PERFORMANCE EVALUATION OF TRAFFICSENS SIGNAL OPTIMIZATION AND REPHASING

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FLOW OF PRESENTATION

- INTRODUCTION
- METHODOLOGY
- ANALYSIS
- RESULT SUMMARY
- CONCLUSION

INTRODUCTION

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- Two (2) signalised junction at Jalan Mutiara Emas Utama, JB were identified as a study area
- The distance is less than 500m, therefore, possible to coordinate
- The ever increasing traffic volume at the study area continues to place heavy demands at Jalan Mutiara Emas
- Coordinated signals often provide a good solution for this growing problem

METHODOLOGY

- The objective of this study is to evaluate junctions network performance of different signal strategies:
  - Signal Rephasing (Plan 1)
  - Signal Timing and Optimization (Plan 2)

- Details of junctions configuration of both junctions as below:

Plan	Intersection	Cycle (s)	Phase Splits (%) (AM)					Phase Splits (%) (PM)					Phase Sequence
			1	2	3	4	5	1	2	3	4	5	
Plan 1	B25	180	22	16	22	22	16	25	19	19	19	18	3,4,5,1,2
	B26	165	32	16	28	24	NA	39	15	24	21	NA	2,3,1,4
Plan 2	B25	180	22	16	22	22	16	31	19	22	17	11	1,2,3,4,5
	B26	145	28	16	28	28	NA	31	17	31	21	NA	1,2,3,4

- Parameters used in this study are Travel Time (s), Control Delay (s) and CO_2 Emission (cc)

METHODOLOGY

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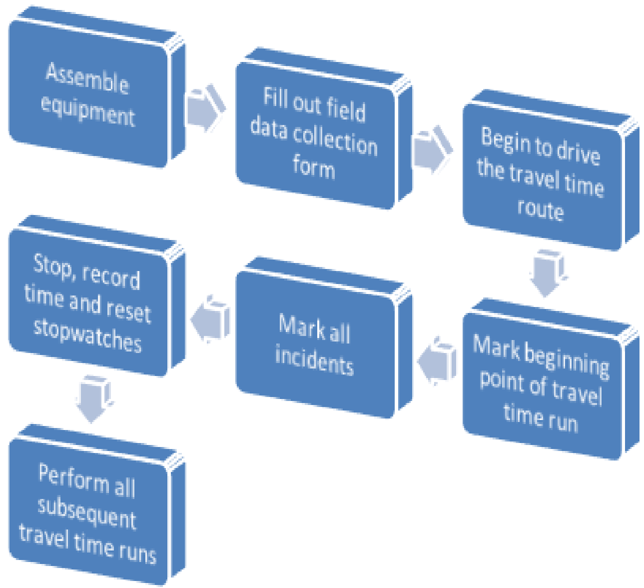
1. TRAVEL TIME

- Measure by using Manual Test Vehicle technique
- Sample size is referring to FHWA Travel Time Handbook

Traffic Signal Density (signals per mile)	Average Coefficient of Variation (%)	Sample Sizes		
		90% Confidence, = 10% error	95% Confidence, = 10% error	95% Confidence, = 5% error
Less than 3	9	5	6	15
3 to 6	12	6	8	25
Greater than 6	15	9	12	37



Manual Test Vehicle Technique Procedures

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2. CONTROL DELAY

Computed based on Highway Capacity Manual 2000 method

$$d = d_1 \times PF + d_2 + d_3 \tag{1}$$

$$d_1 = \frac{0.5C\,[1 - g/C]^2}{1 - (g/c)\,[\min X, 1.0)} \tag{2}$$

$$d_2 = 900T\,[(X-1)^2 + 8KiX/Tc\ ] \tag{3}$$

where,

d	= control delay (sec/veh)
d1	= uniform delay (sec/veh)
d2	= incremental delay (sec/veh)
d3	= residual demand delay (sec/veh)
PF	= uniform delay adjustment for quality of progression
c	= capacity of lane group (veh/hr)
X	= v/c ratio for lane group (veh/hr) with v representing demand flow rate
C	= cycle length (sec)
g	= effective green time for lane group
T	= duration of the analysis period (hr)
k	= incremental delay adjustment
I	= incremental delay adjustment for filtering and metering by upstream signals

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3. CO_2 EMISSION

Computed using vehicle trajectory data, obtained from field data measurement. Equation was developed by Oguchi, 1996

$$E = K_C\,(0.3T + 0.028D + 0.056AEE) \qquad (1)$$

$$AEE = \sum_{k=1}^{k} \sigma_k \binom{n}{k} v_k^2 - v_{k-1}^2$$

where,

E	: volume of CO_2 emission
T	: travel time (s)
D	: travel distance (m)
AEE	: acceleration energy equivalent (m^2/s^2)
K_C	: coefficient to convert the gasoline fuel consumption to the volume of CO_2 emission
s_k	: $\sigma_k = 1$ if $v_k > v_{k-1}$, otherwise $\sigma_k = 0$
v_k	: velocity at time k (m/s)

ANALYSIS AM PEAK

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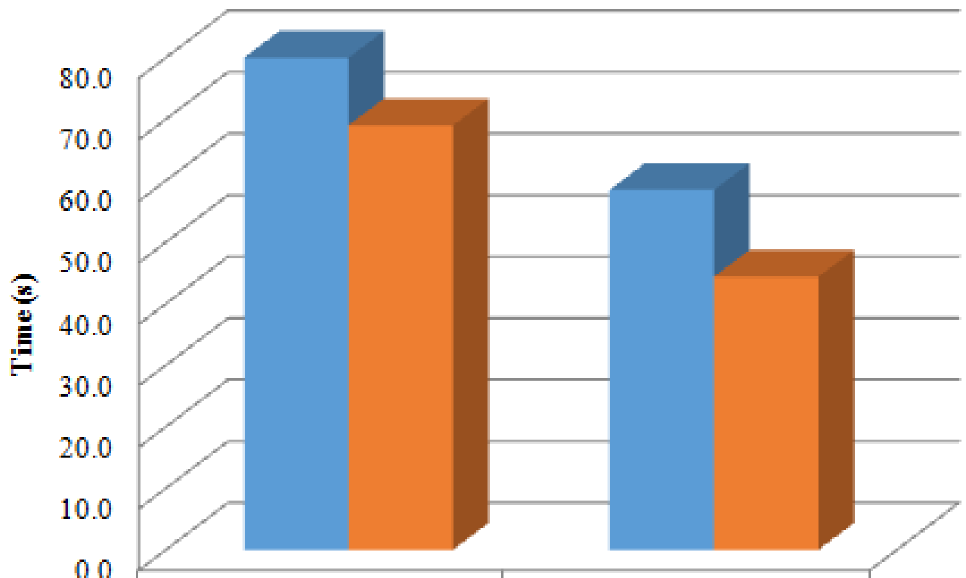
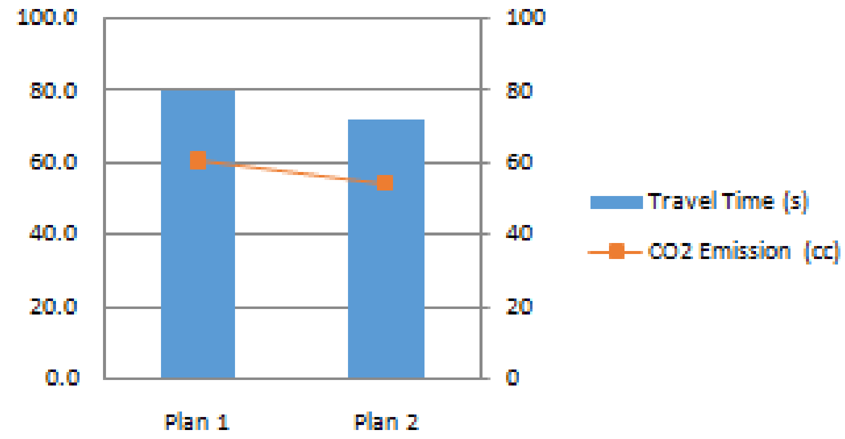
Performance Evaluation during AM Peak



	Travel Time (s)	Control Delay (s)
Plan 1	80.0	58.5
Plan 2	69.0	44.4

Travel Time vs CO_2 Emission (AM Peak)



ANALYSIS PM PEAK

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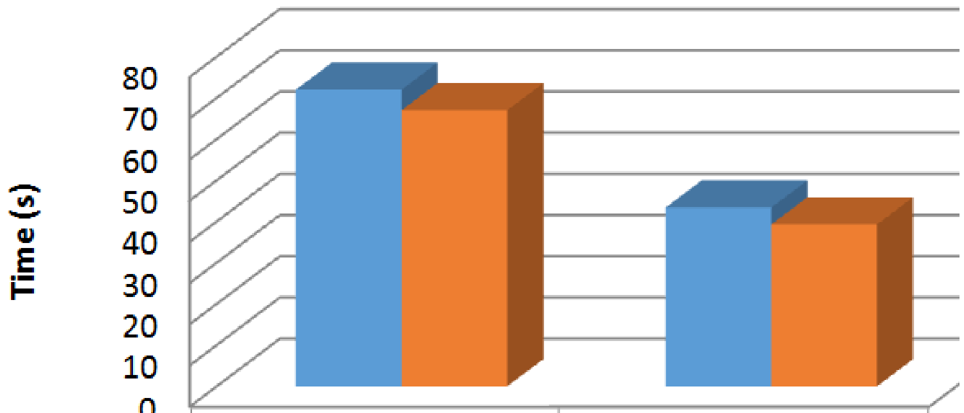
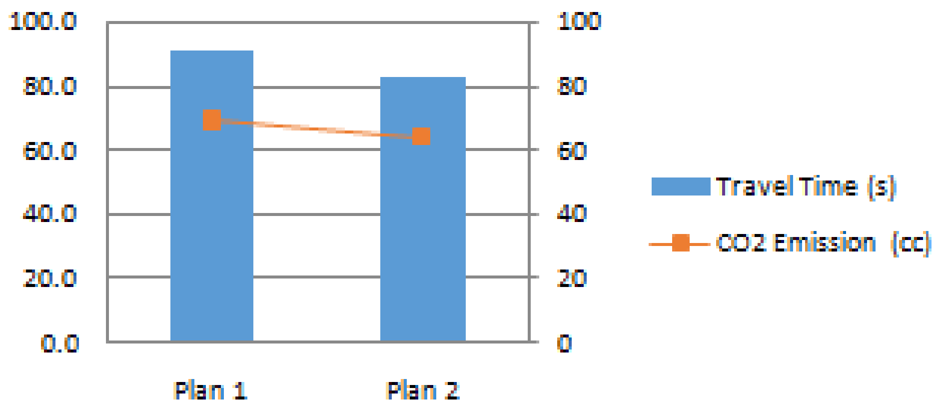
Performance Evaluation during PM Peak



	Travel Time (s)	Control Delay (s)
Plan 1	72	43.4
Plan 2	67	39.3

Travel Time vs CO_2 Emission (PM Peak)



RESULT SUMMARY

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Parameters	AM Peak (Northbound-Southbound Direction)			PM Peak (Southbound-Northbound Direction)		
	Plan 1	Plan 2	Differences (%)	Plan 1	Plan 2	Differences (%)
Travel Time (s)	80	69	7	72	67	6
Travel Speed (km/hr)	21	23	7	23	27	6
Control Delay (s)	58.5	44.4	13.7	43.4	39.3	5
CO_2 Emission	60	54	5	64	37	4

CONCLUSION

- The analysis was done at Northbound-Southbound (NB-SB) corridor during AM peak whereas the analysis of Southbound-Northbound (SB-NB) corridor was done during PM peak.

- The method of collecting data and analysis is entirely by **field measurement data** and **computational equation**

- The analysis indicates Plan 2 (signal timing optimization) resulted efficient coordinated network performance compared to Plan 2 (signal rephasing)

- The network junctions result shows significant improvement on the coordination by **reduction of 7% travel time** and **13.7% control delay**. Whereas, in PM peak, the network junctions performance indicates a significant improvement as the **travel time** and **carbon emission is reduce to 7%** and **5%** respectively. This result is compared to the signal phasing arrangement strategies to evaluate the network junction performance.