Consideration of (Inter)national or Regional Freight Transport Models and Its Performance Indicators In Kalimantan Island

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Abstract: Trade has increased in last couple decade amongst ASEAN countries, on international or regional scale, and highly depend on networks which sharing enhances complementarians and degrees of specialization among in the region. Kalimantan island has unique characteristic, because politically divided among three countries: Indonesia, Malaysia, and Brunei Darussalam. This paper will elaborate (inter)national or regional freight flow between West Kalimantan and Sarawak (Malaysia). There are six freight transportation models that are discussed in this paper and activity-based model can be a more valid and reliable choice of decision tools because as an improvement on the previous method. The second part is about performance of international freight. From the analysis conducted, it can be concluded in that performance of international freight in Kalimantan Island needs to be improved. To improve the performance of freight transport is to strengthen transportation network infrastructure and efficiency in freight transport system.

Keyword: (Inter)national Freight Transport; Activity-Based Model; Performance Indicator

1. INTRODUCTION

Trade has increased in last couple decade amongst ASEAN countries, on (inter)national or regional scale, and highly depend on networks which sharing enhances complementarians and degrees of specialization among in the region and ultimately augments intra-industry trade (Shujiro 2004). Indonesia is an archipelagic state situated geographically in the South - east Asia with its ten immediate neighbors. Indonesia is made up of an estimated 17,000 separate islands and makes Indonesia the world's largest country that is comprised of islands. Therefore, it has international land and maritime boundaries with the ten countries, i.e. Malaysia, Singapore, Vietnam, the Philippines, Palau, Papua, New Guinea, Australia, Timor - Leste, India, and Thailand (Sobar Sutisna, Sri Handoyo, 2006)

Kalimantan Island with an area 287,000 km2 which is the third-largest island in the world and the largest island in Asia. This island has unique characteristic, because politically divided among three countries: Indonesia, Malaysia, and Brunei Darussalam. With this characteristic, interaction in social, economy, and culture is unenviable. Although the above-mentioned conditions are relatively common in other parts of the world, in research in Indonesia, inter(national) or regional freight is a rare study given that almost all parts of Indonesia are bounded by the sea with neighboring countries.

Because Kalimantan has area much larger than others, Indonesia, i.e. Kalimantan has role as supplier to other neighborhood countries. Kalimantan island is consisted of five provinces in Indonesia territory: North Kalimantan, Central Kalimantan, East Kalimantan, West Kalimantan, and South Kalimantan. In Sanggau regency, which one of regency border in West Kalimantan, there is a cross-border checkpoint (PPLB) which improved with immigration, customs, quarantine and handler smuggling (Saru Arifin, SH. 2012). This paper will elaborate international freight flow between West Kalimantan and Sarawak (Malaysia).

In 2014, export value from West Kalimantan to Malaysia was US $54,166,184 or equivalent to 8,31% of the total export value. That value increase in 2015 and reach US$ 112,465,965 or equivalent to 13,96% of the total export. In 2014, import value from Malaysia to West Kalimantan was 71,585,638. In 2015, total import value West Kalimantan from Malaysia was US $65,986,926 or equivalent 10,51% of total import value (Central-Bureau-of-Statistic 2015). From data of the highest export value we could withdraw conclusion that rubber, timber still become main import commodities from Sarawak, Malaysia. Since international trade is depend on government policy whereas trade flow affect the flow of freight it is important to analyze international cross-border freight flow in Kalimantan, especially West Kalimantan. There are eight ports which exported commodities from West Kalimantan. Four ports are marine port, one is airport and three port are located at border. If in 2014, Entikong become the border-port with largest tonnage of export commodities, it changed in 2015 when Nanga Badau began operations.

2. LITERATUR REVIEW

We need transport model to answer the questions about how the performance of transportation system in the future and what policy, investment, demography or land use changes could affect that performance. Most freight transport models that are used by national, international, and regional authorities are lacking important aspects of coordination decision-making such as the choice of shipment size and the use of consolidation and distribution centers (Ben-Akiva et al. 2013). Ben-Akiva and de Jong (2013), after classifying freight transport models in categories, national, international and regional, using the term (inter) national as a regional equivalent. This naming is the underlying author using the term. Freight demand modelling may play a particularly important role in developing countries where the effort to increase exports and to gain access to underdeveloped areas are even more urgent (Ortúzar & Willumsen 2011).

Freight transport models are used to assess the impacts of different types of policy measures, such as changes in national regulations and taxes or infrastructure investments in specific links, nodes and corridors (de Jong et al. 2013).

Many scholars distinguish two kinds of trades in scope of regional i.e. regional trade and regional border trade. The regional trade indicates trade flows between countries within a region such as East, South, or Southeast Asia. Regional border trade defines trade between countries across regions. Most importantly, the regional border effect may capture all time-invariant factors that facilitate trade among countries in a region. For example, in a gravity model framework, the regional border effect on South Asia implies some intrinsic factors captured by the regional border facilitate or impede regional trade in South Asia. That is, after controlling for the gravity variables, regional trade in South Asia is larger than regional border trade between South Asia and other Asian regions. Especially since 1990, many Asian countries have become involved in regional trade agreements (RTAs). As a result, there are more than 30 RTAs in Asia, both multilateral and bilateral, currently in force (Lee & Bae 2013). When forming an RTA, members agree to lower trade barriers to each other but their tariffs on imports from outsiders remain unconstrained (Hector Calvo-Pardo 2009). Differently from the European case (Perkmann 2003), cross-border regionalism in Southeast Asia is mostly an economic top-down approach and the state government is a leading actor in pursuing border economic activities and encouraging companies to relocate their labor-intensive industries to various ASEAN countries (Debrah et al. 2000). Beside cooperation in form of growth triangles (refer to the Johor-Singapore-Riau triangle there is the Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA), the main aim pursued by this cooperation are cross-border investment, construction of road, improvement of transport systems. Indonesia and Malaysia have another cooperation framework that known as Sosek Malindo (social and economy cooperation between Malaysia and Indonesia).

2.1 Gravity

In 1857 Henry Carey gave the basis for most predictions of the quality and quantity of the travel produced by various land uses when he suggested that it could be predicted by an inverse square law by analogy to Newtonian physics and the "great law of molecular gravitation (Button & Hensher 2005). The gravity model was also the basis of the Lowry model introduced in 1964 (Lowry 1964), which directly linked transport to employment, services, and residential location (Egger & Pfaffermayr 2016). Trade flow data and commercial vehicle survey data have relationships. Because in many studies, since trade flow data are rarely available, its estimation use transportation flow or commercial vehicle survey data. Akin to Newton's law of gravity, it specifies bilateral exports (or imports) between two countries as a multiplicative function of exporter mass (supply potential), importer mass (demand potential), and bilateral impediments (trade costs or preferences) for aggregate, sector-level, or even firm-level trade flows (Egger & Pfaffermayr 2016). The basic hypothesis underlying a gravity model is that the probability that a trip of a purpose *k* produced at zone *i* will be attracted to zone *j* is proportional to the attractiveness or pull of zone *j*, which depends on two factors: the magnitude of activities related to the trip purpose k in zone *j*, and the spatial separation of the zones *i* and *j* (Kutz 2003). The gravity model, computes the number of trips between origin *i* and destination *j* (T_{ij}) as simple function of the sizes of the origin and destination (P_i and P_j), and the distance between them (d_{ij}) using a scaling factor k (Sivakumar 2007).

Voorhees well known as a researcher who introduced the application of the gravity model concept for the trip distribution step of the stepwise travel forecasting procedure (Voorhees 1955). This application is based on the assumption that the effect of spatial separation with respect to trip making is proportional to the inverse of the square of travel time between the respective pairs of zones (Kutz 2003). The next major advance in the macroeconomic modelling of spatial flows was the development of the entropy maximization theory (Wilson, 1974), which give rise to a family of spatial interaction models including the gravity model, the production- constrained model, the attraction-constrained model, and the doubly-constrained model (Sivakumar 2007).

It is difficult to find literature about freight transportation at international level because very few works have been developed and most of them are simple models that neglect modal split and path choice (Nuzzolo et al. 2009). In 2004, using the estimation of gravity models has turned increasingly structural since the publication of the paper by Anderson and van Wincoop (2004). The benefit from this model is that empirical models which based on few parameter explain data on bilateral trade flow relatively well, while being consistent with general equilibrium (Egger & Pfaffermayr 2016). So, if study will be conducting on freight flow between West Kalimantan and Sarawak (Malaysia) which has characteristic as bilateral trade flow this model could be use and will give good result.

2.2 Multi-Regional I/O Framework

Assessment is used in Transport infrastructures planning and become important thing for researcher, both at a national and international scale. Cascetta et al (see Ben-Akiva et al. 2013) proposed the multi-regional input-output (MRIO) approach is well-developed in its theoretical foundations and widely adopted in the practice: up-to-date and exhaustive reviews are reported amongst others in Juri and Kockelman (2005) and Cascetta, Marzano, and Papola (2008). There are at least two significant improvement was made in multi-regional input output to make it better model transport demand.

In multiple regions case with interacting economies, the original extension of the Leontief input-output model to the case of multiple regions with interacting economies (see Isard 1951) was mainly aimed at modelling the economic system, but several significant improvements were made over the years to better model transport demand:

1) The integration with random utility models for the estimation of trade coefficients (RUBMRIO), addressed amongst others in (de la Barra 1989), Cascetta (2001) and Jin, Kockelman, and Zhao (2003);
2) The taxonomy of several MRIO formulations accordingly with the assumptions on import/export flows to/from the external of the study area, as analyzed in Marzano and Papola (2004) and Cascetta et al. (2008);

These improvements successfully made MRIO models be a reliable and stable modelling tool, useful as a freight demand model (i.e. providing o-d flows as a function of economic and transport variables) and as a basic macroeconomic impact model (i.e. providing production and GDP as a function of economic and transport variables), as described in detail by Cascetta et al. (2008). In 2015 publish paper, the MRIO framework which compared with observed commodity flows in transportation survey data are converted to production-consumption trade flow show consistent result (Bachmann et al. 2015). Bachmann also make a conclusion that it is possible to create a balanced multi-regional input–output model based on a commercial vehicle survey and the limited supplementary data available at the regional level.

2.3 NEG Theory and Spatial General Equilibrium Models

2.3.1 NEG Theory

Paul Krugman who was awarded the Nobel Prize in economics for his work on the ‘analysis of trade patterns and location of economic activity’, laid the foundation for the new economic geography (NEG) theory (Krugman 2010). Since distance and associated transport costs play a central role in the explanation of agglomeration patterns NEG theory is currently used in several models that predict changes in international and inter-regional freight demand flows. The spatial patterns of production and consumption activities give rise to international and inter-regional trade and freight transportation flows. Cascetta et al (2008) described methodology of modelling freight demand in two steps:

1) representation of spatial distribution of economic activities that is spatial demand and supply of commodities and their changes as response to policies and macroeconomic trends;

2) given the spatial distribution of demand and supply for various commodities the trade flows between countries and/or regions are calculated based on models of micro or representative economic behavior of the trader.

2.3.2 Spatial General Equilibrium Models

Ivanova (Lorant & de Jong 2014) proposed the main approaches that are used for modelling of trade flows between regions and hence freight demand given a particular spatial distribution of supply and demand include:

1) structural spatial models and in particular gravity model;
2) discrete choice models, such as logit and nested logit;
3) (nested) constant elasticity of substitution (CES) functions used as a part of spatial computable general equilibrium (SCGE) models.

There is many research conducted in effort to model trade flow and freight flow and developed methodologies to forecast the future trade flows with considering macroeconomic and policy changes. Using the relationship between them, data on trade in goods and services could derived from freight transport data (Thissen et al. 2014). It is in line with the study's result that if trade data are rarely available, many trade flow estimation techniques use transportation commodity flow or commercial vehicle survey data (Bachmann et al. 2015).

The forecasting of the trade flows is done with the use of econometric models, such as spatial interaction models and the gravity model (Lorant & de Jong 2014). Economists first developed and used MRIO tables for multi-regional economic impact assessment (e.g., multipliers, spillover effects, etc.) and more recently used these tables to develop spatial computable general equilibrium (SCGE) models for economic simulations (see Rose 1995) for a discussion on the relationship between IO and computable general equilibrium (CGE) models) This model could replacing the conventional I/O and gravity type approach because a logical step in model development would be to connect such a model to a model of the rest of the freight transport system (Hancock 2006).

The advantage of using SCGE models for the calculation of the trade flows is that they allow for endogenous calculation of impacts of transport costs and trade tariffs on the regional price levels, production, and income distribution between the regions (Lorant & de Jong 2014). Many experience with SCGE models for instance for Goods Flows in Sweden (Ian 2002), in Japan. In addition, Mahmudah (2010) proposed spatial location modelling/mapping, especially in determination of factories/industries location, in formulating the freight transportation planning for regional scale.

2.4 The Aggregate-Disaggregate-Aggregate (ADA) Freight Model System

Most freight transport models that are used by national, international, and regional authorities are lacking important aspects of logistics decision-making such as the choice of shipment size and the use of consolidation and distribution centers (DCs) (Ben-Akiva et al. 2013).
The recently developed aggregate–disaggregate–aggregate model (ADA) integrates different types of decisions – the choice of ship- ment size by shippers and the choice of transport chain of forward-ers in one combined disaggregate multi-linear Logit model that is based on the total logistics cost (TLC) function (Ben-Akiva and De Jong, 2008).

Disaggregated Modal Split Models represent the shipping firm's decision-making process (Reis 2014). The widely-recognized behavior oriented approaches within the aggregate multi-step framework have been established in the area of transport mode choice where disaggregated mode choice models are estimated using data on stated preference and/or revealed preference expressed by shippers regarding the choice of the transport services usually calibrated separately for different shipment sizes (de Jong et al. 2004).

In the ADA model system, the production to consumption (PC) flows and the network model are specified at an aggregate level for reasons of data availability. Between these two aggregate components is a logistics model that explains the choice of shipment size and transport chain, including mode choice for each leg of the transport chain. This logistics model is a disaggregate model at the level of the firm, the decision-making unit in freight transport. Figure 1 is a schematic representation of the structure of the freight model system. The boxes indicate model components. The top level of Figure 1 displays the aggregate models. Disaggregate models are at the bottom level. So, in the ADA model system, we first have an aggregate model for the determination of PC flows, then a disaggregate ‘‘logistics’’ model, and finally another aggregate model for network assignment.

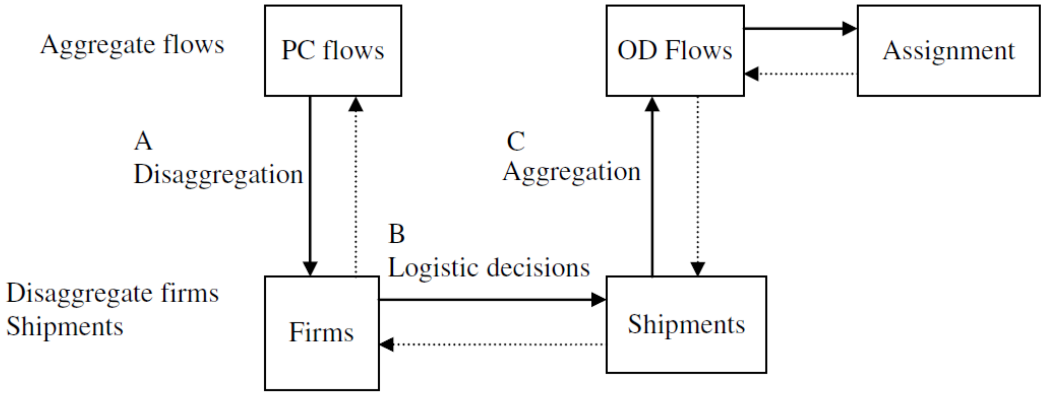


Figure 1. ADA Structure of the (Inter)national/ regional Freight Transport Model System ((Ben-Akiva et al. 2013).

The model system starts with the determination of flows of goods between production (P) zones and consumption (C) zones (being retail for final consumption; and further processing of goods for intermediate consumption). These models are commonly based on economic statistics (production and consumption statistics, input–output tables, trade statistics) that are only available at the aggregate level (with zones and zones pairs as the observational units). Indeed, to our knowledge, no models have been developed to date that explain the generation and distribution of PC flows at a truly disaggregate level (Ben-Akiva et al. 2013).

2.5 Dynamic Optimization and Differential Stackelberg Game Applied to Freight Transport

Transportation network design analyzes how changes to the transportation system impact freight flows. There are three approaches common to use to predict freight flows including the econometric model, the spatial price equilibrium model, and the freight network equilibrium model (see Harker & Friesz 1986))

The shipper–carrier model studies the interaction between two groups of players: shippers, who are decision makers that ship a commodity to markets within a network, and carriers, who are decision makers that provide transportation services to the shippers (Ben-Akiva et al. 2013). The carriers’ ability to provide service will be impacted by the scale of services, and a theoretically precise model must capture the behavior of both types of decision makers simultaneously. The dynamic shipper–carrier problem is modeled as a differential Stackelberg game. The shippers act as followers operating under the Cournot–Nash behavioral assumption while competing on the sale of a homogenous product in several markets. The leader in this problem is a transportation company referred to as the carrier who seeks to maximize its objective function while considering the followers' reactions. (Moshe Ben Akiva et al). The differential Nash game describing the shippers' competition may be articulated as a differential variation inequality (DVI). The DVI is then reformulated as a nonlinear complimentarily problem (NCP) to characterize the follower's Cournot–Nash equilibrium by the implicit solution of a system of equations. Game theory provides a framework for modeling the interaction between groups of players whose utility functions and set of feasible strategies are related (Fisk 1984).

2.6 Activity Based Freight

The four-step model as the conventional approach is the state-of-the-practice in the modelling of freight transport (Cambridge Systematics, Inc. et al., 2008). It became state-of-the practice because the simplicity of aggregate models to be developed based upon non-intensive data (Pendyala et al., 2000).

The freight transportation modeling literature lacks appropriate ''actor-based'' micro-level models, and thus, the role of actual decision-makers is mostly overlooked (Liedtke & Schepperle 2004). Many others have emphasized the need for a better understanding of decision-making processes (Southworth, 2003; Wisetjindawat et al., 2005; Hensher and Figliozzi, 2007; de Jong and Ben-Akiva, 2007; Roorda et al., 2010).

The agent-based approach could use in commodity transport modelling to assess the effect of behavior-oriented transport policy measures (Liedtke 2009). Simulation-based models could better account for the complex interactions among many agents by replicating the individual behavior of the decision-makers (Wisentjidawat et al. 2005). Hereupon, researchers have tried to address the previously mentioned gaps in the freight transportation modeling literature. In a general classification, applied models in the statewide freight transportation can be categorized as (1) vehicle-based, (2) commodity- based, (3) agent-based, and (4) integrated models (Samimi et al. 2014).

Logistic freight mode choice models are occasionally discussed, as well Tavasszy et al. (1998), for instance, developed Strategic Model for Integrated Logistic Evaluations (SMILE) to enable decision-makers to forecast freight flows related to the Netherlands. The SMILE covers three levels, namely production, inventory, and multimodal transportation to find interaction of socioeconomic trends and performance of logistics. Transportation cost and time were considered as the dominant factors in the earlier studies (Hummels 2007) while accessibility, flexibility, and experience with each mode become trendier in the recent behavioral models (Samimi et al. 2011). Although there are useful findings in the literature of freight microsimulation, a clear majority of them deal with urban freight movements (Wisetjindawat & Sano 2003).

Samimi et al. (2014) point that such studies can be valuable for urban transportation planning, but not adequate for effective policy making and infrastructure investment planning for freight since the decision-makers tend to look at, as they should, freight issues from inter-regional, national, or even international perspectives. Beside the limited geographical coverage, many previous efforts only focused on the truck movements (Holguín-Veras and Thorson, 2003).

Freight Activity Microsimulation Estimator lays the foundation for the development of a more behaviorally realistic and credible activity-based freight demand model, capable of analyzing a variety of policies. Developing a nationwide freight microsimulation could be rewarding and provides advantageous insights for future infrastructure investments, a big picture of freight modal shift, and a better understanding of potential impacts of freight activities in a larger scale (Samimi et al. 2014).

Zhou and Dai (2012) have shown advantages and disadvantages of each type of freight movement models based and drawn conclusion that commodity-based models are less welcomed compared to other types of model particularly integrated ones. Furthermore, Chow et al. (2010) point out that if data requirements are addressed, the activity-based approach is one of the practical, behavioral, and reliable freight forecasting models.

Freight Activity Microsimulation Estimator was introduced as a freight activity-based modeling framework (Samimi et al. 2014) with five basic modules, a modular structure of which is illustrated in Fig. 2. Four categories of data are required for developing FAME: information on business establishments, aggregate freight movements, detailed information on a sample of individual shipments and supply chains, and specifications of the transportation networks. A complete database of firms with their primary characteristics is required in the first module to identify all individual freight decision-makers (in this case, firms) in the study area and to introduce their characteristics to the model (Samimi et al., 2010).

There are several well-known agent-based transportation modelling platform, including but not limited to, Transportation Analysis and Simulation System (TRANSIMS), Multi-Agent Transport Simulation Toolkit (MATSim), Sacramento Activity-Based Travel Demand Simulation Model (SACSIM), Simulator of Activities, Greenhouse Emissions, Networks, and Travel (SimAGENT), Open Activity-Mobility Simulator (OpenAMOS), and Integrated Land Use, Transportation, Environment (ILUTE) (Zheng et al. 2014).

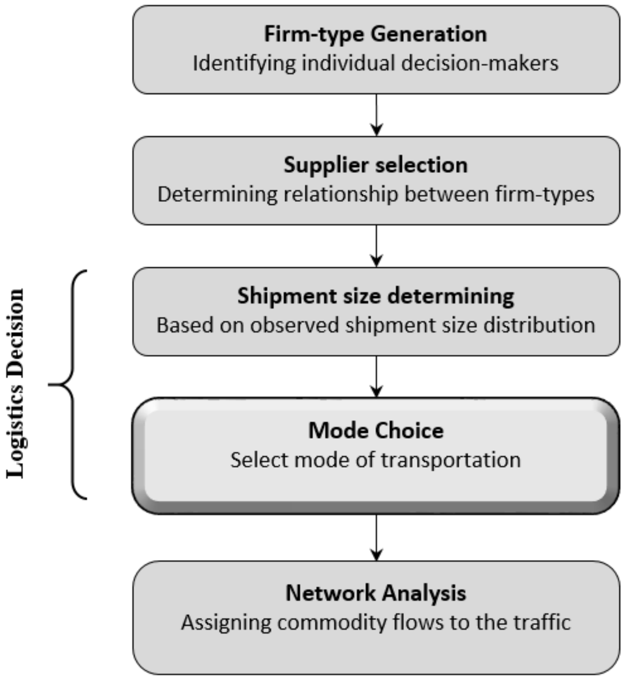


Figure 2. Freight Activity Microsimulation Estimator (FAME) framework and the position of mode choice model in the framework

While other scenario in multi-agent transport simulation using MATSim only consisted of private motorized traffic only, Mohit S. Shah (Shah 2010) added freight and cross-border traffic in attempt to improve the travel demand produced by the simulation.

New research developed a new agent-based model to simulate the transport operations and behavioral reactions of transport agents, applied mode choice variables that are consensually referred to as pivotal in the mode choice process: price, transit time, reliability and flexibility (Reis 2014).

3. PERFORMANCE OF INTERNATIONAL FREIGHT

Before entering the performance (inter) national or regional freight, it helps us to discuss the problems that are experienced at the national level first. There are problems in freight policy that start from two points are (i) the lack of national freight system programs, (ii) performance goals, or targets, that explains the lack of freight system performance data'(NCFRP 2011). Figure 3 lists some of the key transport parameters by Mc Kinnon frequently exposed by the government by implementing the policies they are running. The thing to be aware of this 'evidence-based decision-making' will be very 'hungry' data. The need for data is enhanced by the policy of transport policies that are formulated to a higher level (e.g. regional level) by lower levels of government.

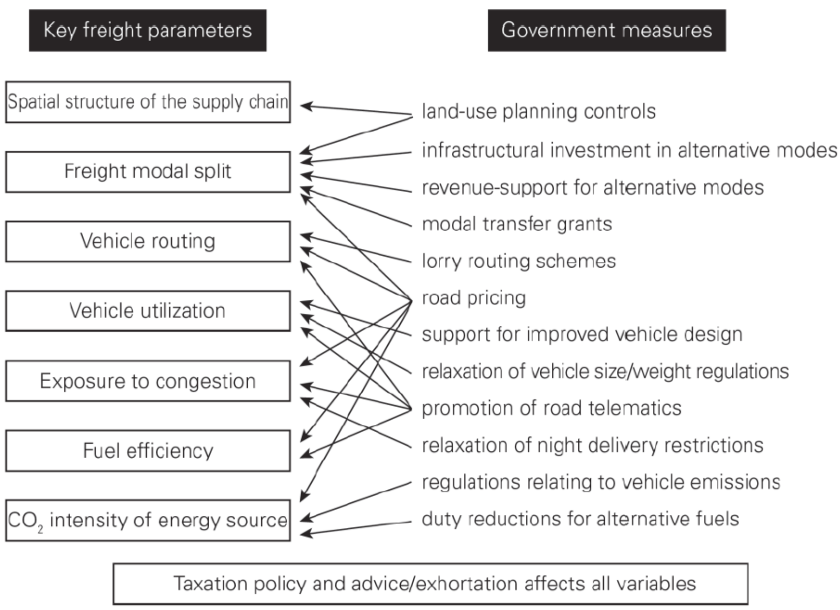


Figure 3. Range of freight transport parameters influenced by government intervention ((McKinnon 2015)

At all levels of freight policy-making, the main goal must be to improve the performance of the freight transport system. At this point, the above points are attempted to apply to the scope (inter)national or regional freight. The term 'performance' can be defined in different ways in this context. McKinnon (McKinnon 2015) examined six performance criteria, all of which are interrelated:

3.1 Transport Intensity

Freight Transport Intensity usually defined as the ratio of freight tonne-kms to an economic output measure such as GDP (McKinnon 2015). It is an important indicator of an economy's dependence on freight transport. Countries at an earlier stage in their development are usually more dependent on the production and export of low-value primary products that must be moved in large quantities relative to national income. As they develop, industrialization, movement up the global value chain and growth of the service sector tend to depress the level of freight transport intensity. OECD / ITF (2015) indicate how freight intensity is a function of both per capita income in a country and the service sector share of GDP. It can also be affected by other factors, however, as illustrated by the diversity of freight intensity trends exhibited by EU member states, even between countries at similar levels of economic development and service penetration (McKinnon 2015). McKinnon also mentioned that broader economic policy affects the GDP denominator in the intensity ratio, but governments seldom try to influence total tonne-kms as an explicit policy objective.

3.2 Modal Split

In most national freight markets, rail, and to a lesser extent waterborne transport, are losing market share to road while one of the main freight policy priorities is to arrest and, if possible, reverse this trend. The modal shift to trucks is partly a response to improvements in road infrastructure but also to changes in companies' logistical requirements which favor road because of its greater speed and flexibility.

3.2.1 Choice of Metric

Most countries that publish freight modal split data express it in terms of tonne-kilometres (often referred to, quietly misleadingly, as 'transport performance') and / or tonnes-lifted. Using the former measure gives rail and waterborne transport a higher share as these are essentially long-haul models whose comparative advantage over road increases with the length of haul. Targets for altering the modal split can also be defined in terms of tonne-kms or tonnes lifted.

3.2.2 Directness of the routing

Measuring the modal split by tonne-km can also give a distorted view of the freight market because of differences in the relative density of the road, rail, and waterway networks. As the latter two networks are invariably much less dense that the road network, routing of the freight flows tends to be less direct. Simply comparing the total length of a country's road and rail infrastructure can also result in under-estimation of differences in the degree of circuity in freight routing. Sometimes, freight is confined to particular lines.

3.2.3 Intermodal Freight Movements

Where the origins and destinations of freight consignments are not directly connected to the rail or waterway networks, road feeder movements are required to provide a door-to-door service. Most government transport statistics do not separately identify these 'inter-modal' movements, though this data can sometimes be obtained from trade associations representing intermodal operators.

3.2.4 Contestability of the freight market

To carry the goods from producer to consumer sometimes need two different modes of transport. This is usually caused by physical geography between these places. In practice, however, modes may only compete for a relatively small proportion of the total freight market. Two choices of modes still depend on how large the volume and how long the distance between two points.

3.3 Market Diversity

There are now many variants of intermodal service, combining modes in different ways. Carriers vary in the size and type of consignment they handle, the speed with which they deliver and the geographical extent of their coverage. Some operate only a basic transport service, while others integrate transport within a logistics package comprising storage, inventory management, order picking and, possibly, a range of other value-adding services qualifying for the title logistics service provider (LSP). As economies develop, so the spectrum of logistics services expands to cater for the varying needs of the new types of business that emerge. Annual surveys of the global third party logistics market have found demand for a broader portfolio of 'value-adding' logistics services steadily increasing (Cap Gemini et al, 2015 see McKinnon 2015).

3.4 Operational Efficiency

Government freight transport policies is a desire to improve efficiency. This used to be justified purely on economic grounds, but it is now recognized that it yields environmental co-benefits and so is considered more sustainable in the 'green-gold' sense of the word.

a. Vehicle Loading

   In a seminal paper on performance measurement in logistics, Caplice and Sheffi (1994) distinguished two types of operational measure widely encountered in the freight sector:
   Productivity: defined as the ratio of outputs (such as tonne-kms or vehicle-kms) to inputs (such as fuel, vehicles, or labor). They described this as 'transformational efficiency' as it measures the efficiency with which a resource is converted into an activity.
   Utilization: the ratio of the capacity actually used to the total capacity available (such as the amount of space in a container actually occupied by a load).

b. Fuel Efficiency

   Most of the latter studies suggest that the energy efficiency of the road freight sector is improving relative to both trucks-kms and tonne-kms. Eom et al (2012), however, found wide variations in both the average energy intensity of trucking across the eleven developed countries they examined and 'their overall trends ... mixed'. In much of the developing world, data are too limited to make similar assessments.

3.5 Service Quality

There is a substantial academic literature on the measurement of logistics service quality at a company level (e.g. Gunasekaran and Kobu 2007), but little discussion of the metrics that should be used at a national level to assess the quality of a freight transport system. The basic criteria are essentially the same at the micro- and macro-scales, comprising average transit time, reliability (i.e. variance around the average) and the condition of goods on arrival.

3.6 Environment Impact

Freight accounts for a high proportion-transport related emissions of noxious and greenhouse gases. Clean Air Asia (2012), for example, estimated that in 2010 freight vehicles accounted for only 9% of all road vehicles in Asia but 54% of total emissions. Much of the environmental impact of freight transport is associated with energy consumption.

4. EMPIRICAL RESULTS

Although the area under consideration is the island of Kalimantan, which is discussed in this paper the pattern of freight movement between the provinces of West Kalimantan, Indonesia and the state of Sarawak, Malaysia. Study about international freight transportation in West Kalimantan border area cannot be separated from The ASEAN Free Trade Agreement was signed by Brunei, Indonesia, Malaysia, Philippines, Singapore, and Thailand in 1992. It consisted of a schedule of preferential tariff reductions, to be implemented progressively until 2008 (later postponed to 2010). When forming an RTA, members agree to lower trade barriers to each other (Hector Calvo-Pardo 2009).

Separated by ±800 km length of borderline, West Kalimantan (Indonesia) and Sarawak (East Malaysia) together form one large economy in Borneo Island, the third largest island in the world with total population of 6.5 million (36% of Borneo total population) and total GDP of 11.2 billion US$. This border pair connected with each other by at least 50 pathways that have been used from generation to generation for different purposes such as leisure, visiting relatives/friends, participating in religious festival and games, or actively involved in economic activities that generate significant income. Among those, Tebedu (Malaysia border district) - Entikong (Indonesia border district) crossing is the only official international gate where formal export and import between the two takes place. Trade along the border of Sarawak - West Kalimantan has a long history with the first government intervention recorded over 40 years ago (Bariyah et al. 2012). Pontianak city and Sambas city are two main producers of export commodities city to Malaysia through Entikong Border. The freight transportation samples were taken from two cities that mention above. The regulatory aspects could be identified by the banning of import for some of the goods and the obligation of freight vehicle transportation to stop at the Malaysian inland port (Tebedu Inland Port) and then replaced by the Malaysian goods vehicle transportation.

4.1 Transport Intensity Results

In the figure below we can see the trends in total export volume from West Kalimantan to Malaysia compared to export volume through Entikong (cross border check-point /PPLB). It explains the impact of cross border trade policy to export volume between Indonesia (West Kalimantan) and Malaysia (Sarawak). Some regulations which banned some types of commodities have big impact on low of export volume level.

When we analysis the freight flow at the critical point (the highest value), it showed us there is 39,475.580-ton commodities flow (Central-Bureau-of-Statistic 2015) from West Kalimantan to Sarawak by truck through Entikong. If the average capacity of truck is 10 tons, the flow of trucks per day are approximately 845 trucks.

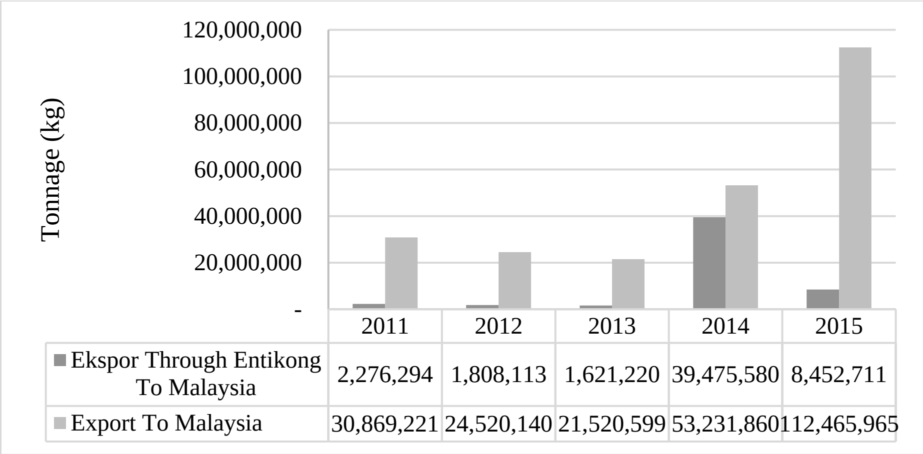


Figure 4. Export Value from West Kalimantan to South East Asia and Malaysia in 2014 and 2015

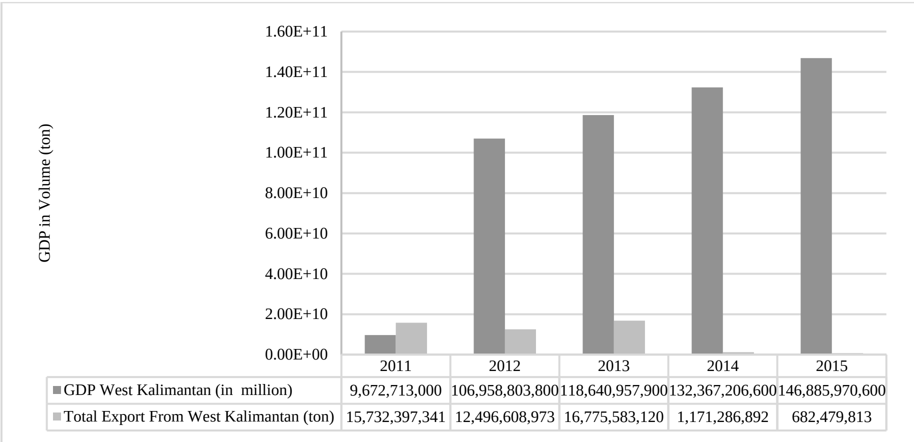


Figure 5. Comparison of Total Export and GDP West Kalimantan

Since transport intensity means ratio of freight tonne-kms to GDP, but the ratio mention in figure 5 is inversely proportional. When it should be increasing of GDP value as rising of export volume or value. That result may be occurred because the GDP value influence of several factors, and export value not a main factor.

4.2 Intermodal Freight Movement

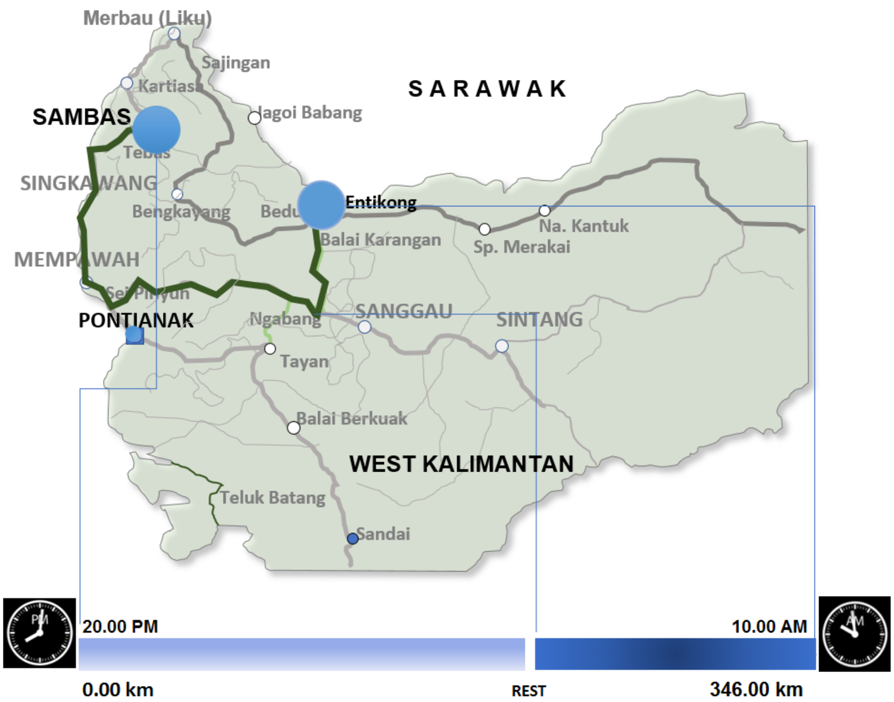
In this case, there is no transfer of freight from one mode to another occurs. Freight transportation from start to end point, i.e. Entikong border, only use one mode. The different alternative to use river transport mode not feasible with consider to water debit and depth of the river. While alternative to use rail could not be include consideration because its infrastructure not yet build.

4.3 Operational Efficiency Results

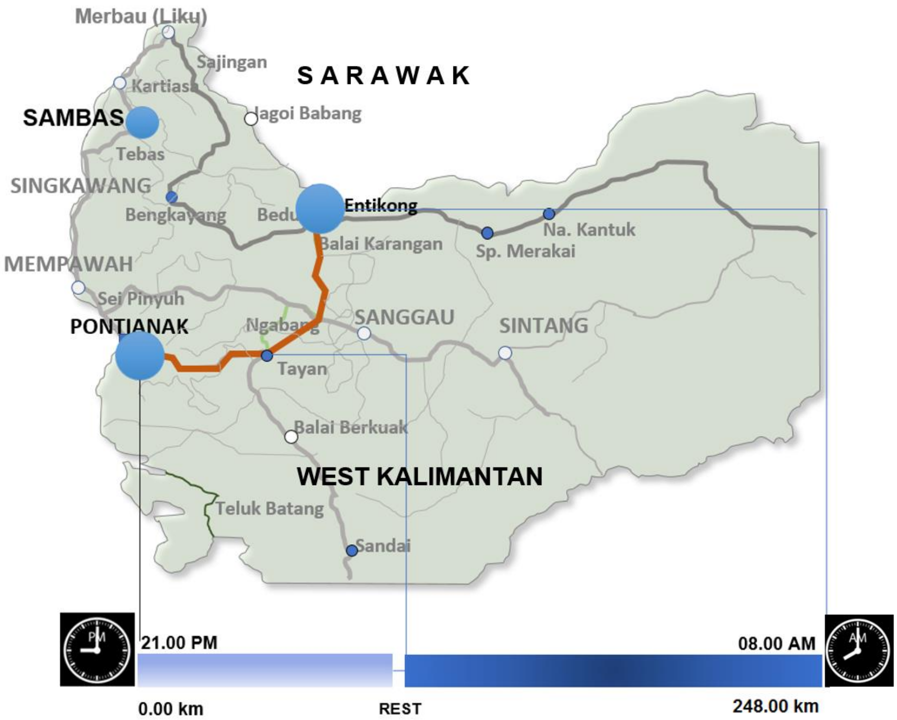
Level of efficiency could be seen in ratio of output of freight vehicle. In this case about frequency, from data collected and conducted interviews, we know that every freight vehicle only used in twice a week. It might be happened because of the distance and production level of the commodities. The ratio of the capacity actually used to the total capacity also indicates efficiency level of freight. From data collected we know that ratio depend on type of commodity and how that commodity packaged.

4.4 Directness of The Routing Results

By analyzing directness route of international road freight transportation both from Pontianak to Entikong and Sambas to Entikong (as the sample of producer commodities export as mention above), it learned that Pontianak Entikong route is relatively straight whereby the Sambas Entikong route is a detour one.



(a)



(b)

Figure 6. Route of Freight Vehicle from Sambas and Pontianak to Entikong (Border)

The better level of efficiency can be achieved by choose alternative route or constructing a much straight road.

5. CONCLUSION

There is a strong relationship between freight flow and trade flows. With reference to the sector of inter-country transport of goods, if the volume of trade increases, it will also increase the flow of goods vehicles in the corridor. It is also important to discuss trade, in this case, trade in a region. There are two types of trade known in the regional sphere of regional trade and regional border trade. The regional trade indicates trade flows between countries within a region such as East, South, or Southeast Asia. Regional border trade defines trade between countries across regions. From this definition, it is clear that the type of trade is discussed in this paper is the regional trade.

The volume of goods transport in an area or corridor is then distributed from the origin zone to the destination zone. The movement of goods among these different geographic units in classical modelling is known as the distribution step.

There are six models in the freight transportation which is used to assess the impacts of different types of policy measures, such as changes in national regulations and taxes or infrastructure investments. The gravity model is a model that early proposed to predict the quality and quantity of the travel produced by various land uses which based on the Lowry models. The second model is a regional multi-I / O approach, which is the better model of transport demand. This approach has integration with random utility models and with assumptions on import/export flows to/from the external of the study area. These improvements successfully made MRIO models be a reliable and stable modelling tool, useful as a freight demand model. The next model is the new economic geography (NEG) theory dan spatial computable general equilibrium (SCGE). The next model is Agregate-Disagregate-Agregate attempted to fill that gap from lacking lacking important aspects of logistics decision-making such as the choice of shipment size and the use of consolidation and distribution centers (DCs). The dynamic shipper–carrier problem is modeled as a differential Stackelberg game. The shippers act as followers operating under the Cournot–Nash behavioral assumption while competing on the sale of a homogenous product in several markets. The last one is activity based freight model, which has similarity with ADA model, this model proposed that intention to fill the lacks appropriate ‘‘actor-based’’ micro-level models, and thus, the role of actual decision-makers is mostly overlooked. This model could use in commodity transport modelling to assess the effect of behavior-oriented transport policy measures. Several researches using multi-agent transport simulation using MATSim, for instance Shah who added freight and cross-border traffic in attempt to improve the travel demand produced by the simulation.

If the shortcomings of the freight transport model the past are; (i) does not have an actor-based micro-level model; (ii) tend to ignore the role of decision makers; and (iii) do not emphasize the need for a better understanding of the decision-making process, then the activity-based model with these three characteristics can be a more valid and reliable choice of decision tools ((Hensher & Figliozzi 2007); (Liedtke & Schepperle 2004)).

Meanwhile, in subject of the performance of international freight which McKinnon classified on six performance criteria are: (1) transport intensity; (2) modal split; (3) market diversity; (4) operational efficiency; (5) service quality; (6) environment impact. Whereas modal split classified in detail as (i) choice of metric; (ii) directness of the routing; (iii) intermodal freight movements; (iv) contestability of the freight market.

In this paper only discussed about four criteria. First, transport intensity which show result that fluctuation of export volume not directly proportional to the value of GDP. It because there are many variables that determine the value of GDP. Second, Intermodal Freight Movement analysis which give result that in case international freight in Kalimantan Island, the carrier only use one single mode, i.e. truck to moving commodities. This is because the other alternatives infrastructures, like river transportation and rail not build yet. Third, Operational Efficiency show that frequency of each vehicles been used is twice a week, fairly low, because the distance and production level of commodities factor. Fourth, Directness of the routing show that Sambas to Entikong route is detour one and need choose alternative route or constructing straight road.

Based on the scope mentioned above, it can be concluded in general that the performance of international transport on the island of Kalimantan still needs to be improved. Things that can be done by the government is to improve the system of transportation of goods, transportation network system, including road infrastructure and multimodal. This paper is the first step of research and application of activity based model in analyzing (inter) national or regional freight. In this case, the modeling is done with the scope of land freight transportation so it is only one review of the overall freight transportation activities that exist. However, this sectoral review is indispensable for improving efficiency in the national or regional transportation system between West Kalimantan and Sarawak.

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