905	1,248	897,862,246	897,862															
21	Kalimantan Tengah	Palangkaraya	7,064,612	1,117,432	8,129,653	63,039,760	66,505,935	21,312,677	1,178,041	9,494,795	17,951,758	1,844,722	1,092,565	1,692,289	128,291	213,870	80,357	16,985	818,041,391	818,041															
22	Kalimantan Selatan	Banjarmasin	4,769,669	1,599,914	5,488,730	42,511,528	98,620,735	30,089,905	1,663,195	13,405,049	25,344,855	2,604,436	1,542,518	2,389,226	181,125	301,949	113,451	23,980	646,976,304	646,976															
23	Kalimantan Timur	Samarinda	4,233,493	3,299,034	1,673,438	12,961,180	28,627,342	103,659,241	3,473,908	27,966,353	52,937,689	5,439,874	3,218,086	4,990,367	378,315	630,679	236,964	50,087	380,747,820	380,748															
24	Sulawesi Utara	Manado	614,360	478,752	158,678	1,228,999	2,714,490	5,959,409	60,425,911	11,288,360	7,655,362	2,604,436	12,417,535	2,014,315	4,748,971	10,931,765	4,107,379	868,165	145,012,905	145,013															
25	Sulawesi Tengah	Palu	3,442,145	2,679,226	994,640	7,712,740	17,035,120	37,355,317	8,789,469	77,605,311	43,042,282	13,828,149	8,180,367	13,687,076	961,676	1,603,186	602,363	127,320	331,697,879	331,698															
26	Sulawesi Selatan	Makassar	18,126,979	14,125,809	628,239	4,865,862	10,747,223	23,594,525	1,988,965	14,362,332	232,574,322	9,077,750	1,853,297	12,435,869	3,092,143	363,209	136,468	28,845	843,576,269	843,576															
27	Sulawesi Tenggara	Kendari	2,455,234	1,913,290	218,849	1,695,039	3,743,831	8,219,232	2,293,883	15,641,913	30,773,322	68,606,557	2,090,461	3,738,704	4,660,964	409,688	1,515,179	324,784	215,444,663	215,445															
28	Gorontalo	Gorontalo	1,231,763	958,754	317,770	2,464,087	5,442,426	11,934,377	26,844,343	22,712,159	15,420,590	5,130,999	27,951,546	4,029,177	2,114,680	4,867,829	1,828,984	386,587	167,292,161	167,292															
29	Sulawesi Barat	Mamuju	7,481,135	5,829,823	446,545	3,458,599	7,639,003	16,770,717	3,946,043	34,436,045	93,766,789	8,315,682	3,651,181	30,845,290	1,271,682	719,752	270,432	57,160	423,433,017	423,433															
30	Maluku	Ambon	1,780,183	2,491,894	31,833	246,558	544,572	1,195,558	8,748,461	2,275,251	21,924,528	9,748,780	1,802,019	1,195,849	32,801,302	5,760,361	4,145,975	888,704	144,222,688	144,223															
31	Maluku Utara	Temate	321,467	250,217	82,932	642,328	1,418,709	3,114,644	31,470,612	5,927,438	4,024,478	1,339,092	6,482,356	1,057,703	9,001,864	20,989,800	7,794,808	1,649,494	104,349,662	104,350															
32	Papua Barat	Sorong	96,307	75,049	24,874	192,658	425,523	934,196	9,439,189	1,777,856	1,207,088	3,953,450	1,944,296	317,244	5,172,071	6,222,435	26,293,798	5,531,717	66,240,692	66,241															
33	Papua	Jayapura	8,317	6,473	2,146	16,618	36,703	80,578	814,170	153,348	104,116	345,820	167,704	27,364	452,416	537,339	2,257,370	64,433,325	69,670,995	69,671															

- Accessibility measures for 90% response of β (1 of 2)

Destination		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Origin		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	100,370,334	152,121,093	20,043,609	25,003,652	6,552,690	9,660,808	1,897,611	4,810,078	147,818	9,951,456	11,117,321	15,216,416	6,100,365	6,506,113	570,526	4,181,796	228,325
2	Sumatera Utara	Medan	39,064,326	390,853,924	30,770,096	30,770,096	10,967,098	16,169,090	7,474,742	229,451	24,352,693	17,256,917	23,619,758	9,469,322	10,099,147	885,602	6,491,214	354,418	
3	Sumatera Barat	Padang	15,510,063	92,720,464	129,708,289	80,618,854	28,745,843	52,076,015	14,693,437	27,344,193	840,309	5,847,891	63,199,429	86,501,845	34,679,181	36,985,765	3,243,312	23,772,553	1,297,973
4	Riau	Pekanbaru	16,667,849	109,357,073	69,450,456	150,566,810	39,241,026	57,918,221	9,764,022	26,745,136	820,990	6,843,897	61,746,427	84,513,103	33,881,881	36,135,435	3,172,257	23,226,005	1,269,537
5	Jambi	Jambi	7,096,052	46,248,536	63,747,238	63,747,238	92,684,737	136,799,052	17,678,807	63,240,267	1,941,273	2,916,901	146,002,646	199,835,637	80,115,474	85,444,119	7,492,665	54,919,098	2,998,564
6	Sumatera Selatan	Palembang	4,160,709	27,117,435	28,983,713	37,419,072	54,405,131	233,051,256	17,974,970	106,431,673	3,267,110	1,719,798	245,718,535	335,945,723	134,832,193	143,800,160	12,609,954	92,325,055	5,046,503
7	Bengkulu	Bengkulu	4,576,513	25,713,422	45,794,502	35,324,841	39,371,630	100,656,505	41,617,671	71,276,005	2,190,369	1,593,262	164,737,091	225,228,110	90,395,555	96,301,229	8,454,092	61,897,492	3,383,327
8	Lampung	Bandar Lampung	2,225,327	13,466,258	16,348,169	18,561,383	27,017,067	114,329,580	13,672,798	216,952,036	6,644,994	6,989,446	499,768,324	683,281,915	274,235,963	292,152,201	25,647,457	187,780,454	10,264,112
9	Kepulauan Bangka Belitung	Pangkal Pinang	352,749	2,132,247	2,591,437	2,939,009	4,277,881	18,102,941	2,167,349	34,276,166	42,059,689	2,884,772	195,374,442	270,090,372	97,143,348	115,483,075	10,138,028	74,226,599	4,057,239
10	Kepulauan Riau	Batam	9,751,427	92,926,082	7,405,309	10,060,252	2,639,405	3,912,956	647,353	14,804,121	1,184,551	102,429,214	84,477,133	116,912,658	42,003,404	49,988,576	4,383,539	32,130,094	1,754,292
11	DKI Jakarta	Jakarta	1,414,681	8,551,271	10,392,831	11,786,749	17,156,232	72,600,955	8,692,048	137,462,876	10,418,058	10,970,236	788,763,910	1,060,627,788	347,970,716	453,494,722	39,767,324	291,483,154	15,914,882
12	Jawa Barat	Bandung	1,072,518	6,483,012	7,879,162	8,935,940	13,006,729	54,980,349	6,582,446	104,099,965	7,977,413	8,409,541	587,485,241	1,424,010,107	294,380,736	457,530,826	50,796,145	294,077,355	16,056,525
13	Banten	Tangerang	1,483,686	8,968,387	10,899,774	12,361,686	17,993,083	76,142,300	9,116,031	144,168,069	9,900,567	10,425,317	665,075,079	1,015,788,763	412,685,351	433,842,032	38,086,124	278,851,412	15,242,066
14	Jawa Tengah	Semarang	594,324	3,592,491	4,366,152	4,951,754	7,207,538	30,500,528	3,647,591	57,685,867	4,420,597	4,660,056	325,548,579	592,966,239	162,947,317	1,098,761,577	86,824,473	693,822,601	37,924,462
15	DI Yogyakarta	Yogyakarta	520,357	3,145,385	3,822,760	4,340,285	6,310,519	26,704,565	3,197,167	50,562,508	3,874,718	4,080,086	285,032,228	657,301,147	142,825,711	866,894,384	110,047,310	666,702,206	39,995,226
16	Jawa Timur	Surabaya	329,338	1,990,740	2,419,456	2,743,961	3,993,979	16,882,827	2,021,273	31,965,998	2,449,626	2,582,320	180,399,217	328,585,815	90,295,490	598,171,976	57,568,575	1,274,458,928	68,818,572
17	Bali	Denpasar	149,017	900,757	1,094,739	1,242,945	1,807,169	7,647,496	915,586	14,479,792	1,109,619	1,168,431	81,625,845	148,676,338	40,901,583	270,956,842	28,619,683	570,307,042	153,788,113
18	Nusa Tenggara Barat	Mataram	117,310	709,101	861,810	978,482	1,422,655	6,020,325	720,775	11,398,902	873,523	919,822	64,258,175	117,042,219	32,198,883	213,304,892	22,530,224	448,961,840	118,808,141
19	Nusa Tenggara Timur	Kupang	8,423	50,916	61,881	70,181	102,152	431,802	51,697	817,575	62,653	66,046	4,613,962	8,404,041	2,309,433	15,299,083	1,615,958	32,201,346	8,521,397
20	Kalimantan Barat	Pontianak	305,107	1,844,270	2,241,443	2,542,072	3,700,119	15,657,995	1,872,556	29,614,078	2,369,569	2,495,161	168,800,500	233,353,910	83,651,937	206,562,448	16,340,716	79,944,315	4,297,772
21	Kalimantan Tengah	Palangkaraya	95,470	577,085	701,363	796,313	1,157,792	4,899,492	586,585	9,276,714	710,895	748,574	52,294,924	95,251,912	26,204,264	173,592,905	13,732,565	292,129,551	15,704,758
22	Kalimantan Selatan	Banjarmasin	65,803	397,757	483,416	548,254	798,012	3,376,991	403,858	6,386,928	489,445	515,957	36,044,450	65,652,695	18,041,382	119,517,036	9,465,216	201,128,370	10,824,556
23	Kalimantan Timur	Samarinda	21,357	129,094	156,895	177,939	258,999	1,096,020	131,074	2,075,207	159,028	167,457	11,698,410	21,307,918	5,855,423	38,832,851	3,071,984	65,277,240	3,513,165
24	Sulawesi Utara	Manado	2,761	16,691	20,285	23,006	33,486	141,704	16,947	268,006	20,538	21,650	1,512,487	2,754,899	757,047	5,015,139	482,661	10,544,126	952,933
25	Sulawesi Tengah	Palu	14,129	85,406	103,799	117,720	171,348	724,300	86,716	1,371,392	105,093	110,786	7,739,415	14,096,857	3,873,821	25,662,535	2,469,784	53,894,710	4,876,173
26	Sulawesi Selatan	Makassar	68,177	412,108	500,857	568,034	826,803	3,498,827	418,428	6,617,356	507,103	534,572	37,344,864	68,021,319	18,692,281	123,828,982	11,917,406	260,345,395	23,528,911
27	Sulawesi Tenggara	Kendari	10,259	62,012	75,366	85,475	124,413	526,485	62,963	996,849	76,391	80,440	5,619,462	10,235,496	2,812,718	18,653,793	1,795,257	39,175,426	3,540,509
28	Gorontalo	Gorontalo	5,337	32,261	39,208	44,467	64,724	273,594	32,756	518,023	39,697	41,848	2,923,450	5,324,880	1,463,279	9,693,645	932,925	20,357,933	1,841,902
29	Sulawesi Barat	Mamuju	29,479	178,190	216,564	245,610	357,498	1,512,843	180,923	2,861,251	219,264	231,141	16,147,389	29,411,452	8,082,277	53,541,893	5,152,917	112,569,650	10,173,567
30	Mahuku	Ambon	7,565	45,729	55,577	63,032	91,746	387,816	46,431	734,293	56,270	59,319	4,143,960	7,547,961	2,074,182	13,740,639	1,322,411	28,857,155	2,610,877
31	Mahuku Utara	Ternate	1,493	9,036	10,970	12,455	18,109	76,634	9,175	145,098	11,119	11,709	817,953	1,489,849	409,865	2,715,192	261,312	5,702,261	515,917
32	Papua Barat	Sorong	477	2,884	3,506	3,976	5,787	24,489	2,929	46,317	3,553	3,742	261,386	476,098	130,832	866,710	83,413	1,822,222	164,685
33	Papua	Jayapura	47	283	344	391	568	2,403	288	4,550	349	367	25,649	46,718	12,852	85,143	8,194	178,811	16,178

Accessibility measures for 90% response of β (2 of 2)

Origin	Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Ai (Million Rupiahs)	Ai (Billion Rupiahs)	
		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Terate	Sorong	Jayapura			
1	Aceh	Banda Aceh	118,842	7,448	336,672	59,962	64,656	22,057	1,662	10,925	157,977	7,012	1,486	9,059	2,472	312	125	30	375,280,709	375,281
2	Sumatera Utara	Medan	184,473	11,562	522,600	93,076	100,363	34,237	2,580	16,958	245,221	10,885	2,307	14,062	3,838	485	194	47	634,165,729	634,166
3	Sumatera Barat	Padang	675,590	42,342	1,913,901	340,871	367,555	125,386	9,450	62,103	898,065	39,864	8,449	51,500	14,055	1,775	711	171	702,337,205	702,337
4	Riau	Pekanbaru	660,789	41,368	1,869,899	333,403	359,104	122,504	9,233	60,676	877,418	38,947	8,255	50,316	13,732	1,736	694	167	735,768,365	735,768
5	Jambi	Jambi	1,560,741	97,817	4,421,473	787,475	849,121	289,666	21,831	143,470	2,074,701	92,092	19,519	118,975	32,469	4,101	1,642	395	1,059,905,122	1,059,905
6	Sumatera Selatan	Palembang	2,626,685	164,441	7,441,221	1,325,300	1,429,048	487,500	36,741	241,190	3,491,666	154,989	32,814	200,231	54,584	6,902	2,763	664	1,502,505,732	1,502,506
7	Bengkulu	Bengkulu	1,761,009	110,246	4,983,296	888,521	957,016	326,473	24,605	161,701	2,338,327	103,794	22,000	134,092	36,595	4,627	1,850	445	1,030,366,215	1,030,366
8	Lampung	Bandar Lampung	5,342,430	334,458	15,117,989	2,695,535	2,903,331	991,530	74,646	490,557	7,093,859	315,233	66,741	406,800	111,019	14,038	5,613	1,351	2,445,302,610	2,445,303
9	Kepulauan Bangka Belitung	Pangkal Pinang	2,111,777	132,206	6,239,687	1,065,502	1,147,640	391,936	29,506	193,909	2,804,089	124,606	26,382	160,802	43,884	5,549	2,221	534	892,777,571	892,778
10	Kepulauan Riau	Batam	913,102	57,227	2,697,952	460,708	496,773	169,467	12,772	83,937	1,213,792	53,878	11,420	69,605	18,996	2,399	960	231	583,673,586	583,674
11	DKI Jakarta	Jakarta	8,283,634	519,165	23,702,067	4,179,526	4,506,710	1,537,403	115,869	761,470	11,011,478	488,780	103,599	631,458	172,329	21,767	8,713	2,095	3,343,514,497	3,343,514
12	Jawa Barat	Bandung	8,357,358	523,785	18,149,369	4,216,724	4,546,820	1,551,086	116,900	768,247	11,109,480	493,130	104,521	637,077	173,863	21,960	8,791	2,114	3,394,545,235	3,394,545
13	Banten	Tangerang	7,933,435	496,666	22,450,007	4,002,833	4,311,407	1,470,778	110,848	728,470	10,534,284	467,598	99,109	604,093	164,861	20,846	8,336	2,007	3,214,435,306	3,214,435
14	Jawa Tengah	Semarang	19,739,533	1,235,777	20,821,280	9,959,627	10,727,403	3,663,564	275,805	1,812,540	26,210,820	1,164,741	246,598	1,503,070	410,199	51,869	20,741	4,993	3,218,270,706	3,218,271
15	DI Yogyakarta	Yogyakarta	20,817,358	1,303,253	16,445,655	7,866,595	8,482,412	2,893,661	265,025	1,741,691	25,186,281	1,119,213	236,959	1,444,317	394,165	49,841	19,930	4,798	2,963,627,716	2,963,628
16	Jawa Timur	Surabaya	35,819,796	2,242,468	6,947,383	14,449,879	15,563,803	5,309,382	499,929	3,281,797	47,510,086	2,108,888	446,492	2,724,484	742,709	93,914	37,595	9,040	2,803,465,737	2,803,466
17	Bali	Denpasar	78,553,033	4,917,746	3,095,139	6,437,586	6,941,536	2,368,012	374,423	2,460,638	35,582,858	1,579,460	334,772	2,040,513	556,871	70,415	28,157	6,778	1,470,738,933	1,470,739
18	Nusa Tenggara Barat	Mataram	101,680,934	6,274,649	2,423,124	5,039,862	5,434,395	5,101,847	477,734	3,139,577	45,400,872	2,015,264	427,143	2,603,531	710,523	89,844	35,926	8,648	1,221,990,953	1,221,991
19	Nusa Tenggara Timur	Kupang	7,188,709	88,751,984	147,030	999,207	2,196,244	4,582,146	429,070	2,816,642	40,776,102	1,809,978	383,207	2,338,321	1,111,497	80,603	32,266	7,759	228,339,312	228,339
20	Kalimantan Barat	Pontianak	2,224,619	117,822	110,754,027	5,309,167	5,724,781	1,952,932	122,196	893,138	1,732,009	188,139	109,135	166,234	14,481	22,955	9,189	2,210	984,937,002	984,937
21	Kalimantan Tengah	Palangkaraya	8,129,122	1,406,756	9,327,631	63,039,760	67,899,422	23,162,974	1,449,318	10,604,909	20,542,686	2,231,440	1,295,837	1,971,641	171,758	272,261	108,989	26,208	900,101,875	900,102
22	Kalimantan Selatan	Banjarmasin	5,603,024	1,976,471	6,429,100	43,402,265	98,620,735	32,113,958	2,009,385	14,703,017	28,481,099	3,093,747	1,796,594	2,733,552	238,131	377,472	151,107	36,336	715,906,121	715,906
23	Kalimantan Timur	Samarinda	5,004,480	3,923,187	2,086,597	14,086,427	30,553,013	103,659,241	4,037,410	29,509,720	57,226,395	6,216,192	3,605,857	5,492,461	478,471	758,446	303,615	73,008	420,944,582	420,945
24	Sulawesi Utara	Manado	803,901	630,206	223,972	1,512,011	3,279,504	6,926,082	60,425,911	12,493,877	9,162,143	3,093,747	12,959,290	2,325,408	5,257,421	11,313,625	4,528,986	1,089,056	158,609,509	158,610
25	Sulawesi Tengah	Palu	4,113,573	3,221,204	1,274,638	8,614,500	18,684,576	39,416,827	9,728,121	77,605,311	47,038,849	15,044,393	8,726,875	14,285,098	1,157,993	1,835,586	734,808	176,695	367,163,030	367,163
26	Sulawesi Selatan	Makassar	19,849,152	15,560,445	824,798	5,568,138	12,077,115	25,506,017	2,380,447	15,695,905	232,574,322	10,097,391	2,137,811	13,044,876	3,501,387	449,661	180,005	43,285	917,122,180	917,122
27	Sulawesi Tenggara	Kendari	2,986,798	2,341,455	303,719	2,050,379	4,447,208	9,392,190	2,724,849	17,017,685	34,229,873	68,606,557	2,396,149	4,177,883	5,165,074	503,999	1,760,739	429,058	242,466,927	242,467
28	Gorontalo	Gorontalo	1,553,842	1,216,762	432,430	2,922,531	6,338,877	13,372,442	28,015,513	24,229,495	17,787,923	5,881,305	27,951,546	4,484,781	2,442,925	5,257,015	2,104,449	506,043	188,127,810	188,128
29	Sulawesi Barat	Mamuju	8,582,491	6,728,115	596,886	4,029,522	8,739,906	18,458,065	4,555,473	35,940,640	98,358,721	9,292,509	4,064,042	30,845,290	1,508,928	859,566	344,095	82,742	474,098,898	474,099
30	Maluku	Ambon	2,202,554	3,007,428	48,897	330,096	715,967	1,512,072	9,685,118	2,739,720	24,826,234	10,803,167	2,081,733	1,418,947	32,801,302	6,166,026	4,569,294	1,113,449	165,866,970	165,867
31	Maluku Utara	Terate	435,231	340,815	121,124	817,695	1,773,555	3,745,624	32,569,918	6,786,686	4,982,401	1,647,355	7,000,623	1,263,164	9,635,808	20,989,800	8,309,931	2,000,449	114,638,329	114,638
32	Papua Barat	Sorong	138,929	108,911	38,706	261,304	566,760	1,196,957	10,408,087	2,168,763	1,592,183	4,594,172	2,237,129	403,658	5,700,158	6,633,648	26,293,798	6,294,749	72,540,916	72,541
33	Papua	Jayapura	13,648	10,687	3,798	25,641	55,615	117,455	1,021,322	212,816	156,237	456,848	219,524	39,610	566,828	651,666	2,568,746	64,433,325	70,936,901	70,937

- Accessibility measures for 75% response of β (1 of 2)

Destination		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Origin		Banda Aceh	Medan	Padang	Pekanbaru	Jambi	Palembang	Bengkulu	Bandar Lampung	Pangkal Pinang	Batam	Jakarta	Bandung	Tangerang	Semarang	Yogyakarta	Surabaya	Denpasar	
1	Aceh	Banda Aceh	100,370,334	178,030,172	27,361,584	33,725,449	10,190,239	16,421,764	3,174,818	9,075,155	379,096	14,677,187	22,619,932	32,422,449	12,314,016	15,296,259	1,371,386	10,848,174	676,002
2	Sumatera Utara	Medan	45,717,714	390,853,924	39,108,275	52,090,227	15,652,288	25,223,958	4,309,223	13,103,605	546,871	30,940,439	32,630,760	46,771,544	17,763,789	22,065,874	1,978,316	15,649,215	975,178
3	Sumatera Barat	Padang	21,172,828	117,846,153	129,708,289	89,464,771	34,939,277	66,850,813	17,477,626	38,617,268	1,613,158	9,424,031	96,254,003	137,966,396	52,399,508	65,089,772	5,835,622	46,161,952	2,876,572
4	Riau	Pekanbaru	22,481,944	135,220,170	77,070,919	150,566,810	45,284,717	73,044,567	12,432,837	37,910,947	1,582,192	10,743,774	94,406,312	135,317,995	51,393,647	63,840,309	5,728,887	45,275,828	2,823,959
5	Jambi	Jambi	11,035,234	66,006,099	48,896,010	73,565,245	92,684,737	149,501,132	20,390,306	77,664,408	3,241,279	5,278,437	193,400,879	277,212,597	105,285,084	130,783,330	11,725,377	92,752,112	5,779,828
6	Sumatera Selatan	Palembang	7,072,512	42,303,496	37,206,856	47,191,710	59,456,762	233,051,256	20,674,568	119,844,938	5,001,660	3,398,614	298,439,362	427,375,652	162,466,755	201,813,424	18,093,579	142,994,924	8,918,927
7	Bengkulu	Bengkulu	7,656,786	40,470,227	54,471,886	44,980,235	45,410,282	115,773,754	41,617,671	85,805,162	3,584,336	3,188,918	213,870,392	306,269,916	116,428,438	144,491,989	12,966,389	102,474,353	6,391,564
8	Lampung	Bandar Lampung	4,198,515	23,607,040	23,087,959	26,310,563	33,179,247	128,738,195	16,459,910	216,952,036	9,037,670	10,933,845	539,260,294	772,239,687	293,566,739	364,327,158	32,693,907	258,382,420	16,115,914
9	Kepulauan Bangka Belitung	Pangkal Pinang	904,667	5,081,988	4,974,833	5,663,987	7,142,638	27,714,020	3,546,667	46,618,055	42,059,689	5,229,942	246,536,351	356,322,377	123,627,209	168,105,733	15,085,434	119,221,324	7,436,112
10	Kepulauan Riau	Batam	14,382,168	118,063,894	11,933,851	15,792,914	4,776,280	7,732,668	1,295,679	23,158,628	2,147,529	102,429,214	122,585,888	177,338,674	61,471,467	83,664,821	7,500,968	59,335,458	3,697,477
11	DKI Jakarta	Jakarta	2,878,390	16,169,427	15,828,491	18,021,181	22,725,824	88,178,056	11,284,476	148,325,268	13,146,193	15,919,055	788,763,910	1,114,007,239	358,004,723	525,566,217	47,119,631	372,733,870	23,226,832
12	Jawa Barat	Bandung	2,285,273	12,837,579	12,566,895	14,307,763	18,042,974	69,943,627	8,950,948	117,652,937	10,524,369	12,755,992	617,052,296	1,424,010,107	311,430,396	529,461,286	57,781,507	375,496,269	23,398,971
13	Banten	Tangerang	2,994,925	16,824,068	16,469,328	18,750,793	23,645,909	91,748,062	11,741,343	154,330,415	12,599,725	15,257,324	684,253,037	1,074,620,239	412,685,351	506,516,501	45,453,662	359,223,727	22,405,621
14	Jawa Tengah	Semarang	1,397,292	7,849,322	7,683,817	8,748,242	11,032,074	42,805,348	5,472,907	71,936,915	6,434,949	7,799,437	377,286,277	686,189,105	190,243,220	1,098,761,577	90,323,003	767,823,399	47,890,935
15	DI Yogyakarta	Yogyakarta	1,250,794	7,026,364	6,878,211	7,838,268	9,875,421	38,317,442	4,903,627	64,454,186	5,765,599	6,981,709	337,729,874	747,691,604	170,454,513	901,825,273	110,047,310	742,729,860	50,060,355
16	Jawa Timur	Surabaya	854,351	4,799,336	4,698,141	5,348,966	6,745,376	26,148,467	3,346,317	43,984,620	3,934,542	4,768,835	230,685,366	419,558,819	116,321,026	661,970,999	64,133,431	1,274,458,928	78,688,000
17	Bali	Denpasar	441,195	2,478,423	2,426,165	2,764,807	3,483,376	13,515,785	1,729,666	22,735,049	2,033,711	2,462,672	119,128,109	216,664,150	60,124,749	342,163,762	35,822,063	652,096,075	153,788,113
18	Nusa Tenggara Barat	Mataram	361,450	2,030,452	1,987,639	2,265,072	2,853,761	11,072,827	1,417,031	18,625,723	1,666,121	2,017,547	97,595,882	177,502,430	49,257,290	280,318,175	29,347,279	534,230,688	124,029,682
19	Nusa Tenggara Timur	Kupang	40,256	226,142	221,373	252,040	317,838	1,232,099	157,676	2,072,528	185,393	224,704	10,869,749	19,769,346	5,480,973	31,191,655	3,265,540	59,445,091	13,801,071
20	Kalimantan Barat	Pontianak	801,637	4,503,216	4,408,265	5,018,933	6,329,185	24,557,757	3,139,849	41,270,760	3,827,091	4,634,321	218,257,552	315,450,641	109,143,995	272,914,569	22,455,487	126,826,682	7,801,712
21	Kalimantan Tengah	Palangka Raya	304,432	1,710,154	1,674,095	1,907,764	2,403,589	9,326,123	1,193,499	15,687,573	1,403,295	1,699,286	82,200,436	149,501,975	41,487,107	236,098,857	19,426,280	373,422,558	22,970,996
22	Kalimantan Selatan	Banjarmasin	223,257	1,254,154	1,227,710	1,397,782	1,762,690	6,839,382	874,454	11,493,985	1,028,168	1,246,184	60,282,303	109,638,389	30,396,810	172,985,123	14,246,407	273,599,576	16,845,951
23	Kalimantan Timur	Samarinda	87,407	491,011	480,658	547,243	690,107	2,677,671	342,355	4,504,140	402,907	487,891	23,600,990	42,924,280	11,900,587	67,787,556	5,577,579	107,116,358	6,595,321
24	Sulawesi Utara	Manado	15,892	89,275	87,392	99,499	125,474	486,849	62,246	818,179	73,188	88,707	4,291,089	7,804,414	2,163,743	12,313,639	1,192,977	23,445,697	2,223,511
25	Sulawesi Tengah	Palu	61,948	347,997	340,660	387,851	489,103	1,896,011	242,640	3,189,300	285,291	345,786	16,726,868	30,421,977	8,434,373	47,999,149	4,650,279	91,308,125	8,667,351
26	Sulawesi Selatan	Makassar	229,950	1,291,749	1,264,512	1,439,682	1,815,528	7,044,399	900,666	11,838,528	1,058,988	1,283,539	62,089,321	112,924,902	31,307,983	178,170,513	17,261,612	339,244,298	32,172,785
27	Sulawesi Tenggara	Kendari	47,445	266,521	260,901	297,043	374,590	1,453,440	185,831	2,444,847	218,698	264,827	12,810,619	23,299,302	6,459,640	36,795,090	3,564,802	69,994,796	6,638,070
28	Gorontalo	Gorontalo	27,522	154,608	151,348	172,314	217,299	842,359	107,800	1,416,941	126,749	153,625	7,431,405	13,515,861	3,747,219	21,325,039	2,066,024	40,566,330	3,850,726
29	Sulawesi Barat	Mamuju	114,339	642,299	628,756	715,857	902,740	3,502,704	447,841	5,886,501	526,563	638,217	30,872,829	56,149,932	15,567,347	88,592,171	8,583,034	168,683,293	15,997,354
30	Maluku	Ambon	36,809	206,775	202,415	230,456	290,619	1,126,584	144,173	1,995,039	169,516	205,461	9,938,880	18,076,329	5,011,591	28,520,448	2,763,133	54,254,058	5,150,023
31	Maluku Utara	Temate	9,522	53,538	52,361	59,669	75,177	291,692	37,329	490,659	43,891	53,148	2,570,975	4,675,959	1,297,588	7,384,442	715,423	14,047,323	1,333,431
32	Papua Barat	Sorong	3,680	20,672	20,236	23,040	29,054	112,734	14,414	189,456	16,963	20,541	993,634	1,807,171	501,031	2,851,316	276,243	5,429,028	514,871
33	Papua	Jayapura	532	2,987	2,924	3,332	4,198	16,288	2,084	27,399	2,451	2,968	143,566	261,111	72,459	412,356	39,950	784,420	74,460

Accessibility measures for 75% response of β (2 of 2)

Origin	Destination	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Ai (Million Rupiahs)	Ai (Billion Rupiahs)	
		Mataram	Kupang	Pontianak	Palangkaraya	Banjarmasin	Samarinda	Manado	Palu	Makassar	Kendari	Gorontalo	Mamuju	Ambon	Ternate	Sorong	Jayapura			
1	Aceh	Banda Aceh	366,169	35,597	884,569	191,205	219,366	90,271	47,898	532,831	32,430	7,665	35,138	12,029	1,991	964	341	491,422,048	491,422	
2	Sumatera Utara	Medan	528,223	51,350	1,276,050	275,826	316,450	130,222	13,802	69,096	768,644	46,782	11,057	50,689	17,353	2,875	1,391	492	758,941,501	758,942
3	Sumatera Barat	Padang	1,558,150	151,473	3,764,085	813,630	933,461	384,128	40,713	203,819	2,267,342	137,998	32,615	149,521	51,188	8,473	4,102	1,452	944,200,193	944,200
4	Riau	Pekanbaru	1,529,651	148,566	3,691,830	798,748	915,543	376,755	39,931	199,906	2,223,818	135,349	31,989	146,651	50,205	8,318	4,023	1,426	975,428,523	975,429
5	Jambi	Jambi	3,130,754	304,352	7,563,087	1,634,807	1,875,582	771,820	81,803	409,528	4,555,715	277,277	65,532	300,430	102,851	17,025	8,242	2,918	1,386,303,819	1,386,304
6	Sumatera Selatan	Palembang	4,831,106	469,215	11,670,696	2,522,692	2,894,234	1,191,006	126,231	631,365	7,029,983	427,869	101,030	463,597	158,564	26,271	12,719	4,503	1,867,866,079	1,867,866
7	Bengkulu	Bengkulu	3,462,112	336,254	8,355,847	1,807,835	2,072,179	852,722	90,377	452,455	5,033,244	306,341	72,401	331,921	113,631	18,827	9,106	3,227	1,369,170,778	1,369,171
8	Lampung	Bandar Lampung	8,729,491	847,841	21,068,725	4,558,339	5,224,866	2,152,069	227,881	1,140,836	12,690,997	773,132	182,555	836,917	286,514	47,471	22,961	8,137	2,827,889,831	2,827,890
9	Kepulauan Bangka Belitung	Pangkal Pinang	4,027,911	391,206	10,077,719	2,103,282	2,410,827	992,995	105,147	526,398	5,855,807	356,734	84,233	386,165	132,202	21,904	10,604	3,755	1,212,757,919	1,212,758
10	Kepulauan Riau	Batam	2,002,809	194,700	5,010,969	1,045,820	1,199,849	493,749	52,331	261,984	2,914,386	177,380	41,922	192,191	65,796	10,891	5,273	1,867	830,979,494	830,979
11	DKI Jakarta	Jakarta	12,581,256	1,223,068	30,646,563	6,569,641	7,537,217	3,101,639	328,733	1,645,732	18,307,610	1,114,266	263,348	1,207,308	413,315	68,416	33,123	11,728	3,666,951,745	3,666,952
12	Jawa Barat	Bandung	12,674,498	1,232,132	24,534,537	6,618,330	7,593,077	3,124,626	331,170	1,657,929	18,443,291	1,122,524	265,300	1,216,256	416,378	68,923	33,369	11,815	3,697,843,341	3,697,843
13	Banten	Tangerang	12,136,431	1,178,736	29,291,413	6,337,364	7,264,023	2,989,216	316,818	1,586,080	17,644,031	1,073,878	253,802	1,163,548	398,334	65,997	31,923	11,313	3,551,262,941	3,551,263
14	Jawa Tengah	Semarang	25,941,036	2,519,492	27,509,505	13,545,810	15,526,498	6,395,206	677,183	3,390,170	37,713,265	2,297,482	542,491	2,487,028	851,420	141,066	68,233	24,181	3,569,307,886	3,569,308
15	DI Yogyakarta	Yogyakarta	27,116,144	2,633,623	22,599,694	11,128,196	12,767,156	5,253,809	655,052	3,279,375	36,480,743	2,222,397	524,761	2,405,749	823,595	136,456	66,003	23,391	3,341,946,550	3,341,947
16	Jawa Timur	Surabaya	42,622,853	4,139,694	11,021,592	18,470,951	21,171,801	8,712,403	1,111,631	5,560,003	61,908,243	3,767,953	889,704	4,082,584	1,396,360	231,353	112,008	39,658	3,135,684,311	3,135,684
17	Bali	Depasar	82,005,388	7,964,676	5,618,581	9,416,112	10,802,916	4,445,506	873,654	4,373,761	48,655,019	2,961,316	699,883	3,208,590	1,098,443	181,994	88,030	31,197	1,816,282,933	1,816,283
18	Nusa Tenggara Barat	Mataram	101,680,934	9,757,852	4,581,838	7,678,646	8,809,556	8,427,670	1,070,350	5,358,475	59,609,268	3,628,030	857,456	3,930,976	1,345,748	222,968	107,849	38,221	1,553,684,883	1,553,685
19	Nusa Tenggara Timur	Kupang	11,179,328	88,751,984	443,506	1,993,648	4,140,587	7,705,937	978,687	4,895,063	54,504,419	3,317,331	783,301	3,594,333	1,953,914	203,685	98,613	34,915	333,332,726	333,333
20	Kalimantan Barat	Pontianak	4,206,488	355,400	110,754,027	8,019,077	9,200,126	3,785,942	343,625	1,879,667	3,919,392	502,874	275,023	397,008	52,479	71,515	34,624	12,259	1,315,151,178	1,315,151
21	Kalimantan Tengah	Palangkaraya	12,385,388	2,806,804	14,088,650	63,039,760	72,257,528	29,734,680	2,698,818	14,776,481	30,782,791	3,949,560	2,162,020	3,118,086	412,172	561,680	271,933	96,282	1,215,560,654	1,215,561
22	Kalimantan Selatan	Banjarmasin	9,082,916	3,726,248	10,332,016	46,188,028	98,620,735	39,040,275	3,543,424	19,400,844	40,416,396	5,185,591	2,838,633	4,093,904	541,164	737,460	357,036	126,414	989,573,412	989,573
23	Kalimantan Timur	Samarinda	8,266,830	6,597,744	4,045,065	18,082,972	37,142,666	103,659,241	6,338,058	34,669,918	72,292,063	9,275,371	5,072,726	7,322,690	967,969	1,319,082	638,624	226,115	592,131,196	592,131
24	Sulawesi Utara	Manado	1,801,118	1,437,469	629,826	2,815,561	5,783,200	10,872,791	60,425,911	16,939,331	15,706,926	5,185,591	14,730,540	3,577,784	7,133,333	12,541,116	6,071,692	2,149,778	223,183,737	223,184
25	Sulawesi Tengah	Palu	7,020,843	5,598,155	2,682,557	12,003,120	24,654,569	46,309,425	13,189,490	77,605,311	61,396,111	19,373,429	10,595,382	16,240,554	2,021,793	2,755,161	1,333,891	472,285	519,046,784	519,047
26	Sulawesi Selatan	Makassar	26,061,028	20,799,267	1,866,450	8,343,740	17,138,155	32,220,842	4,080,869	20,486,631	232,574,322	13,896,387	3,281,271	15,056,757	5,083,724	853,242	413,091	146,261	1,203,640,993	1,203,641
27	Sulawesi Tenggara	Kendari	5,377,058	4,291,422	811,808	3,629,089	7,454,197	14,014,374	4,567,261	21,914,537	47,108,365	68,606,557	3,608,521	5,829,908	7,028,764	938,339	2,763,045	989,195	364,308,903	364,309
28	Gorontalo	Gorontalo	3,119,217	2,487,145	1,089,741	4,876,052	10,015,477	18,812,374	31,844,616	29,417,259	27,302,222	8,857,048	27,951,546	6,184,660	3,766,232	6,621,413	3,205,710	1,135,032	282,558,915	282,559
29	Sulawesi Barat	Mamuju	12,958,390	10,342,072	1,425,507	6,372,557	13,089,317	24,608,765	7,008,877	40,860,475	113,528,358	12,966,968	5,604,447	30,845,290	2,520,803	1,464,089	708,828	250,972	683,007,493	683,007
30	Maluku	Ambon	4,171,690	5,286,795	177,198	792,141	1,627,068	3,058,993	13,140,885	4,783,405	36,045,634	14,701,224	3,209,385	2,370,482	32,801,302	7,562,625	6,116,690	2,189,830	266,257,659	266,258
31	Maluku Utara	Temate	1,080,123	861,250	377,356	1,686,923	3,464,963	6,514,356	36,103,648	10,186,619	9,454,223	3,067,022	8,817,556	2,151,532	11,818,308	20,989,800	10,068,700	3,568,273	163,402,780	163,403
32	Papua Barat	Sorong	417,062	332,857	145,841	651,964	1,339,144	2,517,677	13,953,386	3,936,938	3,653,881	7,209,420	3,407,821	831,527	7,630,522	8,037,637	26,293,798	9,275,424	102,458,982	102,459
33	Papua	Jayapura	60,315	48,093	21,072	94,200	193,488	363,770	2,016,073	568,834	527,936	1,053,264	492,383	120,144	1,114,785	1,162,401	3,785,093	64,433,325	77,908,662	77,909