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Analysis of Road Network Development Strategies in South Sumatra Province

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Abstract: This study aims to establish a road development strategy in South Sumatra Province using a SWOT analysis approach. This research is located on the Road Network in South Sumatra Province, especially in Muara Enim Regency, while the time for this research was planned for 6 months, namely from July to December 2022. The population taken from this study were policymakers in the South Sumatra Province as the party in charge of developing the road network in Muara Enim Regency. In this study, the sampling technique used Non-probability Sampling with the Purposive Sampling method where the sampling technique has predetermined considerations for respondents with a total sample taken of 30 respondents. The results of the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) analysis place the road network development program in South Sumatra Province in quadrant 1. Position in quadrant 1 means that the program has opportunities and strengths. The strategy that must be taken in these conditions is to support an aggressive growth policy or growth-oriented strategy by taking advantage of existing opportunities and the organization's internal strengths.

Keywords: Road network development strategy, SWOT, Internal Factor Evaluation (IFE), External Factor Evaluation (EFE), Growth Oriented Strategy

INTRODUCTION

Transportation has a very important role in developing a region, and facilitating interaction between regions (Polyzos & Tsiotas, 2020). Ease of interaction between regions will bring economic and social benefits (ADB, 2013). A good road/transportation network will stimulate the rise of population movements to carry out socio-economic activities (Headey & Jayne, 2014; Liu & Yamauchi, 2014; Platzer, 2021). This shows that the development of a road/transportation network has a reciprocal relationship with a region's economy to support the growth and development of urban and rural areas (Chakwizira, 2015). Transportation is defined as an activity carrying out the transportation or transfer of cargo, consisting of goods and people from one place to another, from the place of origin to the destination (Dinu, 2018; Harumain et al., 2020; Lowe, 2012). The journey from the place of origin to the destination is called Origin Destination Travel (Polyzos & Tsiotas, 2020).

The condition of the road network which is mostly damaged and the condition of inadequate infrastructure results in low travel time and level of road service so that transportation costs increase. performance of the road itself (Gonzalez et al., 2010; Naazie. et al., 2018). These transportation problems can be solved if transportation infrastructure is built and maintained in an integrated manner so that it provides broad benefits and impacts for the community (Shahraki, 2019; Smits, 2019; Yang et al., 2019).

Handling road infrastructure is a form of concern for the movement of traffic flow of goods/services and people. Regarding economic development, the handling of road infrastructure has a broad influence on road users and the region as a whole (Ng et al., 2019; Van Der Horst & De Ridder, 2007). For this reason, proper studies are needed in handling roads so that they can support regional development and economic growth (ADB, 2012).

The absence of an organized and planned road network management program in the form of long-term, medium-term, and short-term management has resulted in a unpatroned road network handling system by prioritizing priority scales (Schliessler & Bull, 2004). Due to the limited development budget and the high cost of constructing/maintaining the road network, this requires a change in mindset towards planning and setting priorities for the construction and development of transport infrastructure effectively, according to needs based on the reality of activity patterns, patterns of generation-attraction of movements, distribution of movements and comparative advantages between zone within an area, which is formed in a regional transportation arrangement (Leung, 2016).

The development of the South Sumatra Province Road Network is the initial stage in the road handling program carried out by the South Sumatra Province which can later be used as a solution in handling the road network. The Provincial Government of South Sumatra is currently planning to develop a road network by opening roads to production centers and district/city areas so that regions can interact with each other. This is the general goal of government policy in road traffic and transportation, namely creating a transportation system in the regions so that the mobility of people and goods can support economic growth and meet the community's social needs. Several previous studies have been conducted on similar topics, namely research conducted by Hatefi (2018), Makarova et al. (2017), Wu & Zheng (2021), Alexandru (2015), and Ghasemi & Saberi (2020). This study discusses the use of SWOT analysis to determine road development strategies.

The purpose of this research are:

1. Knowing the strengths and weaknesses of the road network development program in South Sumatra Province.
2. Knowing the opportunities and threats of the road network development program in South Sumatra Province.
3. Finding the right road network development strategy to be implemented in South Sumatra Province.

METHODOLOGY

This research is located on the Road Network in South Sumatra Province, especially in Muara-Enim Regency, while the time of this research is planned for 6 months, namely from July to December 2022. The population taken from this study is the policymakers in the South Sumatra Province as the party that handles the development of the road network in Muara Enim Regency. In this study, the sampling technique used non-probability sampling with the purposive sampling method where the sampling technique has predetermined considerations for respondents (Etikan et al., 2016; Palys, 2008) with a total sample taken of 30 respondents. The data collection technique in this study was a questionnaire. Validity and reliability tests are applied to ensure that the resulting data is valid and reliable (Bolarinwa, 2015; Sürücü & Maslakçi, 2020).

There are two types of data sources used in this study, namely primary data and secondary data (Creswell, 2014). Primary data was obtained by distributing questionnaires to respondents (Bird, 2009; Pozzo & Borgobello, 2019) in this case, officials at the Office of Public Works of Highways and Spatial Planning of the Province of South Sumatra and the Office of Transportation of the Province of South Sumatra. Secondary data is in the form of RPJMD, a List of South Sumatra Provincial Roads, and other data.

Data analysis using SWOT. SWOT is a strategic planning method used to evaluate strengths, weaknesses, opportunities, and threats in a project (Muis, 2017). SWOT analysis can be applied by analyzing and sorting out the various things that affect the four factors, then applying them in a SWOT strategy.

The steps for processing research data using SWOT analysis are as follows:

1. Identify the internal and external factors of the variables studied in a study;
2. After finding internal and external factors, an assessment is carried out based on the respondent's answers to the questionnaire;
3. Do the calculation of weighting, rating, and score;
4. Create a SWOT matrix and diagram to see the quadrant positions of the road network development plan in South Sumatra Province, especially in the Muara Enim Regency. The position of the coordinates for the horizontal direction is obtained from the sum of the strong points that have positive values and the points of weakness that have negative values, as well as the coordinates for the vertical direction which are obtained from the sum of the opportunity points with positive values and the threat points with negative values.
5. From the calculation results in number 4, a decision is made based on the location of the analysis result area.

RESULT AND DISCUSSION

1. Result

a. Internal Factor Weights

Internal factors originating from the road network development work in South Sumatra Province, especially in Muara Enim Regency, both in the form of strengths and weaknesses, weight calculations are carried out based on the level of importance ranging from a value of 0.00 (not important) to a value of 1.00 (very important) and where the total weight of the strengths and weaknesses factors should not be more than 1.00. For the internal factors, weights can be seen in the table below.

Table 1. Internal Factor Weights

No	Strengths	Code	Number of Questionnaire Data	Weight
1	Planning a road network capable of supporting intermodal movement spatial planning	S1	142	0,09
2	Accessibility across the region	S2	145	0,10
3	Traveling time	S3	139	0,08
4	Readiness of resources such as land readiness, human resources, funds, tools, and so on.	S4	137	0,08
5	Safety factor for road users and beneficiaries.	S5	136	0,08
6	Road service level.	S6	137	0,08
7	Compliance with the rules of urban spatial planning	S7	138	0,08
Total Strengths			974	0,59

No	Strengths	Code	Number of Questionnaire Data	Weight
Weaknesses				
1	The structural pattern of the road network is not clear	W1	143	0,09
2	Exceeded capacity / Overload	W2	109	0,07
3	Coordination between the executors of the development of the movement infrastructure network and the construction of the utility network	W3	140	0,09
4	Maintenance activities that have an impact on accelerating road damage	W4	134	0,08
5	Project supervision and awareness of OSH procedures among workers	W5	136	0,08
Total Weaknesses			662	0,41
Total Internal Factors			1636	1,00

An example of calculating the weights for internal factors is as follows:

1) The total answers of 30 respondents to the strength factor number 1 are:
   4+4+5+5+5+4+5+5+4+4+5+5+5+4+5+5+4+4+5+5+5+5+5+5+5+5+5+5+5+5+5=142
2) Calculation of the weight of the strength factor number 1:
   Total strength factors + Total weaknesses factors =974 + 662 = 1636
   Number 1 strength factor weight= $\frac{142}{1636}$ = 0,087 ≈ 0,09

b. External Factor Weights

External factors originating from the road network development work in South Sumatra Province, especially in Muara-Enim Regency, both in the form of opportunities and threats, are calculated based on the level of importance ranging from a value of 0.00 (not important) to a value of 1.00 (very important) and where the sum of all the weights of the opportunity and weakness factors should not be more than 1.00. For the external factors, weights can be seen in the table below.

Table 2. External Factor Weights

No	Opportunities	Code	Number of Questionnaire Data	Weight
1	Development progress of a region	O1	138	0,15
2	Increasing the pace of the economy of a region	O2	143	0,16
3	Increase in road capacity	O3	136	0,15
4	Road network asset management	O4	140	0,15

Total Opportunities			557	0,61
Threats				
1	The growth of roads that are not balanced with the growth of motorized vehicles.	T1	106	0,12
2	Excavation of roads almost every month with different digging interests (digging of optical cables, PDAM pipes, etc.) causes potholes and impedes the smooth running of the road.	T2	84	0,09
3	Geographical factors and Rainfall	T3	80	0,09
4	Disruption of road functions by community activities such as spilled markets and parking lots	T4	79	0,09
Total Threat			349	0,39
Total External Factors			906	1,00

An example of calculating the weights for internal factors is as follows:

1) The total answers of 30 respondents to opportunity factor number 1 are:
   5+5+5+4+4+5+5+4+5+4+5+4+4+5+5+4+4+5+5+4+5+5+4+4+5+5+5+4+5+5=138
2) Calculation of opportunity factor weight number 1:
   Total opportunity factors + Total threat factors =552 + 352 = 904
   Opportunity factor weight number 1= $\frac{138}{906} = 0{,}152 \approx 0{,}15$

c. Internal Factor Evaluation (IFE) Matrix Calculation

Calculation of the IFE matrix is a calculation to determine the weight, rating, and score whereas explained above the weight value does not exceed a total of 1.00, and for the rating value of each factor, a value is given on a scale of 1 (very bad), 2 = bad, 3 = normal, 4 = good, and 5 = very good. The following table results from the calculation of the IFE matrix.

Table 3. IFE Matrix Calculation Results

No	Strengths	Weight	Ratings	Score (Weight x Rating)
1	Planning a road network capable of supporting intermodal movement spatial planning	0,09	4,73	0,43
2	Accessibility across the region	0,10	4,83	0,48
3	Traveling time	0,08	4,67	0,37
4	Readiness of resources such as land readiness, human resources, funds, tools, and so on.	0,08	4,57	0,37
5	Safety factor for road users and beneficiaries.	0,08	4,53	0,36
6	Road service level.	0,08	4,57	0,37

No	Strengths	Weight	Ratings	Score (Weight x Rating)
7	Compliance with the rules of urban spatial planning	0,08	4,60	0,37
Total Strengths		0,59		2,74
Weaknesses				
1	The structural pattern of the road network is not clear	0,09	4,70	0,42
2	Exceeded capacity / Overload	0,07	3,63	0,25
3	Coordination between the executors of the development of the movement infrastructure network and the construction of the utility network	0,09	4,67	0,42
4	Maintenance activities that have an impact on accelerating road damage	0,08	4,47	0,36
5	Project supervision and awareness of OSH procedures among workers	0,08	4,60	0,37
Total Weaknesses		0,41		1,82
Total IFE		1,00		4,56

Example of calculating the weight, rating, and score of strength number 1:

1) Calculation of the weight as described above, obtained from a total of 30 respondents' answers to the statement of strengths number 1 divided by the total strengths and weaknesses so that the weight of strengths number 1= $\frac{142}{1636} = 0{,}087 \approx 0{,}09$
2) The calculation of the rating is obtained from the total answers of 30 respondents to the power rating number 1 divided by the number of respondents so that the rating is obtained = 4.73.
3) Calculation of the score for power number 1 is obtained by multiplying the weight and rating, so the score is obtained = 0.09 x 4.73 = 0.43.

d. External Factor Evaluation (EFE) Matrix Calculation

Calculation of the EFE matrix is a calculation to determine the weight, rating, and score whereas explained above the weight value does not exceed 1.00, and the rating value of each factor is given a value with a scale of 1 (very bad), 2 = bad, 3 = normal, 4 = good, and 5 = very good. The following table results from the calculation of the EFE matrix.

Table 4 EFE Matrix Calculation Results

No	Opportunities	Weight	Ratings	Score (Weight x Rating)
1	Development progress of a region	0,15	4,60	0,69
2	Increasing the pace of the economy of a region	0,16	4,77	0,76
3	Increase in road capacity	0,15	4,53	0,68

No	Opportunities	Weight	Ratings	Score (Weight x Rating)
4	Road network asset management	0,15	4,67	0,70
Total Opportunities		0,61		2,83
Threats				
1	The growth of roads that are not balanced with the growth of motorized vehicles.	0,12	3,53	0,42
2	Excavation of roads almost every month with different digging interests (digging of optical cables, PDAM pipes, etc.) causes potholes and impedes the smooth running of the road.	0,09	2,80	0,25
3	Geographical factors and Rainfall	0,09	2,67	0,24
4	Disruption of road functions by community activities such as spilled markets and parking lots	0,09	2,63	0,24
Total Threats		0,39		1,15
Total EFE		1,00		3,98

Example of calculating the weight, rating, and opportunity score number 1:

1) Calculation of the weight as described above, obtained from the total answers of 30 respondents to the statement of opportunity number 1 divided by the total opportunities and threats so that the weight of opportunity number 1= $\frac{138}{906}$= 0,152 ≈ 0,15
2) The rating calculation is obtained from the total answers of 30 respondents to the opportunity rating number 1 divided by the number of respondents, so that the rating is obtained = 4.60.
3) Calculation of the score for opportunity number 1 is obtained by multiplying the weight and rating, so the score is obtained = 0.15 x 4.60 = 0.69.
4) Then the results of calculating the IFE and EFE matrix scores are as follows:
   a. Total strengths score = 2,74
   b. Total weaknesses score = 1,82
   c. Total opportunities score = 2,83
   d. Total threats score = 1,15

e. External Factor Evaluation (EFE) Matrix Calculation

The results of calculations on internal and external factor scores can be described in a SWOT Diagram, which can be seen in the image below. The formula for finding coordinates is as follows:

Coordinate = Coordinate internal analysis; Coordinate external analysis

= 2,74 – 1,82; 2,83 – 1,15

= 1,92;1,68

So, the coordinates are located at (1.92;1.68)

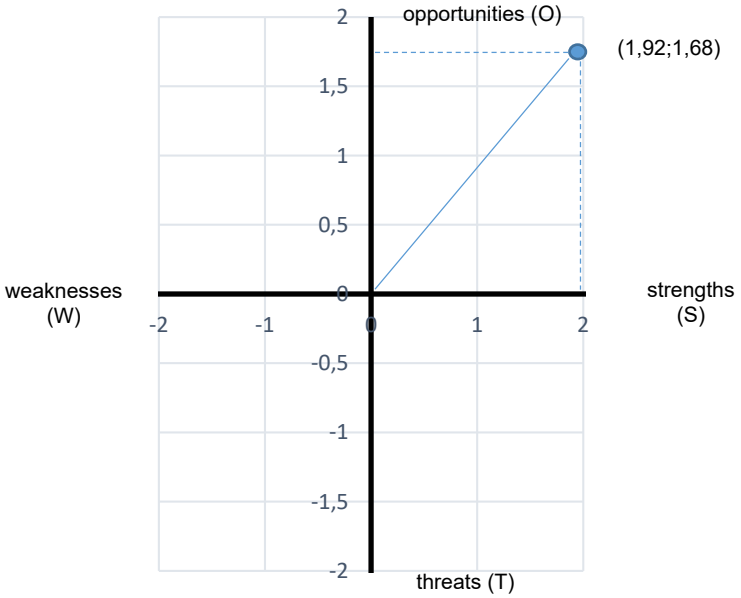

Figure 1. SWOT diagrams

From figure 1 the results of calculations on internal and external factors using SWOT analysis, it can be seen that the coordinate points are in quadrant I. The position in quadrant 1 means that the program has opportunities and strengths. The strategy that must be taken in conditions like this is to support an aggressive growth policy or a growth-oriented strategy by taking advantage of existing opportunities and internal strengths owned by agencies. Then the strategy used in each quadrant can be described as follows:

Internal Factor / External Factor	Strengths - S	Weakness – W
Opportunities – O	SO-Strategy Create a Strategy that uses strengths to take advantage of opportunities	WO-Strategy Create strategies that minimize weaknesses to take advantage of opportunities
Threats – T	ST-Strategy Create strategies that use strengths to overcome threats	WT-Strategy Create strategies that minimize weaknesses and avoid threats

Figure 2. Strategy 4 SWOT quadrants

Based on the position of the coordinate points in quadrant I the development of the road network in South Sumatra Province, especially in the Muara Enim district has good opportunities and strengths so a more mature road network development plan is needed by using the existing strengths to take advantage of opportunities.

2. Discussion

Based on the results of the SWOT analysis, a strategy can be carried out in developing the road network in South Sumatra Province, especially in Muara Enim Regency by using strengths and taking advantage of opportunities, namely as follows:

1) First Strategy
   a. Maximizing road network planning
      Road network planning must be carried out optimally. The approach through discussions with relevant stakeholders is the regional transportation development planning approach by conducting discussions and accommodating input from stakeholders in the Province of South Sumatra relating to the development of the regional transportation network system.
   b. Improve accessibility across the region
      Accessibility is a measure of how easily a location can be reached from other locations through the transportation system. The measure of affordability or accessibility includes the ease of time, cost, and effort in moving between places or areas. Improving accessibility can be done by carrying out continuous road maintenance in each area, repairing and normalizing each drainage system, and intensively carrying out traffic engineering.

2) Second strategy
   a. Prepare land readiness
      Expansion of the road network needs to begin with preparing land readiness. This preparation can be done first by way of land acquisition. The next stage is to carry out land clearing, earthwork, drainage work, road pavement, and compaction.
   b. Preparing HR
      The aspect of human resources involved in road network development activities is one of the vital aspects. That is why it is necessary to make continuous efforts to improve the quality of human resources, either through the provision of training, and comparative studies, or by providing opportunities for existing human resources in South Sumatra Province to pursue a higher level of education.
   c. Prepare funds
      The development of the transportation network in South Sumatra Province requires adequate financial support. For this reason, the South Sumatra Provincial Government must make maximum efforts to prepare funds to be used to support the development of the road network.
   d. Preparing equipment
      Equipment is also needed to support the South Sumatra Province transportation network development program. The South Sumatra Provincial Government can cooperate with private parties or contractors in providing the equipment needed for the development of the road network. In addition, the South Sumatra Provincial Government also needs to prepare its equipment that is used routinely in road maintenance and drainage facilities in South Sumatra Province.

3) Third strategy
   a. Speed up travel time
      Travel time for roads in South Sumatra Province can be increased by implementing capacity management, priority management, and demand management. Capacity management can be done by making the use of capacity and roads as effective as possible, so that smooth traffic movement is the main requirement. The currents at the junctions must be surveyed to ensure optimum control and geometric use. The Right of Way must be organized in such a way that each section has its function, eg parking, pedestrian paths, and road capacity. The use of road space along the road link must be well coordinated. Priority management is carried out by determining the priority of selecting modes of transportation, especially passenger vehicles (buses and taxis). Meanwhile, demand management can be done by rerouting vehicles on the

network to move vehicles from congested areas to non-congested areas. Changing modes of travel, especially from private vehicles to public transport during rush hour. This means priority provision to public transport and control of land use development.

b. Provide security
Providing security can be done by optimizing road sections by determining the function of the road and controlling activities that do not match the function of the road. In addition, the Provincial Government of South Sumatra must also improve the quality of road conditions.

c. Improve road services
Improving the quality of road services can be done, among others, by improving the smoothness of the road surface by providing a layer of asphalt on bumpy road sections, adding several lighting lamps at points that are considered accident-prone, and controlling activities along the road that has the potential to create congestion or decrease the quality of road services.

CONCLUSIONS

The conclusions that can be drawn from this study are:

1. The strengths and weaknesses of the road network development program in South Sumatra Province are:
   a. The strengths of the road network development program in South Sumatra Province that can be identified are:
      (1) Road network planning carried out in South Sumatra Province can support the spatial layout of the intermodal movement.
      (2) Accessibility throughout the South Sumatra Province.
      (3) Travel time in the area of South Sumatra Province.
      (4) Readiness of resources such as land readiness, human resources, funds, tools, and so on.
      (5) Safety factor for road users and beneficiaries in South Sumatra Province.
      (6) Level of road service in South Sumatra Province.
      (7) Conformity of road planning in South Sumatra Province with urban spatial planning principles.
   b. Weaknesses of the road network development program in South Sumatra Province that can be identified are:
      1) The structural pattern of the road network in South Sumatra Province is unclear.
      2) Exceeded road capacity/overload in South Sumatra Province.
      3) Coordination between the executors of the construction of the movement infrastructure network in South Sumatra Province with the construction of the utility network.
      4) Road maintenance activities in South Sumatra Province have an impact on accelerating road damage.
      5) Project supervision and awareness of OSH procedures among workers in South Sumatra Province are still low.
2. Opportunities and threats for the road network development program in South Sumatra Province are:
   a. Opportunities for road network development programs in South Sumatra Province that can be identified are:
      1) Progress of regional development in South Sumatra Province.
      2) Increasing the pace of the economy in the Province of South Sumatra.
      3) Increasing road capacity in South Sumatra Province.
      4) Management of road network assets in South Sumatra Province.

b. Threats to the road network development program in South Sumatra Province that can be identified are:
   1) The growth of roads that are not balanced with the growth of motorized vehicles in South Sumatra Province.
   2) Excavation of roads in South Sumatra Province almost every month with different digging interests (digging of optical cables, PDAM pipes, etc.) causes potholes and hampers the smooth running of the road.
   3) Geographical factors with hilly shapes and high rainfall in South Sumatra Province.
   4) Disruption of road functions in South Sumatra Province by community activities such as spilled markets and parking lots.

3. The results of the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) analysis place the road network development program in South Sumatra Province in quadrant 1. Position in quadrant 1 means that the program has opportunities and strengths. The strategy that must be taken in these conditions is to support an aggressive growth policy or growth-oriented strategy by taking advantage of existing opportunities and the company's internal strengths.

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