

The Effect of Special Economic Zone and International Hub Port Development on the Transportation Infrastructure Provision

Royke Octavian Roring, Ludfi Djakfar, Achmad Wicaksono



Abstract: The Indonesian government has established a Special Economic Zone (SEZ) and International Hub Port (IHP) in Manado, Indonesia. The research aims to understand the effect of both SEZ and IHP and traffic generated by these two developments on the provision of transportation infrastructures. 264 stakeholders were interviewed in this study. The Structural Equation Modeling (SEM) was implemented to answer regressive and dimensional questions. The respondents were first confirmed about their knowledge of SEZ and IHP development before being interviewed. The research variables were divided into 5 namely IHP development, SEZ Development, Logistics Transportation Users, Logistic Traffic Flows and the Provision of Transportation Infrastructures. The Exogenous variables were the IHP development and SEZ development, while the endogenous variable was the Provision of Transportation Infrastructures. The results showed that the Development of the International Hub Ports has the greatest total effect on Logistics Transportation Users, and subsequently on the Traffic Flow of Goods followed by the Provision of Transportation Infrastructures. The Development of Special Economic Zones has a positive effect on the Logistic Traffic Flow and on the Provision of Transportation Infrastructures. Logistics Transportation Users have a direct effect on the Traffic Flow of Goods and on the Provision of Transportation Infrastructures. The Traffic Flow of Goods gives a direct influence on the Provision of Transportation Infrastructures. Logistics Transportation Users are the dominant factors which affect the Transportation Infrastructure Provision. Then, Logistics Transportation Users are influenced by the development of IHP. This research demonstrates that there is a reciprocal relationship between both SEZ and IHP and the provision of transportation infrastructures. Thus, this study recommends that the North Sulawesi transportation infrastructure plan should be aligned with the needs of the SEZ and IHP, which ensures both international and national connectivity. The results of this study can be used to recommend appropriate policies regarding infrastructure provision.

Keywords: Special Economic Zones (SEZ), International Hub Ports (IHP), Logistics Transportation Users, Logistic Traffic Flows, Provision of Transportation Infrastructures, SEM.

Revised Manuscript Received on February 28, 2020.

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I. INTRODUCTION

Manado is a capital of the North Sulawesi Province. About 45 km west of the city of Manado lies the city of Bitung, which has an important role in the transportation sector for the province of North Sulawesi because of its largest port in the northernmost province in Indonesia. Based on Presidential Decree of the Republic of Indonesia Number 14 of 1998, the Manado-Bitung Region was designated as an integrated economic development zone known as the Manado-Bitung Integrated Economic Development Zone (KAPET Manado-Bitung). In addition, through the Presidential Decree of the Republic of Indonesia Number 32 of 2011 about Indonesian government policy for masterplan of the acceleration and expansion of Indonesian Economic Development of 2011 to 2025, Special Economic Zone (SEZ) in Indonesia was encouraged. As a result, a SEZ in the city of Bitung was established by Government Regulation Number 32 of 2014. The map of Manado city and Bitung city is provided in Fig. 1.

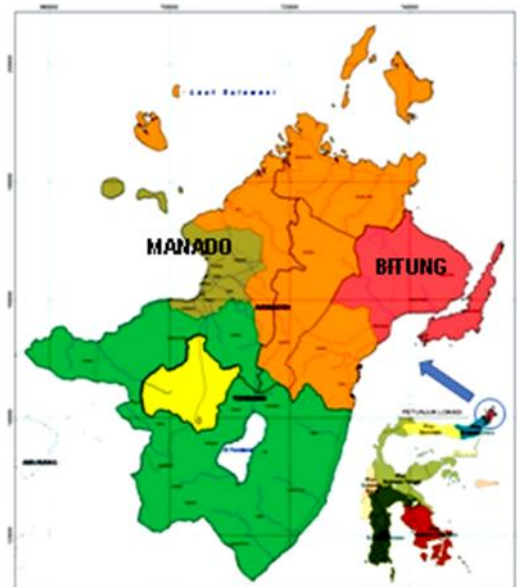


Fig. 1. The map of the city of Manado and Bitung

The special economic zone (SEZ) is an area designated to carry out economic functions and to obtain certain facilities aimed at multiplying the national economic growth, as well as to have a large impact on the increasing domestic employment.



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The need for the development of SEZs is motivated by the undeveloping special areas for export-oriented industrial processes.

On the other hand, it is necessary to accelerate the economic growth, the modernization of industry, as well as the trade and export growth, which impact on job creations, the increase of foreign exchange, and the increase of service products. Researchers have attempted to investigate the level of success of this SEZ for economic growth (Ge, 1999; Makabenta, 2002; Nel and Rogerson, 2013). Besides, the Indonesian government has established the construction of an International Hub Port (IHP) in Bitung in order to accelerate the national economic growth.

These developments are the efforts to stimulate and increase economic activities and to provide more opportunities for the business community to participate more in eastern Indonesia, especially in North Sulawesi Province. One of the main strategies of this development is to strengthen national connectivity through strengthening the infrastructure improvement, including infrastructure in the field of transportation. The infrastructure development in the transportation sector will support strategic economic areas built in various potential regions in Indonesia which are expected to drive economic growth in the surrounding area, and form linkages with the surrounding areas in an integrated regional economic system.

Previous studies also showed that this transportation infrastructure has a great impact on welfare (Czerny, et al., 2014; Wang and Slack, 2004). However, none of these studies investigated the necessity to build supporting transportation infrastructures for supporting the SEZ and IHP. For this reason, this study attempts to model the effect of the Development of Special Economic Zones, Development of International Hub Ports, and Logistics Transportation Users on the Provision of Transportation Infrastructures in Bitung with a Structural Equation Modeling approach.

II. LITERATURE REVIEW

A lot of research on transportation infrastructure had been conducted by researchers. Several research regarding the transportation infrastructures discussed about sustainable infrastructures (Azwar et al., 2013; Krajangsri and Pongpeng, 2016). Furthermore, Ülengin et al (2010) modeled the relationship between transportation and environment. Then, some researchers built a model of mass public transportation demand in developing countries, such as in Supriyatno et al. (2012). While Ewing et al., (2014) and McIntosh et al.(2014) conducted research about travel distance growth in transportation infrastructures, Alqhatani et al (2012) demonstrated the interaction between land use and transportation which is performed by comparing the issue in the Melbourne and Riyadh city. Other research about transportation infrastructures is an evaluation of the effect of new highway construction to the generate travel (Fujii and Kitamura, 2000). Moreover, studies from Cohen and Paul, (2007), Dorantes et al., (2011), Efthymiou and Antoniou (2014, 2013), and Tsutsumi and Seya (2008) showed the effect of transportation infrastructures to the property price. Furthermore, the transportation infrastructures also have impact on the agriculture production as shown by Tong et al.(2013). Most researchers showed that transportation

infrastructures play important roles in economic growth in certain areas (Arbués et al., 2015; Chen and Haynes, 2017, 2015a, 2015b; Deng et al., 2013; Garcia-López, 2012; Jiang et al., 2017; Li et al., 2017; Moralles and do Nascimento Rebelatto, 2015; Peterson and Jessup, 2008). Researchers also investigated the relationship between infrastructures and area developments, e.g. Rumayar et al (2018) who studied about the relationship of land use and existing traffic and its impact to the corridor performance of the Manado - Bitung road. This research is an attempt to build a model that explains the effect of Development of Special Economic Zones, Development of International Hub Ports, Logistics Transportation Users for the Provision of Transportation Infrastructures in Bitung using a Structural Equation Modeling approach.

III. METHOD

A. Conceptual Structure

It is known that the construction of the SEZ and IHP was to encourage economic growth, especially in Eastern Indonesia. In order to succeed the SEZ and IHP, the supporting transportation infrastructures such as toll roads, railroads and airports must be provided. Unlike in the built environment areas, the development of the SEZ and IHP in Bitung city has been established before the supporting transportation infrastructures exist. This development makes the transportation infrastructure provision scenarios that are in line with the need of supporting infrastructures for both the SEZ and the IHP can be provided. Therefore, it needs to be tested whether the North Sulawesi transportation infrastructure development plan is aligned with the needs of the Bitung SEZ and IHP.

In order to achieve this goal, a good understanding of relevant stakeholders is needed. This study investigates the associate stakeholders' perspectives of the effects of SEZ and IHP on the provision of transportation infrastructures. Moreover, this study examines the priority of the supporting infrastructure which is needed for supporting the SEZ and the IHP.

The hypothesis of this research is that, apart from the direct effects on the supply of transportation infrastructures, the SEZ development will increase logistics traffic flows, which in turn will increase the provision of transportation infrastructures. The construction of the IHP can directly affect the provision of transportation infrastructures, as well as increase logistics transportation users (entrepreneurs in the SEZ and surrounding areas) and ultimately result an increase in the transportation infrastructure provision.

B. Data Collection

The data for this study are primary data which were taken directly from the questionnaires distributed to the stakeholders in Manado, Bitung, Minahasa and North Minahasa. 264 respondents were interviewed in this research. The SEM was used by the researcher to answer the regressive and dimensional questions. The dimensions of a concept or a construction were identified by using the confirmatory factor analysis, and the effect or degree of relationship between the factors was measured by using path analysis.



The data were taken using two methods, i.e. direct interviewing the respondents and using application built for mobile phones.

This application was shared via social media. The questionnaires would be filled out after confirming the knowledge of prospective respondents about the SEZ and IHP.

Table-I: Characteristics of respondents

Social-Demographic	Variable	Proportion
Knowledge about KEK and IHP	Less	42%
	Adequate	45%
	full	13%
Age	<=20	2%
	21-30	18%
	31-40	20%
	41-50	45%
	51-60	14%
	61-70	1%
Gender	Male	79%
	Female	21%
Occupation	Indonesian state owned enterprises employees	6%
	Civil servants	38%
	Students	6%
	Private	33%
	Military / Police	1%
	Others	17%

Most respondents answered that they knew enough (45%), while those who answered knew a little and knew very well were as much as 42% and 13%, respectively. These showed that the majority of respondents have known about KEK and IHP although there was only a small proportion of respondents who claim that they really know about the developments. Most respondents (45%) aged between 41 to 50 years, followed by 31 to 40 years (20%), 21 to 30 years (18%), and 51 to 60 years (14%). The remaining 2% aged up to 20 years and 1% aged over 60 years. This age distribution shows that most of the respondents who know about KEK and IHP were in their productive age or working. Only a small proportion are not productive. Most respondents in this study were male (79%), while a minority were female (21%).

The majority of the respondents work as civil servants (38%) or have private works (33%) and other professions (17%). The number of respondents who are students and Indonesian state-owned enterprises employees shares same proportion, 6% each. The military / police profession was as much as 1%. The characteristics of the respondents are shown in Table-I.

The research variables were divided into 5 latent variables, namely: IHP Development, SEZ Development, Logistics Transportation Users, Logistic Traffic Flow and Provision of Transportation infrastructures. The exogenous variables in this study were the development of the SEZ and the Development of the IHP, which have a close relationship between these two variables so that it is difficult to analyze them by using ordinary multivariate analysis such as a regression analysis. Each of these exogenous variables has 8 (eight) indicators. Furthermore, the endogenous variable is the Provision of Transportation infrastructures, in this case toll roads, railways and airports, each of which is indicated by 3 (three) indicators. The development of the Bitung International Hub Port within the framework of this concept, which has a direct influence on the Provision of Transportation infrastructures, is considered to have an effect on the Transportation Users of Manado Bitung Logistics as

shown by the 7 (seven) indicators. Furthermore, this variable also influences the Provision of Transportation infrastructures.

Respondents stated their agreement to the variables' indicators through 5 degrees of agreement in which number 1 stated strongly disagree and number 5 stated strongly agreed. Before the SEM analysis, measuring instrument test i.e. validity and reliability tests were conducted. Afterwards, the data were tested against the normality test, the singularity test, the multi-collinearity test and the outlier test.

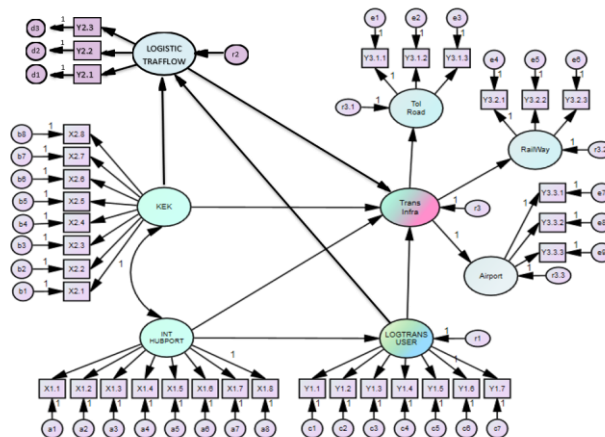


Fig. 2. Conceptual Framework for the Transportation Infrastructure Provision in Manado

The SEM approach is a fit model based on GoF (Goodness of Fit) criteria. In modeling, the suitability test system is very important because the goodness of fit test is a test of compatibility or goodness between the results of observations (frequency of observations) with the frequency obtained based on the expected value (theoretical frequency). In the SEM analysis, there is no single statistical test to test hypotheses regarding the model (Hair et al., 1998), but various fit indexes are used to measure the degree of correspondence between the model presented and the data presented. Fit index used includes 1) Chi Square, to develop and test whether a model is compatible with the data. Chi Square is very sensitive to samples that are too small or too large. Therefore, this test needs to be supplemented with other test equipment. Chi-squares value is a measure of the poor fit of a model. 2) Goodness of Fit Index (GFI), an index that illustrates the overall suitability of the model, calculated from the squared residuals of the predicted model compared to the actual data. GFI value ≥ 0.90 indicates that the model being tested has a good fit. 3) Root Mean Square Error of Approximation (RMSEA), a measure that tries to improve the tendency of chi square statistics rejecting models with a large sample size. RMSEA which values between 0.05 and 0.08 indicates a good index to accept the suitability of a model. 4) Adjusted Goodness Fit of Index (AGFI), a development of the Goodness Fit of Index (GFI) which has been adjusted to the ratio of degree of freedom and analogous to R2 in multiple regression. The recommended value is AFGI ≥ 0.90 . The greater the AFGI value, the better the suitability of the model. 5) Tucker Lewis Index (TLI), an incremental conformity index that compares the tested model with the baseline model. TLI is used to overcome problems that arise due to the complexity of the model.



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The recommended acceptance value is a TLI value ≥ 0.90 .

TLI is an index that is less affected by the sample size. 6) Normed Fit Index (NFI), a measure of comparison between proposed models and null models. The recommended value is $NFI \geq 0.90$. 7) Comparative Fit Index (CFI), an incremental conformity index. The magnitude of this index is in the range of 0 to 1 and values close to 1 indicate the model has a good level of conformity. This index is highly recommended because it is relatively insensitive to sample size and is less influenced by the complexity of the model. The recommended acceptance value is $CFI \geq 0.90$. 8) Normed Chi Square (CMIN / DF), a measure obtained from the chi-square value divided by the degree of freedom. This index is a parsimony suitability index that measures the relationship of goodness of fit models and the estimated coefficient amounts expected to achieve suitability levels. The recommended acceptance value is $CMIN / DF < 2.0$ or 3.0 . The SEM model is arranged according to the conceptual framework presented in Fig. 2.

IV. RESULT AND DISCUSSION

A. Validity & Reliability

Validity test is intended to determine whether the questions in the questionnaire are representative and reliability test is a measure of internal consistency of the indicators of a formed variable that shows the degree to which each indicator indicates a common variable formation. Validity and reliability tests are carried out using confirmatory factor analysis, and the results are presented in Table-II.

Table-II shows that all loading factor values are greater than 0.5, the p-value of the error variance is less than $\alpha = 0.05$ and the Composite Reliability value is greater than 0.7, so it can be said that all latent variables and indicators are valid and reliable. Development of International Hub Port (X1) with the biggest indicators are (X1.5) and (X1.7) with values of 0.872 and 0.861. Development of Special Economic Zone (X2) with the biggest indicators are (X2.1) and (X2.4) with values of 0.867 and 0.770. Logistics Transportation Users

with the biggest indicators are (Y1.2) and (Y1.6) amounting to 0.851 and 0.805. Logistics Traffic Flow with the biggest indicators are (Y2.3) and (Y2.1) amounting to 0.789 and 0.779. The Provision of Transportation infrastructure with the biggest Aspect is Airport (0.99) with biggest indicator (Y3.3.2) with a value of 0.789, Rail Way aspects (0.96) with the biggest indicator (Y3.2.1) with a value of 0.895, and Road Toll aspects (0.85) with the biggest indicator (Y3.1.1) amounting to 0.805.

B. Modeling the Effect of IHP, SEZ, Logistics Transportation Users and Logistic Traffic Flows to the Provision of Transportation Infrastructures

After testing the validity and reliability of each latent variable, several prerequisites must be met in covariance-based structural modeling which are, normal multivariate, non-singular and non-outlier.

Multivariate Normal Assumptions

The normality of data is required for conducting Structural Equation Modeling (SEM) modeling. Normality testing is emphasized on multivariate data by looking at the value of skewness, kurtosis, and it can be seen statistically from the Pearson Correlation value between dj and q. If a significance level of 5 percent is used, then the Pearson Correlation value between dj and q is more than 0.5 or p is smaller than $\alpha = 0.05$, it is said that the data is normally distributed multivariately. The Pearson Correlation value between dj and q is 0.969 or $p = 0.000 < \alpha = 0.05$, so it can be concluded that the data is multivariate normally distributed.

Singularity Assumptions

Singularity can be seen through the determinant of the covariance matrix. A very small or near zero determinant value indicates a Singularity problem, so it cannot be used for research. The results of the study give a Determinant of sample covariance matrix value of $.159 > 0$, so it can be assumed that there is no singularity problem in the analyzed data.

Table-II: Validity and Reliability test

Variabels	Indicators	Convergence validity			Reliability		Composite Reliability
		Loading Factor	p-value	validity	p-value	reliability	
International Hub Port Development (X1)	X1.1	0.830	0.000	Valid	0.000	Reliabel	0.939
	X1.2	0.805	0.000	Valid	0.000	Reliabel	
	X1.3	0.753	0.000	Valid	0.000	Reliabel	
	X1.4	0.769	0.000	Valid	0.000	Reliabel	
	X1.5	0.872	0.000	Valid	0.000	Reliabel	
	X1.6	0.777	0.000	Valid	0.000	Reliabel	
	X1.7	0.861	0.000	Valid	0.000	Reliabel	
	X1.8	0.811	0.000	Valid	0.000	Reliabel	
Development of Special Economic Zone (X2)	X2.1	0.867	0.000	Valid	0.000	Reliabel	0.885
	X2.2	0.635	0.000	Valid	0.000	Reliabel	
	X2.3	0.697	0.000	Valid	0.000	Reliabel	
	X2.4	0.770	0.000	Valid	0.000	Reliabel	
	X2.5	0.636	0.000	Valid	0.000	Reliabel	
	X2.6	0.765	0.000	Valid	0.000	Reliabel	
	X2.7	0.698	0.000	Valid	0.000	Reliabel	
	X2.8	0.509	0.000	Valid	0.000	Reliabel	
Logistic Transportation User (Y1)	Y1.1	0.750	0.000	Valid	0.000	Reliabel	0.913
	Y1.2	0.851	0.000	Valid	0.000	Reliabel	
	Y1.3	0.731	0.000	Valid	0.000	Reliabel	
	Y1.4	0.742	0.000	Valid	0.000	Reliabel	
	Y1.5	0.790	0.000	Valid	0.000	Reliabel	
	Y1.6	0.805	0.000	Valid	0.000	Reliabel	



Logistic Traffic Flow (Y2)		Y1.7	0.742	0.000	Valid	0.000	Reliabel	0.812
		Y2.1	0.779	0.000	Valid	0.000	Reliabel	
		Y2.2	0.735	0.000	Valid	0.000	Reliabel	
Transportation Infrastructure Provision (Y2)	Tol	Y3.1.1	0.805	0.000	Valid	0.000	Reliabel	0.819
	Road (0.914)	Y3.1.2	0.763	0.000	Valid	0.000	Reliabel	
	Rail	Y3.1.3	0.758	0.000	Valid	0.000	Reliabel	
	Way (0.951)	Y3.2.2	0.777	0.000	Valid	0.000	Reliabel	
	Airport (0.952)	Y3.2.3	0.813	0.000	Valid	0.000	Reliabel	
		Y3.3.1	0.690	0.000	Valid	0.000	Reliabel	
	Y3.3.2	0.789	0.000	Valid	0.000	Reliabel	0.800	
	Y3.3.3	0.787	0.000	Valid	0.000	Reliabel		

Note

- | | |
|--|--|
| X1.1 The IHP needs infrastructure | Y1.3 The industrial area around SEZ and IHP are already dense |
| X1.2 IHP Logistics need infrastructure | Y1.4 The trade and service area around IHP is already crowded |
| X1.3 Community around IHP needs infrastructure | Y1.5 SEZ and IHP affect the provision of transportation infrastructures |
| X1.4 Existing infrastructure is adequate for IHP activities | Y1.6 Industrial area in SEZ and IHP affect the provision of transportation infrastructures |
| X1.5 Existing infrastructure is adequate for IHP accessibility | Y1.7 The trade and service area in SEZ and IHP affect the provision of transportation infrastructures |
| X1.6 Existing infrastructure is adequate for activities of community around IHP location | Y2.1 Logistic traffic flow is affected by SEZ and IHP |
| X1.7 The existing infrastructure is adequate for IHP | Y2.2 Local logistic traffic flow is affected by SEZ and IHP |
| X1.8 The existing infrastructure is adequate for Logistic IHP | Y2.3 Local logistic traffic flow is affected by the industry around SEZ and IHP |
| X2.1 SEZ needs infrastructure | Y3.1.1 Logistics flow are influenced by SEZ and IHP |
| X2.2 Logistic SEZ needs infrastructure | Y3.1.2 Local logistic flow are influenced by SEZ and IHP |
| X2.3 Community around SEZ needs infrastructure | Y3.1.3 Local logistic flow are influenced by industry around SEZ and IHP |
| X2.4 Existing infrastructure is adequate for SEZ activities | Y3.2.1 Manado Bitung Toll road is adequate for SEZ and IHP activities |
| X2.5 Existing infrastructure is adequate for SEZ access | Y3.2.2 Need Traffic Engineering for Toll road to support SEZ and IHP |
| X2.6 Existing infrastructure is adequate for activities of community around SEZ location | Y3.2.3 The tol construction should be continued to all parts of Sulawesi island to support SEZ and IHP |
| X2.7 The existing infrastructure is adequate for SEZ | Y3.3.1 Rail road is important for SEZ and IHP activities |
| X2.8 The existing infrastructure is adequate for Logistic SEZ | Y3.3.2 Rail road with TOD concept is important to support SEZ and IHP |
| Y1.1 The existing infrastructure is already heavily used | Y3.3.3 Inter province high speed rail road is needed to support KEK and IHP |
| Y1.2 The existing logistic infrastructure is already heavily used | |

Outliers

Outliers are observations that are far from other observations or appear extreme both univariate and multivariate. Outlier test results in this study are presented in Mahalanobis distance or Mahalanobis d-squared. Mahalanobis values that are greater than Chi-square tables or p1 values <0.001 are said to be outlier observations. In this study there are no data with a value of p1 <0.001, so it can be said that there is no outlier. Furthermore, the influence between latent variables is used in structural equation modeling using the path diagram form as shown in Fig.

3.

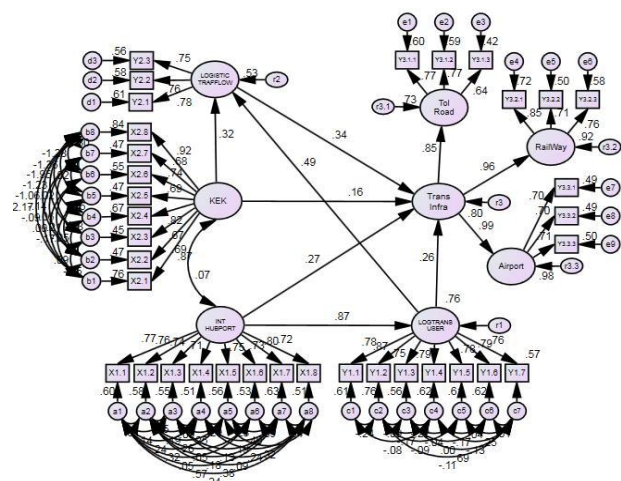


Fig. 3. Model of International Hub Ports, Special Economic Zones, Logistics Transportation Users and Logistic Traffic



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Flows to the Provision of Transportation Infrastructures
 The structural equation in Fig. 3. is as follows:
 Logistic Transportation User = 0.871 IHP
 Logistic Traffic Flow

$$\begin{aligned}
 &= 0.324 \text{ SEZ} \\
 &+ 0.487 \text{ Logistic Transportation User} \\
 \text{Provision of Transportation Infrastructure} \\
 &= 0.268 \text{ IHP} + 0.163 \text{ SEZ} \\
 &+ 0.256 \text{ Logistic Transportation User} \\
 &+ 0.336 \text{ Logistic Traffic Flow}
 \end{aligned}$$

Test result of complete model as in Fig. 3 by utilizing the AMOS program can be seen in Table-III.

Table-III shows that most of the criteria confirm that the model is feasible. It can be concluded that the model is acceptable, which means that there is a match between the model and the data. Testing results of the path coefficient in the Fig. 3 and the above equation in detail are presented in Table-IV.

Table-III: Results of Testing the Transportation Infrastructure Model

Criterion	Cut – Off Value	The calculation results	Information
Chi – Square	Expected to be small	889.947	χ^2 with df = 487 Dissatisfactory
Significance Probability	≥ 0.05	0.000	Dissatisfactory
RMSEA	≤ 0.08	0.056	Good
GFI	≥ 0.90	0.848	Fair
AGFI	≥ 0.90	0.804	Fair
CMIN/DF	≤ 2.00	1.827	Good
TLI	≥ 0.90	0.923	Good
CFI	≥ 0.90	0.937	Good

Utilizing the model and Table-IV, each path coefficient can be interpreted as follow:

- The development of the International Hub Port (X1) is significant and has a positive effect on Logistics Transportation User (Y1). This can be seen from the path coefficient which is positive at 0.871 with a value of C.R. amounted to 10.443 and the significance probability obtained (p) of 0.000 was greater than the significance level (α) determined at 0.05. Thus the International Hub Port Development (X1) has a direct effect on Logistics Transportation User (Y1) of 0.871, which means that every unit increase in the International Hub Port Development (X1) will increase Logistics Transportation User (Y1) value by 0.871.
- Logistics Transportation User (Y1) is significant and has a positive effect on the flow of goods traffic (Y2). This can be seen from the path coefficient that is positive at 0.487 with a value of C.R. of 6.592 and obtained a significance probability (p) of 0,000 which is greater than the significance level (α) determined at 0.05. Thus Logistic Transportation User (Y1) directly influences the Logistic Traffic Flow (Y2) by 0.487, which means that every increase in Logistics Transportation User (Y1) will affect an increase in freight traffic Flow (Y2) by 0.487.
- The Development of Special Economic Zone (X2) has a positive and significant effect on the flow of goods traffic (Y2). This can be seen from the path coefficient that is positive at 0.324 with a value of C.R. of 5,137 and obtained a significance probability (p) of 0,000 which is smaller than the significance level (α) determined at 0.05. Thus the

Development of Special Economic Zone (X2) directly affects the flow of goods traffic (Y2) by 0.324, which means that every increase in the Development of Special Economic Zone (X2), will increase the Logistic Traffic Flow (Y2) by 0.324.

- The Logistic Traffic Flow (Y2) has a positive and significant effect on the provision of transportation infrastructure (Y3). This can be seen from the path coefficient that is positive at 0.336 with a value of C.R. of 4,570 and obtained a significance probability (p) of 0,000 which is smaller than the significance level (α) determined at 0.05. Thus, the Logistic Traffic Flow (Y2) directly affects the provision of transportation infrastructure (Y3) of 0.336, which means that every increase in the Logistic Traffic Flow (Y2) will increase the provision of transportation infrastructure (Y3) by 0.336.

Table-IV: Results of Testing the Path Coefficient in the Model of Transportation Infrastructures

Variables	Coef.	Critical Ratio (C.R.)	p-value	Information
International Hub Port Development (X1) → Logistic Transportation User (Y1)	.871	10.443	.000	Significant
Logistic Transportation User (Y2) → Logistic Traffic Flow (Y2)	.487	6.592	.000	Significant
Special Economic Zone Development (X2) → Logistic Traffic Flow (Y2)	.324	5.137	.000	Significant
Logistic Traffic Flow (Y2) → Provision of Transportation Infrastructure (Y3)	.336	4.570	.000	Significant
International Hub Port Development (X1) → Provision of Transportation Infrastructure (Y3)	.268	2.125	0.034	Significant
Logistic Transportation User (Y1) → Provision of Transportation Infrastructure (Y3)	.256	2.248	.025	Significant
Special Economic Zone Development (X2) → Provision of Transportation Infrastructure (Y3)	.163	3.051	.002	Significant

Source : data analysis

- The development of the International Hub Port (X1) has a positive and significant effect on the provision of transportation infrastructure (Y3). This can be seen from the path coefficient that is positive at 0.268 with a value of C.R. of 2,125 and obtained a significance probability (p) of 0.034 which is smaller than the significance level (α) determined at 0.05. Thus, the International Hub Port Development (X1) directly affects the provision of transportation infrastructure (Y3) by 0.268,



which means that every increase in the International Hub Port Development (X1) will increase the provision of transportation infrastructure (Y3) by 0.268.

- Logistics Transportation User (Y1) have a positive and significant effect on the provision of transportation infrastructure (Y3). This can be seen from the path coefficient that is positive at 0.256 with a value of C.R. of 2,248 and obtained a significance probability (p) of 0.025 which is smaller than the significance level (α) determined at 0.05. Thus, Logistics Transportation User (Y1) directly influences the provision of transportation infrastructure (Y3) by 0.256, which means that every increase in Transportation Transportation User (Y1) will increase the provision of transportation infrastructure (Y3) by 0.256.
- The Development of Special Economic Zone (X2) has a positive and significant effect on the provision of transportation infrastructure (Y3). This can be seen from the path coefficient that is positive at 0.163 with a value of C.R. of 3,051 and obtained a significance probability (p) of 0.002 which is smaller than the significance level (α) determined at 0.05. Thus, the Development of Special Economic Zone (X2) directly affects the provision of transportation infrastructure (Y3) by 0.163, which means that every increase in the Development of Special Economic Zone (X2) will increase the provision of transportation infrastructure (Y3) by 0.163.

V. RESEARCH IMPLICATION

Using the standardized beta coefficient, the strength of the effect of each individual exogenous variables to the endogenous variables can be compared to each other. The higher the absolute value of the beta coefficient, the stronger the effect. This can be done properly because the unit for standardized beta coefficients is standard deviations. In the case of each arrow pointing from an exogenous variable to an endogenous variable, the standardized beta coefficient is equal to the correlation. Since the correlation is known, the determination coefficient can be calculated as the square of the correlation. Hence, it can be seen from Fig. 3 that the implications of this research are as follow:

- 1)The International Hub Port has direct positive effect to the provision of transportation infrastructure for $0.27^2 = 7.29\%$, to the logistic transportation user for $0.87^2 = 75.69\%$ and has indirect positive effect to the provision of transportation infrastructure for $0.87^2 \cdot 0.26^2 + 0.87^2 \cdot 0.49^2 \cdot 0.34^2 = 7.22\%$. These mean that the stakeholders think that the development of the International Hub Port of Bitung will not only increase the provision of transportation infrastructure directly but also increase it indirectly after increasing the logistic transportation users. Moreover, the stakeholders think that the International Hub Port is the most important factor in increasing the provision of transportation infrastructure because of its largest effect.
- 2)The Special Economic Zone has direct positive effect to the provision of transportation infrastructure for $0.16^2 = 2.56\%$, to the logistic traffic flow for $0.32^2 = 10.24\%$ and it has indirect positive effect to the provision of transportation infrastructure for $0.32^2 \cdot 0.34^2 = 1.18\%$. These indicate that the stakeholders believe that the development of the Special Economic Zone will not only increase the provision of transportation infrastructure but also the logistic traffic

flow and eventually this will also increase the transportation infrastructure.

- 3)The Logistic Transportation User has direct effect to the provision of transportation infrastructure for $0.26^2 = 6.76\%$ and to logistic traffic flow for $0.49^2 = 24.01\%$. These suggest that the stakeholders consider logistic transportation user as factor that will increase the logistic traffic flow and the provision of transportation infrastructure. It also supported by the fact that the logistic traffic flow has direct effect to the provision of transportation infrastructure for $0.34^2 = 11.56\%$

VI. CONCLUSION

This research shows the relationship between the development of International Hub Port and Special Economic Zone as an exogenous variable to the Logistic Transportation Users and Logistic Traffic Flow as an intervening variable to the provision of transportation infrastructures. The result shows that both Development of Bitung International Hub Port and Special Economic Zone have direct positive effects to the Provision of Transportation Infrastructures.

Furthermore, the result demonstrates that the Development of the International Hub Port of Bitung affects the Logistics Transportation Users positively, on the other hand, the variable has no effect on Logistics Transportation Users. The Development of the International Hub Port of Bitung has a positive effect on the Logistic Traffic Flow of Goods. This is similar to the Development of the Bitung Special Economic Zone which affects the Goods Traffic Flow positively.

The construction of the International Hub Port provides the greatest effect on the provision of transportation infrastructure as well as becomes the only variable that has an influence on users of logistic transportation. Logistic transport users and the construction of the international hub port of Bitung have the greatest effect on the flow of goods traffic.

This research demonstrates that there is a take and give relationship between SEZ and IHP with the provision of transportation infrastructure, in other words, it is proven that there is a reciprocal relationship between these two factors. The presence of the SEZ and the IHP will greatly affect the provision of transportation infrastructure, on the other hand, the provision of transportation infrastructure is also an important factor that will lead to the success of the SEZ and IHP. In addition, the stakeholders believe that transportation infrastructures which provide better connectivity with both national and international transportation network is the key for the SEZ and IHP to succeed. Furthermore, this study recommends the North Sulawesi transportation infrastructure strategy to be properly planned so it can be well suited with the necessities of the SEZ and IHP.

REFERENCES

1. Alqhatani, M., Bajwaa, S., Setunge, S., 2012. Land-use transport interaction: A comparison of Melbourne, Riyadh. *Procedia-Social and Behavioral Sciences* 43, 3–13.
2. Arbués, P., Baños, J.F., Mayor, M., 2015. The spatial productivity of transportation infrastructure. *Transportation Research Part A: Policy and Practice* 75, 166–177.

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3. Azwar, S.A., Suganda, E., Tjiptoherijanto, P., Rahmayanti, H., 2013. Model of sustainable urban infrastructure at coastal reclamation of North Jakarta. *Procedia Environmental Sciences* 17, 452–461.
4. Chen, Z., Haynes, K.E., 2017. Transportation infrastructure and economic growth in china: A meta-analysis, in: *Socioeconomic Environmental Policies and Evaluations in Regional Science*. Springer, pp. 339–357.
5. Chen, Z., Haynes, K.E., 2015a. Multilevel assessment of public transportation infrastructure: a spatial econometric computable general equilibrium approach. *The Annals of Regional Science* 54, 663–685.
6. Chen, Z., Haynes, K.E., 2015b. Public surface transportation and regional output: A spatial panel approach. *Papers in Regional Science* 94, 727–751.
7. Cohen, J.P., Paul, C.M., 2007. The impacts of transportation infrastructure on property values: A higher-order spatial econometrics approach. *Journal of Regional Science* 47, 457–478.
8. Czerny, A., Höffler, F., Mun, S., 2014. Hub port competition and welfare effects of strategic privatization. *Economics of Transportation* 3, 211–220.
9. Deng, P., Lu, S., Xiao, H., 2013. Evaluation of the relevance measure between ports and regional economy using structural equation modeling. *Transport Policy* 27, 123–133.
10. Dorantes, L.M., Paez, A., Vassallo, J.M., 2011. Analysis of house prices to assess economic impacts of new public transport infrastructure: Madrid Metro Line 12. *Transportation Research Record* 2245, 131–139.
11. Efthymiou, D., Antoniou, C., 2014. Measuring the effects of transportation infrastructure location on real estate prices and rents: investigating the current impact of a planned metro line. *EURO Journal on Transportation and Logistics* 3, 179–204.
12. Efthymiou, D., Antoniou, C., 2013. How do transport infrastructure and policies affect house prices and rents? Evidence from Athens, Greece. *Transportation Research Part A: Policy and Practice* 52, 1–22.
13. Ewing, R., Hamidi, S., Gallivan, F., Nelson, A.C., Grace, J.B., 2014. Structural equation models of VMT growth in US urbanised areas. *Urban Studies* 51, 3079–3096.
14. Fujii, S., Kitamura, R., 2000. Evaluation of trip-inducing effects of new freeways using a structural equations model system of commuters' time use and travel. *Transportation Research Part B: Methodological* 34, 339–354.
15. Garcia-López, M.-A., 2012. Urban spatial structure, suburbanization and transportation in Barcelona. *Journal of Urban Economics* 72, 176–190.
16. Ge, W., 1999. Special economic zones and the opening of the Chinese economy: Some lessons for economic liberalization. *World Development* 27, 1267–1285.
17. Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1998. *Multivariate data analysis*. Englewood Cliff. New Jersey, USA 5, 207–2019.
18. Jiang, X., He, X., Zhang, L., Qin, H., Shao, F., 2017. Multimodal transportation infrastructure investment and regional economic development: A structural equation modeling empirical analysis in China from 1986 to 2011. *Transport Policy* 54, 43–52.
19. Krajangsri, T., Pongpeng, J., 2016. Effect of sustainable infrastructure assessments on construction project success using structural equation modeling. *Journal of Management in Engineering* 33, 04016056.
20. Li, J., Wen, J., Jiang, B., 2017. Spatial spillover effects of transport infrastructure in Chinese new silk road economic belt. *International Journal of E-Navigation and Maritime Economy* 6, 1–8.
21. Makabenta, M.P., 2002. FDI location and special economic zones in the Philippines. *Review of Urban & Regional Development Studies* 14, 59–77.
22. McIntosh, J., Trubka, R., Kenworthy, J., Newman, P., 2014. The role of urban form and transit in city car dependence: Analysis of 26 global cities from 1960 to 2000. *Transportation Research Part D: Transport and Environment* 33, 95–110.
23. Morales, H.F., do Nascimento Rebelatto, D.A., 2015. Transportation infrastructure and economic growth spillovers, in: *Enhancing Synergies in a Collaborative Environment*. Springer, pp. 165–172.
24. Nel, E.L., Rogerson, C.M., 2013. Special economic zones in South Africa: Reflections from international debates, in: *Urban Forum*. Springer, pp. 205–217.
25. Peterson, S.K., Jessup, E.L., 2008. Evaluating the relationship between transportation infrastructure and economic activity: evidence from Washington State, in: *Journal of the Transportation Research Forum*. pp. 20–39.
26. Rumayar, A.L., Sulistio, H., Wicaksono, A., Djakfar, L., 2018. THE INFLUENCE OF LAND USE AND TRAFFIC FLOW TO THE PERFORMANCE OF THE ROAD CORRIDORS USING STRUCTURAL EQUATION MODELING, A CASE STUDY OF MANADO-BITUNG, INDONESIA.
27. Statistik, B.P., BAPPENAS, U., 2005. *Proyeksi penduduk Indonesia (Indonesia Population Projection) 2000-2025*. Badan Perencanaan Pembangunan Nasional. Jakarta: BPS.
28. Supriyatno, D., Sulistio, H., Djakfar, L., Wicaksono, A., 2012. PERMODELAN KEBUTUHAN TRANSPORTASI MASSAL GUIDED BUSWAY MENGGUNAKAN STRUCTURAL EQUATION MODELING. *Jurnal Transportasi* 12.
29. Tong, T., Yu, T.-H.E., Cho, S.-H., Jensen, K., Ugarte, D.D.L.T., 2013. Evaluating the spatial spillover effects of transportation infrastructure on agricultural output across the United States. *Journal of Transport Geography* 30, 47–55.
30. Tsutsumi, M., Seya, H., 2008. Measuring the impact of large-scale transportation projects on land price using spatial statistical models. *Papers in Regional Science* 87, 385–401.
31. Ülengin, F., Kabak, Ö., Önsel, Ş., Ülengin, B., Aktaş, E., 2010. A problem-structuring model for analyzing transportation–environment relationships. *European Journal of Operational Research* 200, 844–859.
32. Wang*, J.J., Slack, B., 2004. Regional governance of port development in China: a case study of Shanghai International Shipping Center. *Maritime Policy & Management* 31, 357–373.

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