An Implementation of Repetitive Scheduling Method in Bus Transportation Schedule

Wistiani Astuti, Nia Kurniati, Dirgahayu Lantara

Abstract*— Sustainable transportation is a transportation system that minimizes the impact on economic, social and environmental aspects. One of the land transportation used in Makassar is Bus Rapid Transit (BRT). Bus Rapid Transit (BRT) Trans Mamminasata is a public transportation service that can be used by the people of Makassar in middle and lower level. In public transport services is often found the uncertainty waiting time of bus arrival and departure at each stop. This research applies repetitive scheduling method in solving the scheduling problem to know the departure and arrival schedule of Bus Rapid Transit (BRT) at every stop. This research proposes the arrival and departure schedule of Bus Rapid Transit (BRT) based on each route at each stop. The result of the repetitive scheduling method is the duration of time and the number of units of the bus according to the condition intensity.

***Keywords*— Bus Rapid Transit (BRT); Repetitive Scheduling Method; Scheduling.**

I. INTRODUCTION

Makassar is the largest city in eastern Indonesia. There are several transportations used include land, sea or air transportation. One of the existing road transportation in Makassar is Bus Rapid Transit (BRT) which is also called busway. One of the Makassar city government programs is to be a developing and smart city in facilitating all the needs by utilizing technology. The sustainable transportation system is a new order of transportation system in the current era of globalization [1]. Transportation is an issue that requires attention and study from various scientific perspectives [2]. Sustainable transportation is a transportation system that minimizes the impact on economic, social and environmental aspects. Bus Rapid Transit (BRT) Trans Mamminasata is a newly applied transportation service in Makassar. The transportation service is the important economic sector for the people of Makassar in middle and lower level due to the affordable cost, safeness and comfort. However, there are still many shortcomings found in the services.

One of the disadvantages found in BRT services is the uncertainty of waiting time of bus arrival and departure at each bus stop due to the scheduling which is still manual and not in real time yet. It causes the accumulation of passengers at the bus stop. Several passengers tend to be bored with this sort of conditions and change to another public transportation. Scheduling is an activity of allocating existing resources to run a set of tasks within a certain timeframe [3].

In order to solve the problem on the irregular and manual Bus Rapid Transit (BRT) schedule, it is necessary to conduct research on Bus Rapid Transit (BRT) scheduling by applying repetitive scheduling method to make and operate scheduling on Bus Rapid Transit (BRT) effectively.

II. EXPERIMENTAL DETAILS

Repetitive Scheduling Method (RSM) is a scheduling method that is generally used in projects with repetitive activities. In Critical Path Method, the main matter to note is that there is a critical path in the path that must be passed when doing scheduling in an activity sequence, whereas in repetitive scheduling method is the optimal material used [4], [5]. There are two important and often confused production rates associated with each activity, a resource production rate (rpr_A) and a unit production rate(upr_A) [6]. The resource production rate for an activity, rprA is the amount of work that can be accomplished by the resource in one time period shown in equation (1).

$$rpr_A = \frac{Q_{Ai}}{T_{Ai}} \quad (1)$$

As pointed in (1), rprA is the resource production rate; QAi is the quantity of work in activity, A, in any repeating unit, i; and TAi is the time needed to complete the A activity in unit i. (1) is most often used to estimate the activity duration, TAi, in as much as the quantity of work, QAi, is taken from the plans and specifications and a standardized resource production rate, rprA, for the selected

resource and method is taken from company databases or from any of several construction guides in common use in the construction industry.

The unit production rate is the number of repetitive units that can be accomplished by a resource during a unit of time. For an activity, A, in any repeating unit, i, the unit production rate, uprAi, can be expressed as (2).

$$\mathrm{upr}_{\mathrm{Ai}} = \frac{1}{T_{Ai}}. \quad (2)$$

It can be seen in (2) that TAi is the time needed to complete the unit. The unit production rate (and not the resource production rate) is the slope of a production line in an RSM diagram. If (1) is solved for TAi, substituted into (2), and applied to any repeating unit, we obtain (3).

$$upr_{Ai} = \frac{rpr_A}{Q_{Ai}} \quad (3)$$

From the result of resource production rate and unit production rate of money obtained, so it can be calculated how good scheduling should be activity. The recurrent data

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Wistiani Astuti, Faculty of Computer Science, Universitas Muslim Indonesia, Makassar, Indonesia.
(E-mail: whistieruslank@gmail.com)
Nia Kurniati, Faculty of Computer Science, Universitas Muslim Indonesia, Makassar, Indonesia.
Dirgahayu Lantara, Faculty of Industrial Engineering, Universitas Muslim Indonesia.

in this paper is the updating of data on the Bus Rapid Transit (BRT) travel time of each stop in each corridor.

III. RESULT AND DISCUSSION

This research is more to design the simulation program for Repetitive Scheduling Method because to get the result of data that is close to reality is by doing updating data which is done continuously, follow the progress of the situation in reality [7]. At this stage, the application of the RSM method is determined into several variables such as: the number of activity stated as rpr_A, the number of repeating units expressed as upr_A, the number of turns in a series of activities is expressed as Q_{Ai}, and the time required in a single activity is stated as T_{Ai}. The process for obtaining rpr_A is obtained from Q_{Ai} divided by T_{Ai}. T_{Ai} is divided by the speed divided by time, whereas to calculate the speed is obtained from the distance divided by the time. The time is obtained based on the real state of the data retrieval process. Meanwhile the distance to the unit per km is obtained from the distance from the departure point to the destination.

This research is performed to find the proper time planning. In achieving these objectives, we estimate the time completion of the activity. The data retrieval time is within seconds and the bus arrival time range is based on the result of observation and the testing which has been done that is 10-15 minutes. There are 11 corridors identified i.e. corridor 1 (Airport – Achmad Yani Street) round-trip, corridor 2 (Sudiang – Gowa) round-trip, corridor 3 (Boulevard Street – Metro Tanjung Bunga Street) round-trip, corridor 4 (Daya – Maros) round-trip, corridor 5 (UntiaStreet – Gowa) round-trip, corridor 6 (Gowa – Metro Tanjung Bunga Street) round-trip, corridor 7 (Gowa – Takalar) round-trip, corridor 8 (Takalar – Metro Tanjung Bunga Street) round-trip, corridor 9 (Maros – Barombong) round-trip, corridor 10 (Tamalanrea Street – Gowa) round-trip. The data is based on each active corridor are corridor 1, 2, 3, and 4.

Table 1: BRT departure schedule for corridor 2

Bus Number	From	To	Departure Time	Arrival Time	rprA (minute)	uprA (minute)
B01	UIN	LPMP	08.05	08.05	28.6	4
B02	LPMP	Kampus UMI	08.10	08.25	19.0	2
B03	Kampus UMI	Kantor Gubernur	08.30	08.34	32.0	4
B04	Kantor Gubernur	UIM Al-Ghazali	08.39	08.47	20.6	3
B05	UIM Al-Ghazali	Dinas Pendidikan	08.52	08.54	22.9	3
B06	Dinas Pendidikan	BRT UNHAS	08.59	09.01	24.6	3
B07	BRT UNHAS	Daya	09.06	09.17	20.4	3
B08	Daya	Dinas Perhubungan	09.22	09.24	26.7	3
B09	Dinas Perhubungan	Kementerian Lingkungan Hidup	09.29	09.35	24.3	3
B10	Kementerian Lingkungan Hidup	Citra Sudiang Indah	09.40	09.42	28.2	4
B11	Citra Sudiang Indah	Buni Permata Sudiang	09.47	09.49	32.0	4

Table 1 shows that the highest average activity sequence obtained from the number of activity performed at one time is 4 routes. The first is the departure route point from "UIN Stop" to "LPMP Stop", rprA of 28.6 and uprA of 4 repeating units. Secondly, the route from "UMI Campus" to "Office of Governor" with rprA achievement of 32.0 and uprA of 4 repeating units. The third, the route from "Ministry of Environment Stop" to "Citra Sudiang Indah Stop" with rprA of 28.2 and uprA of 4 repeating units. The fourth is the route from "Citra Sudiang Indah Stop" to "Sudiang Gem Stop" with rprA a of 32.0 and uprA of 4 repeating units. The four routes are the most frequent in involving the resources in each activity sequence. In Table 2, the BRT return schedule is obtained for corridor 2.

Table 2 shows that the highest average activity sequence obtained from the number of activities performed at one time is 5 routes. The first is the departure route from "Citra Sudiang Indah Stop" to the "Ministry of Environment" Stop, with rprA of 35.6 and uprA of 4 repeating units. Secondly, the return route from "Transportation Department Stop" to "Power Stop" with rprA of 30.8 and uprA of 4 repeating units. The third, the return route from "Power Stop" to "Tamalanrea Stick Stop" with rprA of 28.2 and uprA of 4 repeating units. The fourth, the return route from the "Office of Governor" to "Univ.Bosowa" Stop with rprA of 33.7 and uprA of 4 repeating units. The fifth, the return route from "Halte Panakukkang" to "Campus Stop UNM" with rprA of 30.8 and uprA as many as 4 units are repeated. The five routes are the most frequent in involving a lot of resources in each activity sequence.

Table 2: BRT return schedule for corridor 2

Bus Number	From	To	Departure Time	Arrival Time	rprA (minute)	uprA (minute)
B01	Bumi Permata Sudiang	Citra Sudiang Indah	09.49	10.09	26.7	3
B02	Citra Sudiang Indah	Kementerian Lingkungan HIdup	10.14	10.17	35.6	4
B03	Kementerian Lingkungan HIdup	Dinas Perhubungan	10.22	10.26	17.4	2
B04	Dinas Perhubungan	Daya	10.31	10.33	30.8	4
B05	Daya	Stik Tamalanrea	10.38	10.48	28.2	4
B06	Stik Tamalanrea	Univ. Cokroaminoto	10.53	10.56	21.8	3
B07	Univ. Cokroaminoto	Dinas Pendidikan	11.01	11.03	23.5	3
B08	Dinas Pendidikan	KantorGubernur	11.08	11.23	20.0	3
B09	KantorGubernur	Univ. Bosowa	11.23	11.27	33.7	4
B10	Univ. Bosowa	Mall Panakkukang	11.32	11.43	23.8	3

B11	Mall Panakkukang	Kampus UNM	11.48	11.58	30.8	4
B12	Kampus UNM	Kampus Unismuh	12.03	12.09	22.9	3
B13	Kampus Unismuh	Jl. Raya Gowa	12.14	12.33	23.8	3
B14	Jl. Raya Gowa	Terminal Pallangga	12.38	12.42	20.0	3

IV. CONCLUSION

Based on Table 1 and Table 2 on corridor 2, data of departure schedule and arrival schedule of each route are obtained. The data obtained represents the reality. The highest activity of the number of activities performed in one time can provide information about the most frequent route to pass, and some units are repeated from the departure and arrival schedule for each route on each BRT Trans bus corridor.

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