Dynamic Actor Network Analysis Approach In Management of Mass Public Transport Services

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Abstract. Taking into account the progress of community mobility, increased motorization of private vehicles, congestion, and poor urban transportation services, the Bandung City Government seeks to provide mass public transport services Trans Metro Bandung (TMB). What policies should be established to achieve the successful implementation of the TMB program? This study aims to provide recommendations to TMB management to achieve the success of services that prioritize reliability, comfort, and humanity. The analysis was carried out on stakeholder opinion using actor analysis method software, namely Dynamic Actor-Network Analysis (DANA). The involvement of all stakeholders is needed to get their views, perceptions, and opinions about the implementation of the TMB program. From the interview processing, the results obtained from the perception diagram and identified 19 different factors in one arena. The factors for reducing traffic congestion and improving services for mass public transport are defined as "goals". The analysis of relevance and centrality identifies the limitations of infrastructure, facilities, and financing which are the main causes of the problem so that TMB services cannot be implemented optimally. In the strategy analysis, four actions were analyzed. The most ideal solution strategy that has the maximum utility value, the highest satisfaction, and lowest frustration score is the formation of a consortium and socialization.

Keywords: Mass Public Transportation, Trans Metro Bandung, Dynamic Actor-Network Analysis.

1. Introduction
The city of Bandung as the capital of West Java Province continues to develop into a center for government activities, trade and services, tourism, and settlements. This encourages increased socio-economic activity and community mobility. However, the transportation system of Bandung City has not been integrated into regional development. Authorized agencies in the city of Bandung have made efforts to provide mass public transport services that are reliable and feasible for the travel of Bandung residents, by implementing the Trans Metro Bandung (TMB) program. However, public transport users are still dissatisfied with city transportation and TMB services due to safety, comfort, and driver skills [1,2]. So that the level of personal motorization of the people of Bandung is very high, both users of two-wheeled vehicles and four-wheeled vehicles. Besides, the presence of online-based public transportation is in great demand by the public because it can be a way out for the mobility of
people who expect safe, fast, cheap, and comfortable services. This has an impact on increasing the movement of vehicles on the highway, traffic congestion, and decreasing the service level of several main road sections in Bandung City [3]. Improvements to mass transportation are mandatory, is a good alternative. If there is no representative mass transportation, the volume of vehicles will continue to increase.

The main objective of the existence of public transportation is to provide good and proper transportation services for the community. A good measure is a service that is safe, fast, cheap, and comfortable [4]. The existence of mass public transportation means a reduction in the number of vehicles passing on the road. This is very important in terms of traffic control [5]. The essence of a public transport service operation is to provide transportation services at the right time and place to meet the diverse demands of the community. So the operator must fully understand the pattern of needs and must be able to mobilize supplies to meet the needs economically [6]. The operators of public transportation providers in the city of Bandung must improve the quality of service towards services that prioritize reliability, comfort, and humane.

Bandung City Government must choose the most appropriate policy to be implemented to improve the quality of public transport services. This research will focus on the policy side of improving the service quality of the TMB program as a means of mass public transportation in the city of Bandung. By applying the Dynamic Actor Network Analysis (DANA) software as a simulation tool in analyzing various stakeholder opinions, it is hoped that it can answer a research question, namely “What policies should be established to achieve the successful implementation of the TMB program towards services that prioritize reliability, comfort, and humane?”

2. Methodology

DANA is a type of simulation used in policy analysis to simulate a condition where there are many actors. This approach is based on the assumption that the behavior of actors or stakeholders is determined by a subjective understanding of the situation they are facing. They also act on their perceptions in a manner that is rational and consistent with their assumptions [7]. DANA uses the understanding of each actor as the first step for comparative analysis. Then this understanding is poured in the form of a causal relationship diagram that shows the interrelated factors. Based on this, the analysis results of the DANA software can indicate a level of agreement or conflict between actors, dependency relationships, and sensitive issues [8,9]. The use of DANA requires data input that shows the actor's understanding of an issue and then a perception graph diagram is made. The diagram is a representation of the perceptual map of each actor that describes the causal relationship so that it can be concluded that the most preferred form of strategy for the actors [9]. In this study, most of the data input was obtained through interviews with representative actors or stakeholders. So that the diagram made with DANA only illustrates the understanding of the actors who represent it, and other people who are within the same organizational scope can give different opinions.

Stakeholders or actors, people or organizations, namely those who have a permanent concern and interest in the provision of public transport services, especially TMB services, including New Kobaran, Perum DAMRI, and the Transportation Agency. By involving stakeholders, it can be identified who the key actors are and can be identified about their understanding, interests, positions, relationships, and interests of the related policies [10]. In the research process, researchers interact more effectively with key actors and get support in formulating these policies. From this interaction, it can be seen that the possibility of misunderstanding and/or resistance to formulated policies, in this case regarding the improvement of the service quality of the TMB program, can be made scenarios of preventive action. When stakeholders are involved in formulating a policy, the policy is likely to succeed [10].

The analysis method used by DANA is a mixed-method, while the explanation of the use of the study results according to the objectives of this study uses the descriptive method [11]. To understand the stages of research implementation with a DANA approach, it is described in Table 1 below.

| No | Activities | Definition | Applications in Research |
|----|------------|------------|--------------------------|
| 1  | Determining the Arena | • The process of determining the specific problem of a policy | • Arena : TMB Program Service Improvement |
Determining the Actor
- Actor is a stakeholder who has a relationship and interest in a policy (according to the defined Arena)
  - Kobanter Baru,
  - Perum DAMRI,
  - Dinas Perhubungan (Department of Transportation).

Identifying Perceptions of Actors
- Obtain actor perceptions related to the policy issue being studied (focus on the defined Arena)
  - Making a perception map which is a mental model that is translated from the results of interviews and discussions with actors

Creating a perception map with DANA
- Transferring the perception map of each actor to the DANA software
  - Begin to determine factors, goals, actions, and attributes

Determining Factors
- Classifying perceptions that are a factor in the problem or the cause of a problem
  - Obtained 19 factors

Determining Attributes
- Classifying perceptions based on factors that have a correlation / relationship with the actor
  - Obtained 3 factors which become attributes

Defining Action
- Determine the factors that are determined as a solution recommended by each actor and carried out by the actor concerned
  - Obtained 4 factors which become Action

Setting Goals
- Determine the interests / things that each actor wants to achieve
  - Each actor is set the same Goal

Determine the relationships between actors, factors, and attributes
- Uniting all factors in the form of relationships with one another
  - *MPT = Mass Public Transportation
    - has positive implications
    - has negative implications

Describe models and analyze results
- The computerized process of DANA software in analyzing the combined perception diagrams of all actors in one arena
  - Get analysis results:
    - relevance
    - centrality
    - conflict
    - inferred strategies

3. Results and Discussion
The policy to change the model of mass transportation services-TMB in Bandung is facing many issues, including problems with Organda, the right form of TMB management, financing, target achievement, and other problems that affect service quality and satisfaction levels of TMB users. So a more specific discussion is needed, through this research an appropriate strategy is formulated to overcome the problems that hinder the success of the TMB program.
3.1 Actor Identification

The actors involved in this study were selected based on their knowledge of the provision of public transportation (especially TMB), and their role in influencing the form of policy. The basis for determining actors based on their roles can be seen in Table 2.

### Table 2. Actor Identification

| No | Actor                          | Interviewees                      | Role Identification                                                                 |
|----|--------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|
| 1  | Dinas Perhubungan (UPT-TMB)    | Secretary UPT TMB                 | Has direct influence on the overall management of TMB, is responsible as a regulator, planner, supervision, provision of human resources. |
| 2  | Perum DAMRI                    | Head of Operations                | As the operational executor of TMB, he is responsible for providing the best service and maintenance of the Bus fleet.                           |
| 3  | Kobanter Baru                  | Chairman of the organization      | As an organization that consists of angkot cooperatives, entrepreneurs, and angkot drivers. Play a role in bridging the relationship between city transport operators and the government. As a competitor who views TMB as threatening the sustainability of the city transportation business. |

3.2 Perception Diagram Identification

The actor's perception of an issue is influenced by the information the actor has and is also influenced by motivation, competence, and experience. Even though the perception is very subjective, there is a tendency for information to be conveyed based on facts and actual conditions [8]. Several questions were asked to explore the perceptions of the actors and then discussed together so that a mental model was formed. Several questions were asked in the interview to explore the actors' perceptions of:

a) The response to the implementation of the TMB program to overcome congestion and improve public transport services?

b) What factors can hinder the success of the TMB program?

c) Problems that arise when the TMB program is implemented?

d) The interests of each actor in implementing the TMB program?

e) Recommended solution?

The perception map, which is the mental model for each actor, is transferred to the DANA software to form a perception diagram. The perception diagram is a perceptual map depicting the causal relationship with the privileges which enables the researcher to reveal the thinking of an actor [12]. How does the actor reveal his knowledge of a problem issue, and how he assesses the changes in one factor that causes changes in other factors.

All diagrams have goals that must be achieved, namely "Mass Public Transportation Service" as a goal that must be improved, and "Traffic Congestion" as a goal that must be reduced. The solution recommended by each actor is defined as the action of the actor concerned. Perception diagrams of each actor are presented in figures below, Figures 1 is Dinas Perhubungan (UPT-TMB) Perception, Figures 2 is Kobanter Baru Perception, and Figures 3 is Perum DAMRI Perception.
Figure 1. Dinas Perhubungan (UPT-TMB) Perception

According to the perception of DISHUB / UPT TMB. The financing factor is a factor causing problems in the success of a better mass public transport service program. The ability to finance infrastructure repairs, maintenance of the TMB Bus, and the provision of complete facilities affect the service level of the TMB. Demonstration factors also influence TMB services. Due to the demonstration, TMB could not operate and provide services to the community. If the service level of TMB can be improved, TMB users will continue to grow and be able to attract the interest of private vehicle users. With the reduced number of private vehicle users, it is hoped that it will reduce traffic congestion in the city of Bandung. Efforts to improve mass public transportation-TMB services can also be realized.

Figure 2. Kobanter Baru Perception

According to the perception of the Kobanter Baru. Kobanter Baru assessed that Government was not yet ready for the implementation of the TMB program, it was clear from the availability of facilities and infrastructure. Public transportation can re-increase the number of users and improve its services if there is a government policy on fuel subsidies for public passenger transportation and restrictions on motor vehicle sales, especially motorbike sales.
Figure 3. Perum DAMRI Perception

According to DAMRI's perception, the main problem is the quality of TMB services itself. The factors causing this include the age of the TMB buses, infrastructure, facilities, maintenance costs, and demonstrations of rejection of the TMB by angkot entrepreneurs. DAMRI requires considerable maintenance costs for TMB Buses, however, the cost per KM set by DISHUB is still low so it is not sufficient. Perum DAMRI hopes that angkot, Kobanter Baru, Kobutri, and Organda businesses can form a consortium. Consistency of government policies and attitudes are needed in the implementation of this program.

3.3 Relevance and Centrality Analysis

The analysis carried out with the DANA software tries to describe the perceptions of each different actor on different problem groups and the three perceptual diagrams in one service improvement arena. Relevance value is obtained by looking at the frequency of occurrence of a factor mentioned by different actors. Meanwhile, to characterize the centrality of a factor seen from the number of links (lines that connect between factors). The factor that received a lot of links in was a factor that became the main problem, while the factor that sent a lot of links out was the factor that was the main cause of the problem. As described in Table 3, the main problem factor is TMB services. The factors that are the main cause are the availability of facilities (bus stops), infrastructure (road capacity), and financing.

Table 3. Relevance and Centrality Analysis

| Arena  | Actor | Service Improvements |
|--------|-------|----------------------|
| Facilities | 3 | 100% | 1 | 4 |
| Infrastructure | 3 | 100% | 1 | 4 |
| Traffic Jam | 3 | 100% | 3 | 0 |
| MPT Services | 3 | 100% | 6 | 2 |
| TMB Maintenance Cost | 2 | 67% | 2 | 2 |
| Cost per kilometer | 2 | 67% | 2 | 2 |
| Demonstration | 2 | 67% | 2 | 2 |
| TMB Services [DAMRI] | 2 | 67% | 9 | 2 |
| Financing [DISHUB] | 2 | 67% | 1 | 4 |
| MPT/TMB User | 2 | 67% | 4 | 3 |
| Private Vehicle User | 2 | 67% | 3 | 2 |
| Consistency of Government | 1 | 33% | 0 | 2 |
| Consortium [Kobanter Baru] | 1 | 33% | 0 | 1 |
| Free Market [DISHUB] | 1 | 33% | 0 | 1 |
Conflict Analysis
Conflict in this study relates to a situation where there are two or more actors who want to make changes to a factor in opposite directions. The comparison between the three perception diagrams, which shows the views of each of the different actors on the same policy issue, can show the presence or absence of conflicts, namely goal conflict and action conflict [9].

Table 4. Conflict Analysis

| Arena I® Actor A® | Service Improvements |
|-------------------|----------------------|
| # Goals | µ Goal Conflict | # Actions | µ Action Conflict |
| 18 | 0 | 2 | 0 |

The results of DANA software processing on conflict analysis are shown in Table 4. In the diagram of the perceptions of each actor, there are no contradicting goals, because in this case study the goals are set first. So that goal conflict shows zero. Likewise, action conflict also shows zero, meaning that there is no conflict in terms of actions taken by each actor.

3.5 Inferred Strategies Analysis
By using DANA software, it can be obtained the ideal solution strategy that has the maximum utility value, highest satisfaction, and lowest frustration value. The term tactic used in DANA denotes the changes that can be made by the actions of individual actors [9].

Presented in Table 5, there are four actions proposed by the three actors. The results of the calculation of the conclusion of the strategy show that the solution strategy as recommended by DANA, in ideal conditions, first takes action to form a consortium and conducts socialization. With the greatest utility value, the satisfaction scores 75%, and the frustration score 0%.

Table 5. Inferred Strategies Analysis

| Arena I® Actor A® | Service Improvements |
|-------------------|----------------------|
| Factors | *All actors | Base | Ideal | Worst |
| Consortium [Kobanter Baru] | 1 | 2 | (+11) | 1 | 2 | (+19) |
| MPT Services [DAMRI] | no tactic | no tactic |
| Financing [DISHUB] | no tactic | no tactic |
4. Conclusion

Based on the inferred strategy analysis, the most ideal solution strategy is one that has the maximum utility value, the highest satisfaction, and the lowest frustration value. So the actions that must be taken in improving the management of the TMB are the formation of a consortium and conducting socialization.

Currently, the financial management institution for TMB is the Regional Public Service Agency (BLUD) which is the Technical Implementing Unit (UPT) under the Transportation Agency (DISHUB). Operations and maintenance of the TMB Bus are in collaboration with DAMRI. Formation of a consortium in the management of Mass Public Transport - TMB, through increased cooperation partners involving Kobanter Baru and other operators who are members of Organda. Together provide reliable Mass Public Transport - TMB services.

The socialization can be carried out by Kobanter Baru (or Organda) - accompanied by the DISHUB - as the organization where entrepreneurs and angkot drivers gathered, as a form of support for the TMB program and eliminating the turmoil of rejection of this program.

5. Recommendation

PPK-BLUD is semi-government (quasi-public governance), is more flexible in managing finances without fully depending on the APBD, and has the authority to establish cooperation for the benefit of services. By increasing the number of cooperation partners in the consortium, the management status of Regional Owned Enterprises (BUMD) can be a consideration for the government to become a means to provide the best service to the community.

In addition to serving the interests of the wider community, BUMD's goal is to pursue and seek profit. That way, TMB managers will be more motivated in increasing work professionalism and creating innovations for customer satisfaction.

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