Environmental Risk Analysis Of Road Improvement In Tarakan City

E Prihartanto and D Nawir
Civil Engineering Department, Borneo Tarakan University.
E-mail: eqho.prihartanto@gmail.com

Abstract. The development of the Tarakan City Road network for coastal areas has increased. The area of Tarakan in particular, the Binalatung Street has improved quality, it aims to help the community activities to fulfill daily needs. In the activity of this beach road increase has risks that can affect the quality of the work so it is interesting to be researched from the point of view of Public Works and the planning of the city Department as the owner. The research method is done by spreading questionnaires and interviews, with respondents from the Public Works and the planning of the city Department of Tarakan as the owner of the project to increase the road of Tarakan. From the questionnaire will be processed with statistics to find out the highest risk events from the road enhancement activities. The results obtained from this study are from 13 risk variables from 9 risk criteria. analysis of inter-risk relationships followed by micmac analysis so that it is obtained: 1). Autonomous: 1 risk variable. 2). Dependent: 4 risk variables. 3). Linkage: 5 risk variables. 4). Independent: 3 risk variables.

1. Introduction
The development of an area can be seen from the geographical location where the island is located. Islands surrounded by the sea have the potential to develop areas to maximize natural resources, especially coastal areas. Tarakan Island is located 3°.19'-3°.20' North Latitude and 117°.34'-117°.38' East Longitude. At present the development of Tarakan Island is still not evenly distributed, especially roads. This uneven development causes a lack of progress in an area due to the difficulty of access to transportation, especially land transportation. The development of road networks is closely related to the progress of a region, where the region will have transportation management so that it has an impact on several aspects such as socio-cultural aspects, political and defense aspects, and economic aspects, in the Eastern region of Tarakan Island. Researchers want to conduct further research related to the risks that occur from increasing roads in coastal areas in Tarakan City, considering that the City of Tarakan as the only city in North Kalimantan bordering Malaysia will be an example in the implementation of decision making from the results of the analysis.

The impact of improving roads on the environment in the coastal areas of the city of Tarakan becomes its own object. where the environment is part of the variable studied. so it will provide information that the variable can be one of the keys of the variable relationship. The methodology used to formulate a classification of the relationships between variables is shown by the diagram drawings, where the coordinate of variables shows that one variable can affect the other or the variable is independent.
the use of ISM to model variable relationships before they are classified, the result that will appear is the classification of the processed variables to be taken policy.

2. Literature study

2.1. Road
Human activity in daily life in transferring both human beings and goods from the area of origin to the destination requires roads as the main means. Road has an understanding [1]: Roads are all parts of the road, including complementary buildings and equipment intended for public traffic, which is at ground level, above ground level, below the surface of the land and/or water, and above the surface of the water, except railroads and cable roads.

2.2. Risk
Risk can be defined as variations in things that might occur naturally in a situation [2]. Risk can be interpreted as a threat to life, property or financial gain due to the danger that occurs. In general, risk is associated with the likelihood (probability) of occurrence of events beyond the expected [3].

2.3. Probability Impact Analysis
According [4] argues that the value of risk is the result of multiplication of the value of the probability of occurrence of risk with the value of the risk impact that occurs. Risk assessment can be formulated as follows:

$$ R = P \times I \quad (1) $$

Where $R$ = Risk level, $P$ = probability of the risk that occurs, $I$ = The level of risk impacts that occur. With this formula risk assessment is not based on absolute estimates.

2.4. Development of facilities and infrastructure
The form of government services to the community can be in the form of construction of facilities and infrastructure that have a role in development in coastal areas. As explained in [5]: Infrastructure is the completeness of the basic physical occupancy that meets certain standards for the needs of a decent, healthy, safe and comfortable residence. Facility is a facility in a residential environment that serves to support the implementation and development of social, cultural and economic life. Development support for the region can be realized with the cooperation of stakeholders in the role of developing coastal areas. Critical success factors are the conditions, features, or variables that when properly nurtured, sustained, maintained or managed can have a significant effect on the success [6].

2.5. Interpretive Structural Modeling
Interpretive Structural Modeling (ISM) was first proposed [7] to analyze the complex socioeconomic systems. ISM is a computer-assisted learning process that enables individuals or groups to develop a map of the complex relationships between the many elements involved in a complex situation. The basic idea is to use practical experience and knowledge of the experts to decompose a complicated system into several sub-systems (elements) and construct a multilevel structural model. ISM methodology has so many advantages, but apart from that it has a few disadvantages or limitations. The main limitations of ISM are the relationship among the variables are totally depends upon the user’s knowledge and their experience within their industries [8]. This methodology is interpretive as the judgment of the group decides whether and how the different elements are related. It is structural on the basis of mutual relationship; an overall structure is extracted from the complex set of elements. It is a modeling technique, as the specific relationships and overall structure are portrayed in a digraph model. It helps to impose order and direction on the complexity of relationships among various elements of a system [9]. It is this concept of relatedness in the context of a particular relationship which distinguishes a system from a mere aggregation of components [10].
2.6. MICMAC analysis
Matrice d’Impacts croises-multiplication applique an classment (cross-impact matrix multiplication applied to classification) is abbreviated as MICMAC. The purpose of MICMAC analysis is to analyze the drive power and dependence power of factors. MICMAC principle is based on multiplication properties of matrices. It is done to identify the key factors that drive the system in various categories. Based on their drive power and dependence power, the factors, have been classified into four categories i.e. autonomous factors, linkage factors, dependent and independent factors [11].

3. Method
This descriptive research concept is to identify risks the project owner contained in project to improve Binalatung Street in Tarakan City.

![Flowchart of Research]

3.1. Data collection
Data collection is done from research references related to the subject and object research, from references These include journals, textbooks, thesis, seminar and research report. Primary data collection is done by researcher by:
- a) Interview
- b) Questionnaire

3.2. Respondents
Respondents in this study were The Public Works and Spatial Planning Office of Tarakan City as the owner of the Road improvement project Binalatung City of Tarakan.
4. Results and discussion

Analysis for risk assessment has been obtained from the processed results of the questionnaire. The results of the questionnaire from the respondents' answers are then processed from the risk variables arising from increased roads. Presented in Table 1 are the results of ranking each risk criterion and the highest risk ranking results are obtained [12].

Table 1 Recapitulation of the highest risk variables from the risk criteria

| No | Risk criteria   | Risk variables                                                                 | Risk rating | Notation |
|----|----------------|-------------------------------------------------------------------------------|-------------|----------|
| 1  | Political risk | Lack of coordination between relevant agencies in making decisions that can affect project execution | 1           | RP1      |
|    |                | There are inputs from other agencies which result in design changes and technical work | 1           | RP2      |
| 2  | Environmental Risk | Lack of worker awareness to maintain the cleanliness of the project environment | 1           | RL       |
| 3  | Economic Risk  | Demands of workers in wage increases that are not in accordance with standard wages | 1           | RE       |
| 4  | Financial Risk | Late payment by contractors to suppliers of building materials or materials    | 1           | RK       |
| 5  | Natural Risk   | Very shallow ground water level making it difficult to carry out the project   | 1           | RA       |
| 6  | Technical Risk | It is difficult to coordinate with utility owners regarding the relocation of utilities | 1           | RT       |
|    |                | Image mismatch with technical specifications                                  | 1           | RPR1     |
|    |                | Design changes due to adjustments to field conditions                         | 1           | RPR2     |
|    | Project Risk   | The contractor does not submit a request and shop drawing to the supervision consultant before carrying out a job | 1           | RPR3     |
| 7  | Human Risk     | Low productivity.                                                             | 1           | RM1      |
|    |                | The lack of competent project members                                         | 1           | RM2      |
| 8  | Safety Risk    | The lack of security at the project location.                                 | 1           | RKE      |

Then after going through the process of selecting a risk rating, a notation is given on each variable to be processed using the Interpretive Structural Modeling (ISM) method. By using the ISM method, will find a contextual relationship between variables in pairs. Symbol for a relationship between variables with a value of 1 while for variables that do not have a relationship symbolized with a value of 0 so that in Table 2 is displayed in Reachibility Matrix, where These drive power and dependence helps to classify the inhibitors into four clusters namely (i) autonomous, (ii) dependent, (ii) linkage and (iv) independent.
### Table 2 Reachability Matrix

| No | RISK VARIABLES (i/j) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Driver Power |
|----|----------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|-------------|
|    | RP1                  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 1  | 2  |             |
|    | RP2                  | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1  | 1  | 0  | 0  | 6  |
|    | RL                   | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 1  |
|    | RE                   | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0  | 1  | 1  | 0  | 7  |
|    | RK                   | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1  | 0  | 0  | 0  | 6  |
|    | RA                   | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0  | 0  | 0  | 0  | 2  |
|    | RT                   | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0  | 0  | 1  | 8  |
|    | RPR1                 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1  | 1  | 1  | 1  | 12 |
|    | RPR2                 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1  | 1  | 1  | 1  | 0  |
|    | RPR3                 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1  | 1  | 1  | 0  | 12 |
|    | RM1                  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1  | 1  | 1  | 1  | 13 |
|    | RM2                  | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1  | 1  | 1  | 1  | 11 |
|    | RKE                  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1  | 1  | 1  | 1  | 13 |
| Dependence |                  | 10| 9 | 9 | 8 | 10| 5 | 7 | 8 | 8 | 9  | 9  | 7  | 5  |     |

After being classified from the Reachability Matrix, a diagram will be made based on the accumulated value of driver power and the accumulation of dependence values for each variable risk relationship, so that the relationship between risks will be classified into clusters (i) autonomous, (ii) dependent, (ii) linkage and (iv) independent. so that it can be seen in figure 2 below.

![Figure 2. Mic Mac Analysis](image-url)
5. Conclusion
The relationship between the variables that have been analyzed shows the classification. Therefore the results of the analysis carried out to the final stage show that the risk variables that have the highest ranking have a relationship between risk variables with qualifications based on the cluster as follows:

1. Autonomous:
a. Very shallow ground water level making it difficult to carry out the project

2. Dependent:
a. Lack of worker awareness to maintain the cleanliness of the project environment
b. Lack of coordination between relevant agencies in making decisions that can affect project execution
c. Late payment by contractors to suppliers of building materials or materials
d. There are inputs from other agencies which result in design changes and technical work

3. Linkage:
a. Demands of workers in wage increases that are not in accordance with standard wages
b. Image mismatch with technical specifications
c. Design changes due to adjustments to field conditions
d. The contractor does not submit a request and shop drawing to the supervision consultant before carrying out a job
e. Low productivity.

4. Independent:
a. It is difficult to coordinate with utility owners regarding the relocation of utilities
b. The lack of competent project members
c. The lack of security at the project location.

References
[1] Undang undang Nomor 22 Tahun 2009 Tentang Lalu lintas dan Angkutan Jalan
[2] Asiyanto 2009, Manajemen Risiko Untuk Kontraktor. (Jakarta : PT. Pradnya Paramita)
[3] Soeharto I 2001. Pencegahan dan Penyembuhan Penyakit Jantung Koroner. (Jakarta : PT Gramedia Pustaka Utama)
[4] Hillson D. 2002. Extending The Risk Process to Manage Opportunities. International Journal Project Management 20 235
[5] Undang Undang Nomor 1 Tahun 2011 Tentang Perumahan dan Kawasan Perumniman.
[6] R. Oloruntoba 2010 An analysis of the Cyclone Larry emergency relief chain: some key success factors, Int. J. Prod. Econ. 126 85–101.
[7] Warfield J. 1980. Societal Systems: Planning, Policy and Complexity. (US: John Wiley & Sons Inc.)
[8] Kannan G, Pokharel S and Sasi K P 2009. A hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider Resources, Conservation and Recycling 54 28-36.
[9] Singh M D, Shankar R, Nairn R and Agarwal A 2003 An interpretive structural modeling of knowledge management in engineering industries Journal of Advances in Management Research 1 28–40
[10] Watson R 1978 Interpretive Structural Modeling- A useful tool for worth assessment? Technological Forecasting and Social Change 11 165-185.
[11] Sharma H D, Gupta A D and Sushil 1995 The objectives of waste management in India: a future inquiry Technological Forecasting and Social Change 48 285–309.
[12] Xu Z and Jing F 2007 Applying ISM in Risk Analysis for the Government Undertaking Public Construction Project (China: Value Engineering)