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# Developing Model of Logistics Costs in Indonesia's Cement Projects: A Literature and Empirical Study Approach

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## Abstract

This research aims to disclose yearly Pandora boxes to determine precisely variable costs that drawing up of logistics model in Indonesia's cement projects. It begins caused by difficulties to plan an effective projects at the stage of deployment of costs allocation at the preliminary phase. The research period taken was 2010 to 2018 of 8 cement projects in Indonesia by quarterly and had been tested with a statistical tool EVIEWS10.00 to develop robust model. This research employs literature study to assess model previously developed and then reconfirmed by empirical. The model developed is synthesized of 4 dependent variables accordingly defined as foreign logistics costs, domestic manufacture, domestic logistics costs, and total investment costs. Each adjusted R-squared that representing confidence level is consecutively 72.54%, 67.12%, 65.16% and 67.65% or bigger portions are in the model while smaller other in outside model. A 10-variable independent is a new novelty of developing logistics model for executing cement's projects in Indonesia and a concerning significant findings that variable of foreign logistics costs took big portion of the model and therefore must be prior carefully anticipated. This research is giving contribution for planning projects carefully and precisely to avoid budget exceeded generally in every projects.

**Keywords:** Foreign Logistics Costs, Domestic Manufacture, Domestic Logistics Costs, Total Costs of Investments, Cement Projects, Indonesia

## 1. Introduction

Indonesia today is entering a phase where large of projects were being built massively. Infrastructure projects are becoming the highest attention of Indonesian people as the projects is a hope and a dignity of future Indonesia. It was about US\$ 310.34 billion funding prepared by Indonesia government to finance the projects for period of 2014-2019, but it likely does not adequate as generally every project executions is always experiencing of budget exceeding. The costs analysis is predominantly being caused of the inaccuracy to determining of project costs.

Abdallah (2004) was advised that conducting costs analysis at the projects should neither be expert nor high quality of scientist. In the terms of logistics –as focus on this paper– the general approaches must be prior understandably before going into detail. Abdallah (2004) proposed 7 guidelines which is consecutively (1) define fixed and variable (or running) costs related to logistics systems; (2) calculate unit cost measurements; (3) describe factors that drive the cost of fixed and variable costs, (4) identify information sources and approaches for measuring fixed and variable costs. Furthermore; (5) define what constitutes logistics-related costs relative to other distribution functions, and define logistics costs in the context of this model; (6) understand the different approaches for defining costs and choose the appropriate one, and (7) describe the general approach for conducting cost analyses. The other ways to approach model of logistics costs is by performing network analysis (Lukinskiy and Dobromirov, 2016). The logistics networks advised by Lukinskiy and Dobromirov (2016) is synthesizing based on the classical model of Harris-Wilson. The classical model of a six-version obtained for a simple supply network showing; particularly, additional value added to the product price stemming from the previously performed by logistic operations. The choice of an optimum version of the supply network is made based on the criterion of minimum total costs.

Almohsen and Ruwanpura (2011) stated that model of logistics costs for construction or projects could be defined as flow of raw materials, equipment, machineries, and other goods that have related to the projects from the point of demolition to the point of installation. Being able to coordinate these factors are the main key to the success carrying of the project(s). Conversely, because mismanagement will cause conflicts between factors and will cause project delay or uncontrolled costs. The importance of logistical to support project construction is due to the portion of material distributed reaching 60% to 70% of the total project values generally.

## 2. Literature Review

### 2.1. The Important of Logistics Model

Handling projects are task that neither simple nor easy. Determining costs especially are becoming the hardest phase since at the beginning stage. For every project's planner or project manager, budget allocations are imperative as it will be reported to the project owner and becoming main preference to be evaluated periodically. Project officials will be challenged at the case, either excess budgets are indicating not professional or even more shortage of budgets.

Shakantu *et al.*, (2003) had warned that transportation costs are matter that must be considering during construction at the projects. This statement is not quite progressive as traditionally, delivering materials for construction are mandatory tasks or projects will be incomplete as materials had not been assembled or installed yet. But Shakantu *et al.*, (2003) advised that supplier selection must be tended on the basis of the lowest prices to anticipate surprise additional costs later. Further research is being raised by Sobotka and Czarnigowska (2005) that starting to elevate logistics problems within projects. Supply systems, logistics have been described with suggests for creating new logistic guidelines for the purpose of integrated logistics services with the goal of making construction projects more effective and efficient.

Logistics issues then taking big portions of attentions. Logistical analysis of construction are frequently being assessed by researchers. Impact to the performance of projects are measured with the results to develop a conceptual logistics model (Vidalakis *et al.*, 2011). At this stage, the term of transportation costs is gaining to become popular. But so far, defining costs and or logistics model at the projects remain unanswered.

Engblom *et al.*, (2012) began to state a quantitative of their findings that logistics costs at the generally projects often exceeding of 10% total project's costs. Variables determining of logistics then have been introduced that consisting of six individual components: transport, warehousing, inventory, logistics administration, transport packaging, and indirect costs of logistics. The study employs a statistical tool of generalized linier mixed model (GLMM) to examine several variables of time, the number of employees, turnover, industry, and level of internationalization that resulting all of them statistically significant explanatory variables of logistics costs. Beside

Engblom *et al.*, (2012) who estimated a certain number logistics contribution at the projects, Guerlain *et al.*, (2019) follows by a bigger proportion of 30% logistics costs contribution during construction.

Further research to bolster Shakantu *et al.*, (2003), construction materials again are becoming issues in the projects. Research conducted by Fang and Thomas (2011) is concerning flow of construction materials that corresponding tightly with logistics. The materials intended is bulky components like precast concrete units, fabrication, and also rebar. Fang and Thomas (2011) employs of the activity based costing (ABC) approach to identify the model with the purpose to help managers or project planners to minimize logistics costs during construction. Matouzko and Methanivesana (2012) strengthened findings of Fang and Thomas (2011), they found a reduce the costs at the certain project in Sweden of 65 SEK/m<sup>2</sup> and also shorten lead time by 3.3%. Matouzko and Methanivesana (2012) at their paper remain that logistics model is often underestimated but proper logistics planning is promising benefits for every projects.

The important of developing logistics model at the projects has been presented at the recent study by Bengtsson (2019). Bengtsson (2019) reveals logistics is mandatory to improve efficiency in construction projects, though this qualitative study is rather distinctive as inserted variable of commitment, communication and cooperation when implementing the logistics model. But Bengtsson (2019) is accompanied by Papadopoulos *et al.*, (2016) who earlier presented qualitative research studying effective management of the construction logistics.

To be aware of gradually increasing logistics costs about 10% to 30% previously stated by Engblom *et al.*, (2012) and further by Guerlain *et al.*, (2019), the construction is undergoing to be customize as modular systems that easily handling in a simple logistics (Hsu *et al.*, 2018). This new model project execution is changing a conservative ways to bring almost all construction materials within project environment. The component of constructions as like plate-works or fabrication is now at the adjacent of location of installation with only less logistical needed. The way is automatically decreasing costs of logistics.

## 2.2. Factors Influencing Logistics

### 2.2.1. Foreign Factors

In this sector, expanding and enhancing businesses are key. According to Zeng and Rossetti (2003) due to encourage in advancing technology and increasingly power of competition, developing business operations throughout worldwide are urgently needed. The most challenge with this strategy is more complexes because there are distance factor presented, currency differences, culture, and other factors that must be consider into account carefully. The logistics portion of this aspect takes a significant portions of the total logistics costs came from foreign. Furthermore; Carana (2004) said that factors affecting foreign was a distance, cargo size, type of container, and the number of multi-modal transports required. Gkonis and Psaraftis (2012) stated factors that must be taken into account for efficient logistics are price of oil, exchange rate, distance, and size of cargos shipped.

### 2.2.2. Oil Prices

Research by Beverelli (2010) who examined effect of oil prices on sea freight costs showed a fairly high level of elasticity. It found that logistics costs for container escalated 0.19-0.36 each of 1% increase of oil price. According Beverelli (2010), the OECD explained level of elasticity between 0.018-0.150. The other researchers found relationship elasticity between oil price and sea freight costs are about 0.232-0.327 (Hummels, 2007), while Mirza and Zitouna (2009) found the elasticity at 0.008-0.103.

Because oil as a source of ship engine fuel, the cost of oil is dominant factor in the structure of freight costs. Some literatures state that oil makes up nearly 60% of the structure of freight costs (Gkonis and Psaraftis, 2012) to 75% (Polo, 2011) called the bunker adjustment factor (BAF). The BAF component became part of unit cost (surcharge) in which already considered to anticipate oil price uncertainty. The BAF is always varying and determined by each ship provider. The BAF as a constanta, for example in 2007, was 5.4 times the international crude oil price in ton, 2008 (5.3 times), 2009 (6.1 times), 2010 (5.9 times), and 2011 (6.3 times).

Type of ship engines on the other hands also determine important role of the BAF consumption in regard of speed. According to Gentle and Perkins (1982) a ship with a diesel engine requires 201 grams/kWh of marine fuel oil (MFO) type, while ships with steam turbine engine type require higher of 292 grams/kWh. For illustration, a ship with a class of 8,200 teus in 2006 requires 230 tons to 250 tons of MFO per day (Eljardt, 2006) worth US\$99,000 from the loading port of Hamburg, Germany to the Tanjung Perak, Indonesia which is about 10,051 Nautical Mile (NM) distance.

### 2.2.3. Exchange Rates

Based on Agenor (2000) increasing integration of global finance required a comprehensive study in international exchange rate performance. Samuelson and Nordhaus (2004) saw a positive side post World War I (1914-1918) and World War II (1939-1945) in the terms of exchange rates. The world has been enjoying development of cross-border economic cooperation that has a positive impact such as trade relation, the money market integrated systems, developing democracy, and rapid economic growth. According to Samuelson and Nordhaus (2004) to enter international trading system, necessary translational and equivalency value of currency called exchange rate system is required. This exchange rate is a point equilibrium of value of the country's economic representation in the global international trade's scope.

Research Ma and Cheng (2005) calls that integrated currency systems have eventually impacted both positive and negative affect against currencies in other countries. Negatively, there has been a significant prone in a crisis transmissions from countries within trade relations. Joyce (2012) stated negative impact of global economy is very open, for example in terms of exchange rate, currencies from developed countries have bigger opportunity to suppress currencies in other developing countries. According to Mishkin (2007) there were two exchange rate transactions, each a spot transaction and the other is a forward transaction. Spot transactions accommodate short term, while forward transactions employ for a certain period longer. Exchange rate transactions are not traded but operated with operational mechanism of hundreds of dealers connected by integrated computers in an information platform systems. The exchange rate equilibrium occurs if variables supply and demand matched together. The point of balance does always change depending on the trigger future.

### 2.2.4. Distances

Based on Gkonis and Psaraftis (2012) the factor of distance is an important variable in logistics systems. The distance makes consume of bunker adjustment factor (BAF) bigger and travel time becomes longer. The factors along with the speed of ships make total accumulation of logistics costs structure to be higher and expensive. These factors are a major concerning for logistics researchers, because it makes usage of bunkers un-economical consumption. In order to reduce the use of bunkers, ships are campaigning to lowering speed from originally 24 knots to 26 knots to only 15 knots to 18 knots (Gkonis and Psaraftis, 2012). This is also intended to reduce tariff of logistics costs in terms of sea freight costs and to drive global trading between countries higher.

### 2.2.5. Sizes

Shipping is a different type of business's services of logistics in general. The liner only offers limited chamber in regular scheduled departures on certain routes on a certain destination ports basis (Szmigiel, 1979). Based on Powel (2001) approximately 90% total volume of goods traded internationally using ships. The type of vessels to serve containers is growing rapidly because they enjoy protection and subsidies nationally and internationally due to higher guarantee in terms of safety, security, and environmentally factors than other types of vessels.

The unit of measure of ships stated in deadweight tonnage (DWT) and gross tonnage (GT). The DWT unit describes cargo capacity of ships while unit of GT is volume capacity where 100 cubic feet is equivalent to 1 GT. If a container known as a twenty-foot equivalent unit (TEU) with dimensions of length of 20 feet, width of 8 feet, and height of 8 feet is equivalent to 12,8 GT. This container has a standard capacity of 18 metric tons but is effectively filled with 13 metric tons, depending on the density of the goods.

Christiansen (2007) stated that sending cargos by sea are not a simple tasks. Vessel facilities have limited space and room, therefore users in sea transportation services must comply with strictly liner regulations. Ships included

in the common carrier or regular ship give priority to cargo with standard containers of either 20 feet or 40 feet in either normal size or in high cube (HC) category. The basis of these provisions are considering speed and practicality in cargo management and handling in ships as well as for cargos' safety. Cargo dimension that is not in standard size of the container or in breakbulk type, will be measured based on the unit of freight-ton or FRT. This unit is a combination of weight of cargo in tons and/or based on dimensions of packages in cubic meters (CBM), where the largest unit is taken. Cargos in breakbulk with FRT unit should be serviced by vessels categorized as Non-Vessel Operating Common Carrier (NVOCC) or called ship tramper. Nowadays, there are more multi purposes vessels (MPV) that can accept both in containers and in breakbulk types of cargos at once in a vessel.

Cargo packaging is also concerning. The handling arrangement of cargo packaging forms great affects the amount of sea freight costs. Research Manzanero and Krupp (2009) concerned that efficient logistics only achieved if as much as possible size or dimensions and weight of the cargo should be to put in a container's size. This reason considers that costs of sea freight will be much efficient and economical because scheduled vessels are easily found and therefore will be cheaper. Cargo in containerization is now the best alternative for shipping of goods by ships in terms of security of cargos, avoiding and protecting damage, and the cheapest tariff in freight costs.

Today recent update, dimension of the containers have also developed quickly. United Nation (1990) defined that there are seven types of containers commonly used and have been varied now. The latest development, the length of container has reached 45 feet instead of previous 40 feet. This will have effect of changing specifications in international logistics modes and subsequently to affect in feeder transportation. Previously, the dimensions of a relatively standard container were length, width, and high consecutively 12,190 mm x 2,435 mm x 2,590 mm, with a maximum cargo capacity of 35 net tons.

Table 1. Container Type

No	Generation	Container Type
1	Part I	General Cargo Container
2	Part II	Thermal Container
3	Part III	Tank Containers
4	Part IV	Bulk Container
5	Part V	Container Platform
6	Part VI	Collapsible Container
7	Part VII	Air Mode

Source: UN (1990)

#### 2.2.6. Insurance

Research by Whittle (1987) states that insurance protection industry has existed since 400 BC when administrator of the city government of Rhodes, Greece decided on matters that included the general average in commercial law. General average is an elementary principle result from the sea law, justice, and public policy. Since the discovery of the American continent in the XV century, the demand for protection against the loss of trade goods has increased. Several mechanisms were tested to obtain a best protection system for both merchandise and crew members and the result we have known today is marine insurance.

Marine insurance currently provides protection for ships (hull and machinery) and protection for cargos that can be selected based on needs (Nieh and Jiang, 2006; Skuld, 2009). Based on Carana (2004) the factors that encourage consideration of premiums insurance are labor, terrorism threats, packaging techniques, shipping methods, age of the ships, until sabotage.

Based on the main points of the definition, insurance is a financial institution whose line of its business is to accept transfer of risk from each individual or entity by accepting a premium and has obligation to pay compensation or claim if the customer suffers financial losses due to an event occurred which is promised. Insurance is part of

financial institution because it collects premiums from third parties to pay compensation if the customer experiences risk or loss.

### 2.2.7. Customs

Based on Ballou (2004) there are six mandatory types of documents applied in field of international transportation, namely bill of lading (B/L), freight bill, freight claim, commercial invoices, packing lists, and certificate of origin. These documents become mandatory when dealing in international trade and must be presented.

Customs is a matter of country level in order to better evaluate and meeting target according the Trade and Transport Facilitation (TTF) policy efforts over time and across countries. Lowering mandatory costs for logistics reduce the cost of delivering products, thereby encouraging sales, increasing trade, opening new markets and generally encouraging business. Performance evaluation also helps to improve the efficiency of supply chains and the functioning of related infrastructures, services, procedures and regulation. This factor has been researched by Rantasila and Ojala (2012).

## 2.3. Domestic Logistics

According to Ran (2009) after the goods have passed through customs clearance gate, the logistics activities are still needed upto the customer's point. Logistics in this region are called hinterland logistics consisting of a combination of lands, rails, and water in certain country. These hinterland logistics are very important in the whole distribution chains and become a competitive factor of a nation (Zondag, 2008). The combination of ports with integrated hinterland lines will be the nation's main competitiveness in reducing total costs of the whole chains logistics. Baan (2015) explained in his study that domestic logistics in Indonesia has a number of very serious challenges related to the limited infrastructure facilities for transportation. Using the Nagurney-Qiang model, Baan found logistical disparities between the eastern and western parts of Indonesia. These disparities drive logistics costs to be expensive in the eastern Indonesia compared to the western side. In the Nagurney-Qiang model, each port is ranked and found with a Julius-Peterson-Mattson network analysis that Tanjung Perak Port is the most strategic port for maintaining entire logistics chains in Indonesia. The Tanjung Perak and Tanjung Priok routes are important routes while the Sorong and Makassar at the eastern routes are next.

### 2.3.1. Feeder

Feeder transportation is a part of short-distance sea transportation services that plays an important role for maintaining connectivity (Kotowska, 2014). According to Yuwono (2014) in Indonesia has a national connectivity structure according to Figure 3. Domestic ports which are already meeting international standard according International Ship and Port Facility Security Code (ISPS) consecutively Belawan, Tanjung Priok, Tanjung Emas, Tanjung Perak, and Makassar Port. All five ports placed as the main Indonesia's ports, while other ports as feeder.

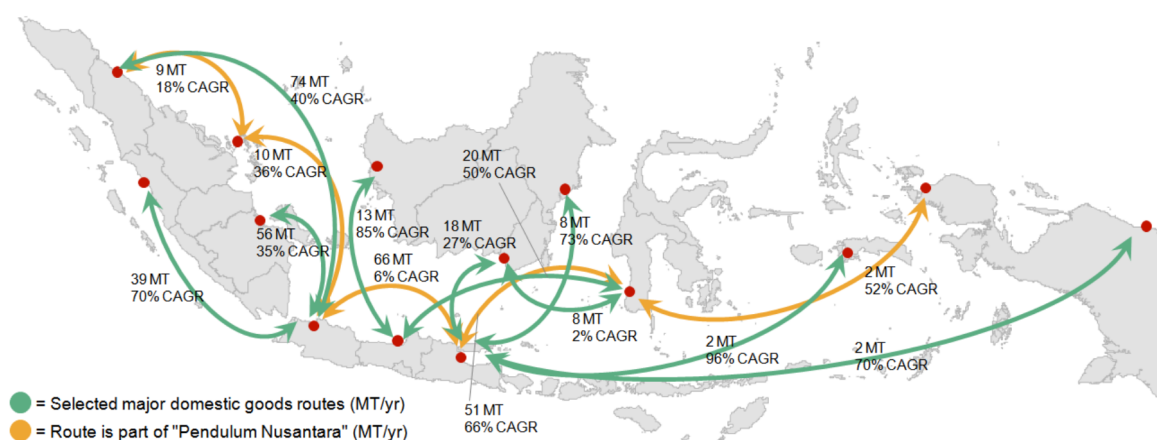


Figure 1. Indonesia Sea Connectivity

Source: Baan (2015)

Baan (2015) states that geography of Indonesian archipelago that is separated by water and seas are absolutely depending majority in sea transportation. The tools that play important is ferries under regulatory of the Directorate General of Sea and the roll-on roll-off (roro) ships under supervise of the Directorate General of Land Transportation. Ferries are intended to serve shorter distances under 150 kilometers while roro's ships are to serve longer shipping distances. Figure 4 shows a map of Indonesia's domestic shipping served by ferries and roro ships. Ferries is intended for passengers while roro's ships for goods.

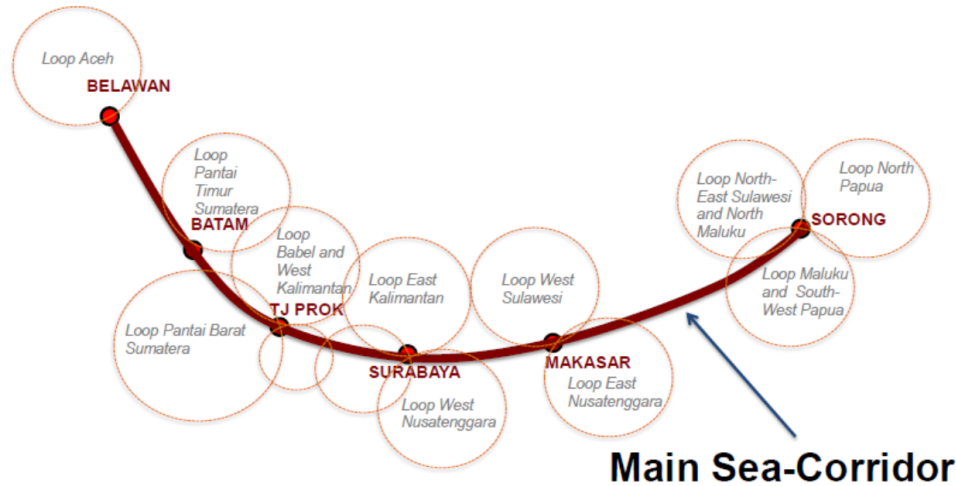


Figure 2. Feeder Transport Structure  
Source: Yuwono (2014)

### 2.3.2. Inland Transport

According study by Carana (2004) road infrastructure in Indonesia would potentially increase costs in logistics, due to time required becomes longer due to limited infrastructure and uncertainty transports. The physical size of road and capacity are very limited and worsen substantially during rainy season. The inadequate road capacities made several times handlings at several points, created excess charges and frequently broke the logistics chain. Limited infrastructure has been worsen with weak regulation and uncertainty laws. The result is high tariff and sacrificing quality. Carana (2004) mentions that poor of maintenance and poor quality of road have pressured inland transport to be higher and expensive. Repairs are often done than build a new and resulting delays in logistics because frequency of damages increased.

## 3. Methodology

This paper is researching a certain logistics costs in projects instead to discuss all associates within projects that complexed and complicated. Determining variables that developing model of logistics costs in projects are especially in quest as the findings is not yet immediately found. The methodology is based-on literature by tracer studies. Literature research is selected by tracer study to enroute model of logistics model early developed. In this study, the oldest literature that presenting associate models is since 1976 while at the recent is 2019.

The findings, advices, recommendations are all reconstructed into nearest possibly associated with origin literature to get comprehensive figure and understanding. After reformulated, the model then be tested with empirical data taken from 8 cement projects in Indonesia within period of 2010-2018. Results from statistical tests are the best given to give appropriate comments that the model is fit or not-fit.



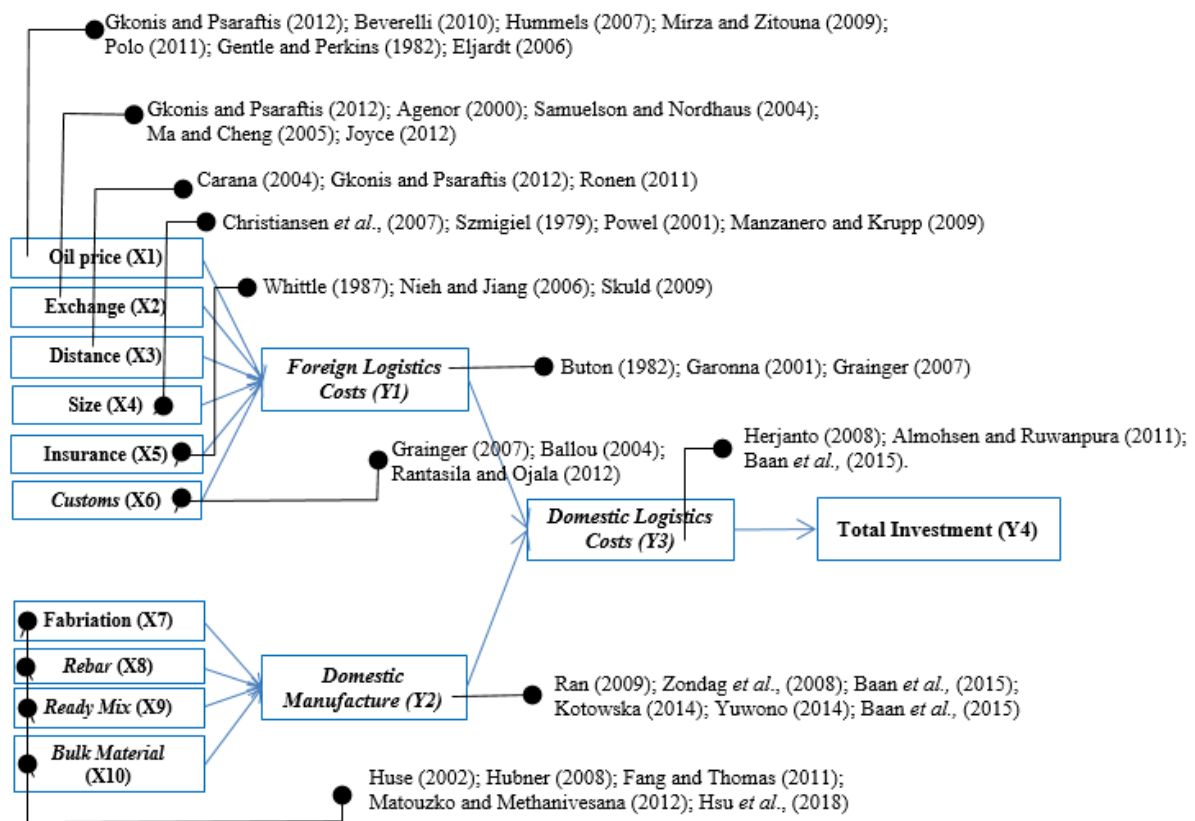


Figure 3. Determining Model of Logistics Costs

Based on Figure 3 after reconstruction several literature studies, it can be seen that model of logistics costs at the projects is predominantly consisting of foreign logistics costs (Y1) and domestic manufacture (Y2). The two main sources variables determining model of logistics costs is a network analysis results advice by Abdallah (2004) and Lukinskiy and Dobromirov (2016).

The independent variables that contribute to the formation of variable foreign logistics costs is oil price, currency of exchange rate, distance, size, insurance, and customs. Gkonis and Psarafitis (2012) states that oil price and distance are combinations that determining consumption bunker adjustment factor (BAF). Based on Jabara (2009), the variable of exchange rate is considered; while Christiansen (2007) revealed the importance of variable size. According Nieh and Jiang (2006) and Skuld (2009); variable insurance becomes a factor that must be taken into account, added by Grainger (2007) and Hubner (2008) the next variable will be customs. The effect of these variables to the variable of foreign logistics costs is formulated in hypothesis 1.

In the second model formulated independent variables of fabrication, rebar, ready-mix and bulk material are all the components to form of variable domestic manufacture. Based on Huse (2002) states that type of projects' execution has experienced a significant change to an EPC contract that provides a greater portion of domestic resources than the type of turn-key contract. Research by Hubner (2008) states that components of capital goods that can be produced domestically are primarily becoming domestic portion. Based on SMGR (2012) which carried out the implementation of the 4<sup>th</sup> Tuban new cement plant project, components of capital goods domestic's categories are fabrication, rebar, ready-mix, and bulk materials. This second model best describing of hypothesis 2.

In hypothesis 3, it is formulated effect of variable foreign logistics costs and variable domestic manufacture altogether and partially influencing to the variable of domestic logistics costs as a moderating variable. Based on Hubner (2008); Garonna (2001); Grainger (2007) induced by the decision of the World Trade Organization (WTO) on the General Agreement on Tariffs and Trade (GATT) in 1947 stated that international trade activities absolutely require customs activities. Hubner (2008) later suggested that necessary completion costs of compliance is

presented. Based on Huse (2002) due to impact of project contracts with the term engineering procurement construction (EPC), the portion of domestic resources is much greater. Kotowska (2014); Yuwono (2014); and Baan (2015) each mentioned that combination of multi-modal logistics within one island and between islands are important factor for the implementation of logistics in terms of domestic manufacture section.

Hypothesis 4 formulates effect of variable of domestic logistics costs to the variable of total investment that representing total costs for the project. Based on Carana (2004) the variable of domestic logistics costs is called within terminology intra-island logistics. Almohsen and Ruwanpura (2011) stated that logistics for construction can be defined as flow of raw materials, equipment, machineries, and other goods that have a relation from the demolition point to the installation point.

From the explanatory mentioned above in explaining of the relationship of influence between variables based on literature studies and tracer studies, it can be modeled in the conceptual framework as following Figure 4.

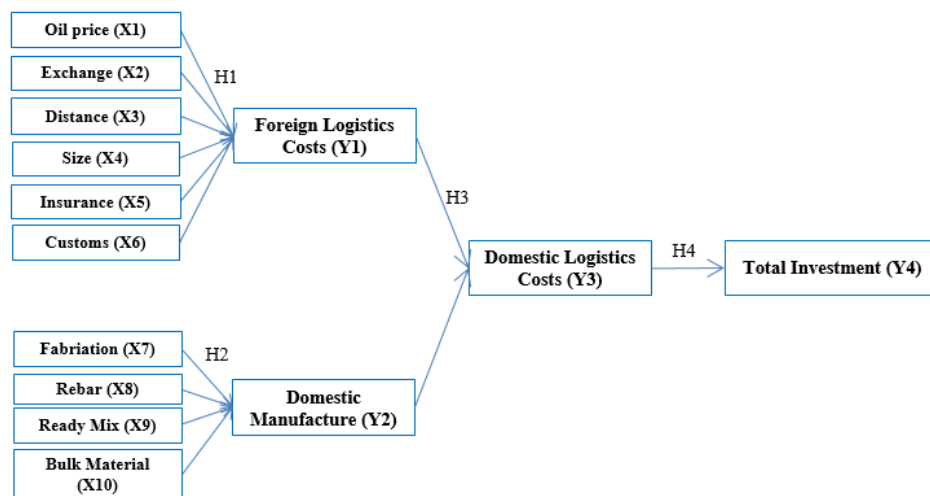


Figure 4. Model of Logistics Costs

Where:

X1 = Oil is the price of international crude oil is an exogenous variable based on WTI index in US\$.

X2 = Exchange is the exchange rate of the US\$ against the Indonesia's rupiah is an exogenous variable in Rp.

X3 = Distance is factor distance from the loading port is an exogenous variable in nautical mile (NM).

X4 = Size is the physical size of the cargo shipped is an exogenous variable in FRT (freight-ton).

X5 = Insurance is the insurance value of the cargo sent is an exogenous variable in US\$.

X6 = Customs is the value of compliance costs consisting of customs formality costs and other charges that are official as exogenous variables in Rp.

X7 = Fabrication is a component of fabrication in the country (plate works) for the construction of construction structures is an exogenous variable in ton.

X8 = Rebar is the component for concrete construction is an exogenous variable in ton.

X9 = Ready-mix is the material to make concrete from the batching plant an exogenous variable in ton.

X10 = Bulk-material is another construction supporting material such as cable, cable tray, grating is an exogenous variable in ton.

Y1 = FLC is a foreign logistics costs component of logistics costs from abroad is an endogenous intervening variable in US\$.

Y2 = DM is the domestic manufacture component of the logistics costs of manufacturing from domestic is an endogenous intervening variable in Rp.

Y3 = DLC is the domestic logistics costs components of logistics in the country is variable endogenous intervening in Rp.

Y4 = TI is the total investment or total project costs. The total investment cost is an endogenous variable in Rp.

H1, H2, H3, H4 are hypotheses

Based on Figure 4 it can be seen that proposed model is combining variables of oil (X1), exchange (X2), distance (X3), size (X4), insurance (X5), customs (X6), fabrication (X7), rebar (X8), ready-mix (X9), bulk material (X10), foreign logistics costs (Y1), domestic manufacture (Y2), domestic logistics costs (Y3), and the variable total investment (Y4).

Developing models of logistics costs based on hypothesis are then into account. Hypothesis is a temporary answer to the problem at hand or a statement that describes the relationship of variables. In other words, a hypothesis is a proposition that contains a temporary solution to address problems which must be verified using statistical tests. Testing this hypothesis will produce findings of related literature, and empirical which will then become the basis for proposed model. Following model of logistics costs are:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon_1 \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 X_7 + \beta_2 X_8 + \beta_3 X_9 + \beta_4 X_{10} + \varepsilon_2 \quad (2)$$

$$Y_3 = \gamma_0 + \gamma_1 \hat{Y}_1 + \gamma_2 \hat{Y}_2 + \mu_1 \quad (3)$$

$$Y_4 = \delta_0 + \delta_1 \hat{Y}_3 + \omega_1 \quad (4)$$

Where:

X1 = Oil price in US\$.

X2 = Currency of exchange rate in Rp.

X3 = Distance in Nautical Mile (NM).

X4 = Size in FRT.

X5 = Insurance in US\$.

X6 = Customs in Rp.

X7 = Fabrication in ton.

X8 = Rebar in ton.

X9 = Ready-mix in ton.

X10 = Bulk-material in ton.

Y1 = foreign logistics costs in US\$.

Y2 = domestic manufacture in Rp.

Y3 = domestic logistics costs in Rp.

Y4 = total investment in Rp.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \gamma_1, \gamma_2, \delta_1$  are regression coefficients.

$\beta_0, \gamma_0, \delta_0$  are constants or intercepts.

$\varepsilon_1, \varepsilon_2, \mu_1, \omega_1$  are the coefficient of error.

## 4. Analysis

### 4.1. Testing Models

The analysis type used in this research is recursive because the causal relationship is only one-way and not reciprocal. Variable oil prices (X1), exchange rates (X2), distance (X3), size (X4), insurance (X5), and customs (X6) have only one-way relationship that affects foreign variables logistic cost (Y1). Likewise the fabrication variables (X7), rebar (X8), ready-mix (X9), and bulk material (X10) have only one-way causal relationship affecting the variable of domestic manufacturing cost (Y2). Next, the foreign logistics costs variable (Y1) and the domestic manufacture cost (Y2) have only one recursive effect on the domestic logistics costs variable (Y3) and finally the domestic logistics costs variable (Y3) has only single causal relationship to the total Investment (Y4). The prerequisites for interpreting the coefficient in a recursive analysis is considered significant or significant if the value is smaller than  $\alpha = 0.05$ . Furthermore, the level of significance of the coefficient can be observed in the

influence between variables, both direct effect and indirect effect by looking at the level of significance between the related variables.

#### 4.2. Test to Find Optimal Lag

Determination of the lag test of each estimation is an important stage because it deals with the most optimal time the influence of the independent variables to the dependent variable. This test is to get a best time effect of independent variables of first estimate to the variable foreign logistics costs, the effect of independent variables of second estimate to the variable domestic manufacture cost, the effect of independent variables of third estimate to the variable domestic logistics costs and the effect of independent variable of fourth estimate to the total investment variable. Criteria the best lag is based on the highest adjusted R-square, the significant number of prob t-test, the significant prob F-stat and values of Durbin-Watson stat that best indicating the absence of autocorrelation. Based on the best criteria of the panel data method, the best lag test results are obtained of lag 2 as following in Table 2.

Table 2. The Best Lag is 2

Model	Selected Method	Adj R <sup>2</sup>	Significant t-test	Prob statistic	(F- DW- stat
1	PLS	0.725363	4 out of 6	0.000000	2.061981
2	PLS	0.671209	4 out of 4	0.000000	1.938147
3	PLS	0.651626	1 of 2	0.000000	1.897979
4	PLS	0.676480	1 of 1	0.000000	1.934602

Source: processed with EViews 10.00

#### 4.3. Determining of Estimation Model

The first test conducted in this study was the chow test or the F-Test statistical test to choose the best estimation technique between the pooled least square (PLS) model and the fixed effect model (FEM). The hypothesis is as follows:

H<sub>0</sub>: pooled least square (PLS) model

H<sub>1</sub>: model of fixed effect model (FEM)

Based on the test results if obtained  $F_{count} > F_{table}$  or if the value of p-value  $< \alpha$  at the confidence level  $\alpha = 0.05$  then the hypothesis H<sub>0</sub> stating model of pooled least square (PLS) is rejected, or accept the hypothesis H<sub>1</sub> so that the model chosen must use the fixed effect model (FEM) as an estimation technique in testing this first structural equation. If the chosen model is fixed effect model (FEM), the next test must be performed of Hausman test to select the best estimation technique between models of fixed effect model (FEM) and random effect model (REM). This test is carried out with the following hypothesis:

H<sub>0</sub>: random effect model (REM)

H<sub>1</sub>: model of fixed effect model (FEM)

Based on the Hausman test if the significant value of  $\chi^2_{count} > \chi^2_{table}$  or a p-value  $< \alpha$  with a confidence level  $\alpha = 0.05$  or otherwise significant then the hypothesis H<sub>0</sub> is rejected so the model fixed effect model (FEM) is more appropriately used. If the opposite is the case then the hypothesis H<sub>1</sub> is rejected and the hypothesis H<sub>0</sub> accepted then the model of random effect model (REM) are better suited to resolve these estimates. Based on the chi square distribution table with a confidence level  $\alpha = 0.05$ , the chi square results obtained at the first estimate are 11.07; the chi square for the second estimate is 7,815; then the third estimation chi square is 3.841; while the fourth estimation chi square value is 0 because it only has one independent variable.

Table 3. Selection of Research Model Estimation Techniques

Estimate	Influence Between Variables	Test Type	Prob	Selected Estimation Model
1	The effect of crude oil prices, exchange rates, distances, cargo size, insurance costs and customs fees on foreign logistic costs	<i>Chow test / Restricted F-test</i>	0.5898	PLS
		<i>Hausman test</i>	-	
2	Effect of fabrication, rebar, ready mix and bulk material on domestic manufacture costs	<i>Chow test / Restricted F-test</i>	0.3588	PLS
		<i>Hausman test</i>	-	
3	The effect of foreign logistic costs and domestic manufacturing costs on domestic logistic costs	<i>Chow test / Restricted F-test</i>	0.7681	PLS
		<i>Hausman test</i>	-	
4	The effect of domestic logistic cost on total investment	<i>Chow test / Restricted F-test</i>	0.2583	PLS

Source: processed with EViews 10.00

Based on Table 3 can be witnessed the results of the *F*-test or *chow* test in the first regression estimation to test the best estimation technique between the *pooled least square* (PLS) and *fixed effect model* (FEM) obtained the significance value of the *F* test is 0.5898 which means it is greater than the value of  $\alpha = 0.05$  so the hypothesis  $H_0$  accepted or selected model is *pooled least square* (PLS). In regard to the chosen *pooled least square* (PLS) estimation model, it is not necessary to proceed with the *Hausman* Test so that the estimation that must be used is *pooled least square* (PLS). The other three estimations are also showing the same condition with first regression, hence all estimations will employ the PLS estimation.

#### 4.4. Identification of Estimated Results First Equation

To identification of the estimation results of the regression equation in testing the first equation (*foreign logistics costs*) to find out how much influence of the independent variables of oil price (X1), the exchange rate (X2), distance (X3), cargo size (X4), insurance costs (X5) and customs (X6) have a significant altogether and partially significant to the dependent variable *foreign logistics costs* (Y1). The estimation results of this regression equation are done using the PLS method according advised in Table 3. The results of the first estimated regression test can be witnessed in Appendix 1. Based on the results, the first estimation regression equation can be formulated as follows:

$$FLC = -48193.11 + 1114.324 * OIL - 59.98031 * EXCHANGE - 0.246449 * DIST + 12.06561 * SIZE + 0.507226 * INS + 1.09 * 10^{-5} * CUST$$

Based on the results of the regression test, it can be explained that the price of crude oil has a positive coefficient which means it has a linear effect to the foreign logistics costs. The same thing happened with the variable cargo size, insurance costs, and customs. The negative coefficient found on the variable exchange rate and distance which means it has the opposite effect to the foreign logistics costs.

In addition based on the results, that the variable of oil price, exchange rates, the size of the cargo, and customs have affected significant to the variable of foreign logistics costs, while variable distance and insurance are not significant to the dependent variable. The dominant factor determining the first model is oil price with a coefficient value of 1114.324 meaning that each increase of oil price of every US\$1 per barrel will trigger an increase of

foreign logistics costs by US\$1114.324. the regression coefficient of variable exchange rate is -59.98031 or have a negative relationship means every appreciation of the currency rupiah against the US dollar, it will cause a decrease in the cost of foreign logistics costs of US\$59.98031. The regression coefficient for distance is -0.246449 or having a negative relationship means that every an increase of the distance between ports of one nautical mile (NM), it will cause a decrease in foreign logistics costs by US\$0.246449. Further, the value of regression coefficient for the size of the cargo is 12.06561 or has a positive relationship meaning that every an increase of cargo size by one freight ton (FRT) it will cause an increase in foreign logistics costs by US\$12.06561. The regression coefficient for the insurance variable is 0.507226 or has a positive relationship meaning that every an increase of insurance value of one US dollar, it will cause an increase in foreign logistics costs by US\$0.507226. Finally, the regression coefficient for customs is  $1.09 * 10^{-5}$  or has a positive relationship meaning that every increase of customs cost by one rupiah, it will cause an increase in foreign logistics costs by US\$1.09 \*  $10^{-5}$ .

#### 4.4.1 The Coefficient of Determination ( $R^2$ )

The results of the coefficient of determination ( $R^2$ ) shows the ability of all independent variables were able to explain further variation of the variable. The results based on Appendix 1 obtained the adjusted R-squared ( $R^2$ ) coefficient value is 0.725363. This shows that the first model of logistics costs of foreign logistics costs as the dependent variable in this model can be explained by 72.5363% by the independent variables mentioned in the model of oil prices, exchange rates, distances, cargo sizes, insurance costs and customs while the remaining 27.4637% are influenced by other variables outside the model.

#### 4.4.2 F-Test (Simultaneous)

Tests to proof of independent variables together have influenced to the dependent variable is done by using test F. Based on result in Appendix 1 obtained value of  $F_{arithmetic}$  amounted to 74.51247 with a significance level of 0.000000. This shows that altogether the independent variables, consecutively oil price, the exchange rate, the distance, the size of the cargo, insurance costs and customs significantly have influenced the variable foreign logistics costs. Using other methods by comparing the F test results showed that  $F_{count} > F_{table}$  of  $74.51247 > 2.70$  then  $H_0$  is rejected or  $H_1$  accepted, so it can be said that the variation of the regression models were able to explain the variations of the model independently.

#### 4.4.3 t-Test (Partial)

Based on Appendix 1 can be used to verify partial regression analysis results in the independent variable on the dependent variable with a degree of confidence level  $\alpha = 0.05$ . There are 4 (four) variables that have a significant relationship while the other 2 (two) are not significant to the dependent variable. Variables that have a significant regression value are the price of crude oil with prob 0.0439; exchange rate with prob 0.0008; the size of the cargo with prob 0.0008; cost of customs with a prob of 0.0000. The variables that do not significantly affect the variable foreign logistics costs are the distance with prob 0.7304 and insurance costs with prob 0.1728.

Table 4. First Estimated t Test Results

Relationship between Variables			Prob	Information
Crude oil prices	→	foreign logistics costs	0.0439	Significant
Exchange rate	→	foreign logistics costs	0.0008	Significant
Distance	→	foreign logistics costs	0.7304	Not significant
Cargo size	→	foreign logistics costs	0.0008	Significant
Insurance fee	→	foreign logistics costs	0.1728	Not significant
Customs	→	foreign logistics costs	0.0000	Significant

Source: processed with EViews 10.00

Based on Table 4, it can be concluded that the first hypothesis proposed the regression model is unacceptable or rejected which is alleging that the variable of oil price, exchange rate, distance, size of the cargo, the cost of insurance and customs partially effected to the foreign logistics costs.

#### 4.5. Identification of Estimated Results of Second Equation

Identification equation of the second estimate is to examine the effect of exogenous or independent variables of fabrication (X7), rebar (X8), ready mix (X9) and bulk material (X10) to the dependent variable of domestic manufacture cost (Y2). The results of the regression test can be seen in Appendix 1. Based on the appendix, it can be explained that the variable fabrication, rebar, ready mix and bulk material have a positive and significant influence coefficient which means that every increasing volume weight for fabrication, rebar, ready mix and bulk material will increase the costs in the domestic manufacturing costs. Based on the regression results presented in Appendix 1 then model regression of the second estimation can be structured as follows:

$$DM = -1.74 * 10^8 + 142578.4 * FABR + 42513.57 * REBR + 40660.03 * READYMIX + 227738.3 * BULKM$$

The coefficient of fabrication is 142578.4 or have a positive relationship means that if the volume of fabrication have increased by one ton, the cost of domestic manufacture will increase by Rp 142,578.4. The coefficient for rebar is 42513.57 or has a positive relationship meaning that every an increase in the weight of rebar by one ton, it will cause an increase in logistics costs of domestic manufacturing costs by Rp 42,513.57. The coefficient for ready mix is 40660.03 or has a positive relationship meaning that every an increase of ready mix volume one ton, it will cause an increase in logistics costs of domestic manufacture of Rp 40,660.03. While the coefficient for bulk material is 227738.3 or has a positive relationship means that every an increase in the volume of bulk material capital goods by one ton, it will cause an increase in logistics costs for the domestic manufacture cost of Rp 227,738.3.

##### 4.5.1 The Coefficient of Determination ( $R^2$ )

Based on the results of test data from this study, it was obtained coefficient of determination ( $R^2$ ) that indicates the size or ability of the dependent variable can be explained or influenced by the independent variables. The higher the  $R^2$  then indicates that the estimation is better, and vice versa if the smaller  $R^2$  then the estimation is not quite convincing. Results of test based on Appendix 1 obtained the coefficient of determination adjusted R-squared ( $R^2$ ) is 0.671209. This shows that the cost of domestic manufacturing as the dependent variable in this model can be explained by 67.1209% by the independent variables in the research model of fabrication, rebar, ready mix and bulk material while the remaining 32.8791% is influenced by variables outside the model.

##### 4.5.2 F-Test (Simultaneous)

Proof of independent variables together have influenced to the dependent variable is done by using test F. Based on results of F-test as seen in Appendix 1 obtained value of  $F_{arithmetic}$  amounted to 86.23025 with a significance level of 0.000000. The results of this test indicate that all independent variables together in this study, consecutively fabrication, rebar, ready mix and bulk material, have a significant effect to the domestic manufacture variable. Using other methods by comparing the F test results showed that  $F_{count} > F_{table}$  is  $86.23025 > 2.90$  then  $H_0$  is rejected or  $H_1$  accepted, so it can be said that the variation model is be able to explain by the variations of the independent variables.

##### 4.5.3 t-Test (Partial)

Based on data test results in Appendix 1 obtained result of partial regression analysis results in the independent variable on the dependent variable with a degree of confidence level  $\alpha = 0.05$ . The complete test results of the partial coefficient of the t-test can be seen in Table 5. Based on the table, it can be seen that the all independent variables have a partial effect on the domestic manufacture variables are fabrication, rebar, ready-mix, and bulk material. With this regards, the second hypothesis proposed in this study can be accepted, which is a hypothesis that stated that the fabrication, rebar, ready mix, and bulk material variables have a partial effect on the domestic manufacture variable.

Table 5. Second Estimated t Test Results

Relationship between Variables			Prob	Information
Fabrication	→	domestic manufacture cost	0.0000	Significant
Rebar	→	domestic manufacture cost	0.0413	Significant
Ready mix	→	domestic manufacture cost	0.0000	Significant
Bulk material	→	domestic manufacture cost	0.0000	Significant

Source: processed with EViews 10.00

#### 4.6. Identification of Estimated Results of Third Equation

The identification the results of the regression estimation for the third equation is purposed to observe the effect the derived variable of foreign logistics costs (FLC) and domestic manufacture (DM) to the dependent variable domestic logistics costs (DLC). The results of regression for the third estimation of domestic logistics costs can be seen in Appendix 1. Based on the appendix, it can be explained that the foreign logistics costs variable has a positive effect coefficient which means that if the foreign logistics costs increases due to the rise of import of capital goods, it will increase the domestic logistics costs. The other independent variable, the variable of domestic manufacture also has a positive coefficient, which means that if the factor of domestic manufacturing increases because of the additional procurement of capital goods from within the country, it will increase the cost of domestic logistics costs.

Based on Appendix 1 can be seen that values regression coefficient of foreign logistics costs (FLC) is 6284.305 or has a positive correlation means that if the cost of foreign logistics cost (FLC) increases by one dollar the United States then the cost of domestic logistics costs (DLC) will be increased by Rp 6,284.31. The value of the regression coefficient for domestic manufacturing (DM) is 0.013841 or has a positive relationship meaning that every an increase in domestic manufacturing (DM) of one rupiah, it will cause an increase in domestic logistics costs (DLC) of Rp 0.013841. Based on Appendix 1 then the regression equation for the third estimations as follows:

$$\text{DLC} = 5.94 * 10^8 + 6284.305 * \text{FLC} + 0.013841 * \text{DM}$$

##### 4.6.1 The Coefficient of Determination ( $R^2$ )

Based on result of the test for the third estimation, it can be obtained by the coefficient of determination ( $R^2$ ) that indicates the size or ability of the variation of the dependent variable can be explained or explained by the independent variables. Based on Appendix 1 obtained outcome of test that the coefficient of determination adjusted R-squared ( $R^2$ ) is 0.651626. This shows that the domestic logistics costs (DLC) as the dependent variable in the third estimation model in this study can be explained by 65.1626% by the independent variable in the model that is foreign logistic cost and domestic manufacturing while the remaining 34.8374% is influenced by other variables outside the model.

##### 4.6.2 F-Test (Simultaneous)

Proof of independent variables altogether have impacted to the dependent variable is done by using test F. Criteria for significance can be based on the results of the  $F_{\text{count}}$  and coefficient probability  $F_{\text{count}}$  based on result of F test calculation as presented Appendix 1 obtained value of  $F_{\text{arithmetic}}$  amounted to 157.1846 with a significance level of 000000. This shows that combining foreign logistics costs (FLC) and domestic manufacture (DM) variable have a significant effect to the domestic logistics costs (DLC). Using other methods by comparing the F test results showed that  $F_{\text{count}} > F_{\text{table}}$  is  $157.1846 > 3.47$  then  $H_0$  is rejected or  $H_1$  accepted, so it can be said that the variation model of the dependent able to explain the variation of the independent models together.

##### 4.6.3 t-Test (Partial)

Based on Appendix 1 have partial regression analysis results in the independent variable on the dependent variable with a degree of confidence level  $\alpha = 0.05$ . The complete results of the partial test of the coefficient of the t-test



can be seen in Table 6 which can show an interpretation of the significance of the partial and found that foreign logistics costs are more significant than domestic manufacture.

Table 6. Third Estimated t Test Results

Relationship between Variables		Prob	Information
Foreign logistic costs	→ domestic logistic cost	0.0000	Significant
Domestic manufacture cost	→ domestic logistic cost	0.8967	Not significant

Source: processed with EViews 10.00

Based on Table 6 it can be seen that not all variables are proposed in this study consisted of variables foreign logistics costs (FLC) and domestic manufacture (DM) partially have effected to the dependent variable domestic logistics costs (DLC). The results of the domestic manufacture (DM) regression test were 0.8967 which showed no significant effect to the domestic logistics costs (DLC). Based on the test results it can be concluded that the hypothesis of a third proposed in this study cannot be accepted or rejected which hypothesis alleging that the variable foreign logistics costs (FLC) and domestic manufacture (DM) are partially effecting to the variable domestic logistics costs (DLC).

#### 4.7. Identification of Estimated Results of the Fourth Regression Equation

Results of regression test of the fourth estimation is to determine and investigate the effect of variable domestic logistics costs (DLC) to the variable total investment (TI). Results of regression of the fourth estimation is presented in Appendix 1. Based on the appendix, it can be explained that the domestic logistics costs (DLC) variable has a significant positive effect coefficient to the total investment (IT).

Based on Appendix 1 it can be seen that the value of the domestic logistics costs (DLC) regression coefficient is 81.70923 or has a positive relationship meaning that if the domestic logistic cost factor (DLC) increases by one rupiah the total investment cost (IT) will increase by Rp 81.70923. Therefore regression of the fourth estimated research can be arranged as follows:

$$TI = 6.33 * 10^{10} + 81.70923 * DLC.$$

##### 4.7.1 The Coefficient of Determination ( $R^2$ )

Results of test data from this study were obtained coefficient of determination ( $R^2$ ) which shows the ability of independent variables able to explain more variation from change in the dependent variable. Based on the results of the regression test fourth estimation as presented in Appendix 1 obtained coefficient of determination adjusted R-squared ( $R^2$ ) is 0.676480. The result indicates that the variable total investment (TI) as the dependent variable of the fourth estimation can be explained by 67.6480% by the independent variable in the model of research that domestic logistics costs (DLC) while the remaining 32.3520% influenced by other variables outside the model.

##### 4.7.2 t-Test (Partial)

Based on the test results of data as presented in Appendix 1 obtained results of partial regression analysis on the independent variable on the dependent variable with a degree of confidence level  $\alpha = 0.05$ . Learn from the test results obtained by the value of the coefficient of partial test as shown in Table 7.

Table 7. Fourth Estimated t Test Results

Relationship between Variables		Prob	Information
Domestic logistic cost	→ total investment	0.0000	Significant

Source: processed with EViews 10.00

Based on Table 7 it can be seen that the independent variables affect significantly to the total investment variable partial so the hypothesis fourth proposed in this study accepted which hypothesis alleging that the variable domestic logistics costs (DLC) influence partial significant to the total variable investment (IT).

#### 4.7.3 F-Test (Simultaneous)

Proving the effect of simultaneous independent variables domestic logistics costs (DLC) on the dependent variable total investment (TI) is done by using test F. Criteria for significance can be based on the results of the  $F_{count}$  and prob  $F_{count}$  based on results of the regression test fourth estimation as shown in Appendix 1 obtained value of  $F_{arithmetic}$  amounted to 366.9242 with a significance level 0.000000. This shows that the domestic logistics costs (DLC) variable significantly influences the total investment (IT) variable. Using the methods of testing other by comparing the value of  $F_{arithmetic}$  and prob  $F_{arithmetic}$  shows that  $F_{count} > F_{table}$  is  $366.9242 > 4.30$  then  $H_0$  is rejected or  $H_1$  accepted, so it can be said that the variation model of the dependent is able to explain the variations of the model independently.

## 5. Conclusion

Executing cement projects in Indonesia are still confusing and questioning ever been. Controlling budgets especially became puzzling and based on experienced was always traditionally exceeded that consequently prone to be targeted by auditor. The problems is the best model logistics costs were not discovered even at the preliminary level in Indonesia. Practitioners and or experts are only relying information and data from uncertain sources that explaining logistics costs in Indonesia at 27% GDP. The number that does not make sense comparing logistics costs in regions are about 7% to maximum of 12%.

Based on the need that logistics costs model is urgently demanding in Indonesia, through theoretical, literature, and empirical approach, the model is proposed and presented. Based on study, model logistics costs in Indonesia consists of foreign logistics costs, domestic manufacture, domestic logistics costs that build of total costs investment. To be concerning that variable foreign logistics costs found took bigger portion in Indonesia and must be prior becoming high attention to every investor who are willing to make investment in Indonesia.

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### Conflict of Interest

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**List of Appendixes**

## Appendix 1.

**First estimation**

Dependent Variable: FLC

Method: Panel Least Squares

Date: 04/19/19 Time: 20:11

Sample (adjusted): 2010Q4 2018Q4

Periods included: 36

Cross-sections included: 8

Total panel (balanced) observations: 288

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-48193.11	50296.09	-0.958188	0.3394
OIL(-2)	1114.324	548.6637	2.030977	0.0439
DEXCHANGE(-2)	-59.98031	17.62008	-3.404089	0.0008
DIST(-2)	-0.246449	0.714039	-0.345148	0.7304
SIZE(-2)	12.06561	3.532927	3.415189	0.0008
DINS(-2)	0.507226	0.370404	1.369384	0.1728
CUST(-2)	1.09E-05	7.29E-07	14.92872	0.0000
R-squared	0.735230	Mean dependent var		183370.5
Adjusted R-squared	0.725363	S.D. dependent var		125434.2
S.E. of regression	65734.83	Akaike info criterion		25.06542
Sum squared resid	6.96E+11	Schwarz criterion		25.19558
Log likelihood	-2098.495	Hannan-Quinn criter.		25.11825
F-statistic	74.51247	Durbin-Watson stat		2.061981
Prob(F-statistic)	0.000000			

**Second estimation**

Dependent Variable: DDM

Method: Panel Least Squares

Date: 04/13/19 Time: 23:14

Sample (adjusted): 2010Q4 2018Q4

Periods included: 36

Cross-sections included: 8

Total panel (balanced) observations: 288

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.74E+08	40753599	-4.259762	0.0000
FABR(-2)	142578.4	33104.23	4.306955	0.0000
REBR(-2)	42513.57	20669.41	2.056834	0.0413
DREADYMIX(-2)	40660.03	2431.197	16.72428	0.0000
DBULKM(-2)	227738.3	50198.38	4.536766	0.0000
R-squared	0.679084	Mean dependent var		-13174460
Adjusted R-squared	0.671209	S.D. dependent var		4.21E+08
S.E. of regression	2.42E+08	Akaike info criterion		41.47213
Sum squared resid	9.51E+18	Schwarz criterion		41.56510
Log likelihood	-3478.659	Hannan-Quinn criter.		41.50986
F-statistic	86.23025	Durbin-Watson stat		1.938147
Prob(F-statistic)	0.000000			

**Third estimation**

Dependent Variable: DLC

Method: Panel Least Squares

Date: 04/13/19 Time: 23:16

Sample (adjusted): 2010Q4 2018Q4

Periods included: 36

Cross-sections included: 8

Total panel (balanced) observations: 288

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.94E+08	79957957	7.433304	0.0000
FLC(-2)	6284.305	356.3266	17.63636	0.0000
DDM(-2)	0.013841	0.106494	0.129973	0.8967
R-squared	0.655798	Mean dependent var		1.75E+09
Adjusted R-squared	0.651626	S.D. dependent var		1.01E+09
S.E. of regression	5.96E+08	Akaike info criterion		43.26605
Sum squared resid	5.86E+19	Schwarz criterion		43.32183
Log likelihood	-3631.348	Hannan-Quinn criter.		43.28869
F-statistic	157.1846	Durbin-Watson stat		1.897979
Prob(F-statistic)	0.000000			

**Fourth estimation**

Dependent Variable: TI

Method: Panel Least Squares

Date: 04/13/19 Time: 23:18

Sample (adjusted): 2010Q3 2018Q4

Periods included: 36

Cross-sections included: 8

Total panel (balanced) observations: 288

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.33E+10	7.98E+09	7.927778	0.0000
DLC(-2)	81.70923	4.265628	19.15527	0.0000
R-squared	0.678328	Mean dependent var		1.91E+11
Adjusted R-squared	0.676480	S.D. dependent var		1.02E+11
S.E. of regression	5.82E+10	Akaike info criterion		52.42372
Sum squared resid	5.90E+23	Schwarz criterion		52.45974
Log likelihood	-4611.287	Hannan-Quinn criter.		52.43833
F-statistic	366.9242	Durbin-Watson stat		1.934602
Prob(F-statistic)	0.000000			