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Modelling Dwell time Variation for the City Bus Transport System of Surat City

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INTRODUCTION

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DWELL TIME DISTRIBUTION

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REFERENCES

DWELL TIME

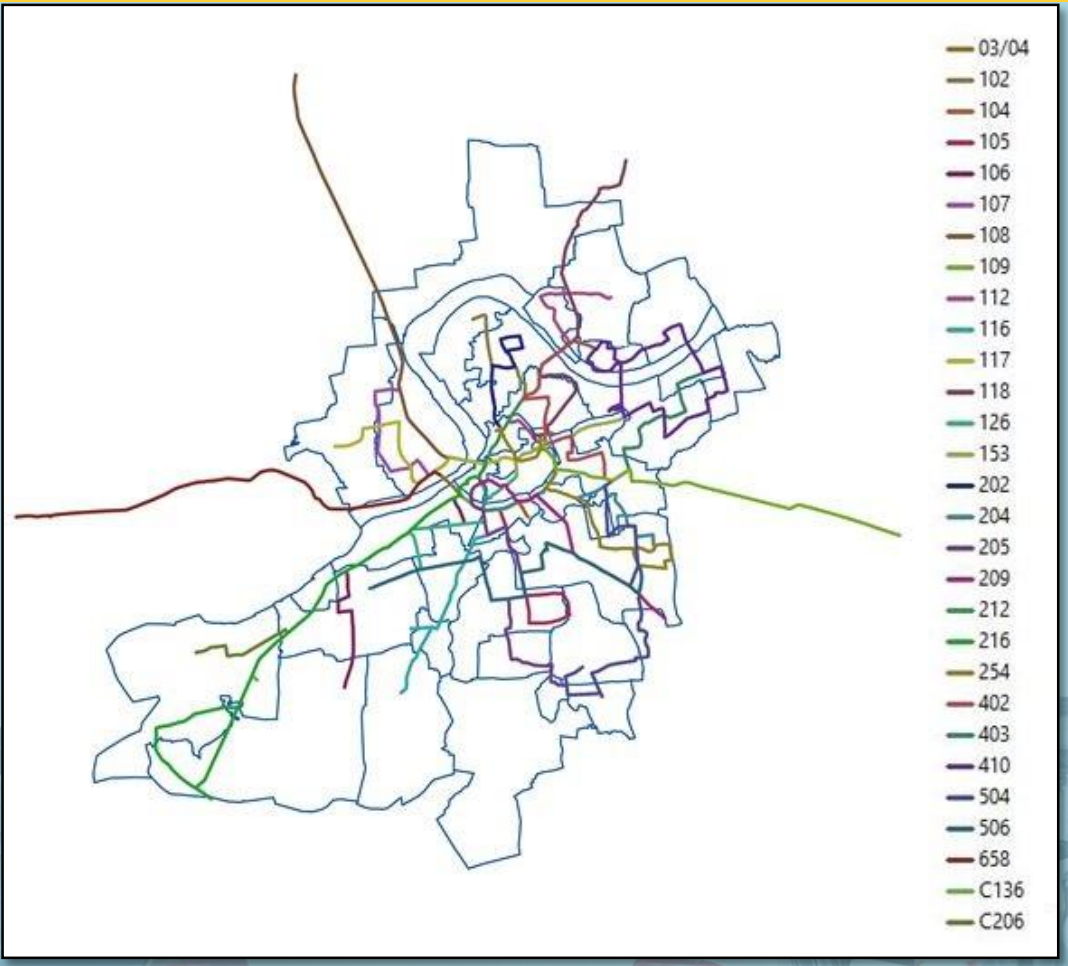
- DEFINATION

- SIGNIFICANCE

LITERATURE REVIEW

Sr no	Author	Influencing factor	Method
1	Levinson, H. S. (1983)	• Total number of boarding & alighting passenger	Linear regression model
2	Guenthner (1983)	• Total boarding and alighting	Natural logarithmic model
3	(Lam, Cheung, 1999)	• Effect of crowding conditions on dwell time	Linear regression model
4	Rajbhandari (2003)	• Passenger boarding & alighting • Standee inside bus	Linear regression model
5	(Bertini, R. L. 2004)	• Passenger boarding & alighting	Ordinary least square
6	(Dueker et al. 2004)	• Passenger boarding & alighting, • On time performance • friction at bus stop	Multi linear regression
7	Kittelson and Associates (2005)	• Boarding and alighting	multivariate linear regression model
8	(Zhang, Baoming, and Dewei 2008)	• Passenger alighting and boarding behaviour	cellular automata-based micro-simulation model
9	(El-Geneidy and Vijayakumar 2011)	• Passenger boarding & alighting, • times of day, • bus type, • passenger load, • weather condition	Linear regression
10	(Tirachini, A., Hensher, D.A., Rose 2013)	• Payment methods, • The existence of steps at doors, • Age of passengers • Possible friction between users boarding, alighting and standing	multiple regression models

STUDY AREA



- One of the fastest growing cities, Surat is selected for study.
- Population : 4.5 million (Source: census 2011)
- Area of city : 326.5 km2
- Presently, 238 buses are running on 37 different routes (28 routes of City bus and 9 routes of BRTS) routes.
- The city bus has capacity of 32 seats per bus (24 seating and 08 standee).

DATA COLLECTION

Dwell time measurement

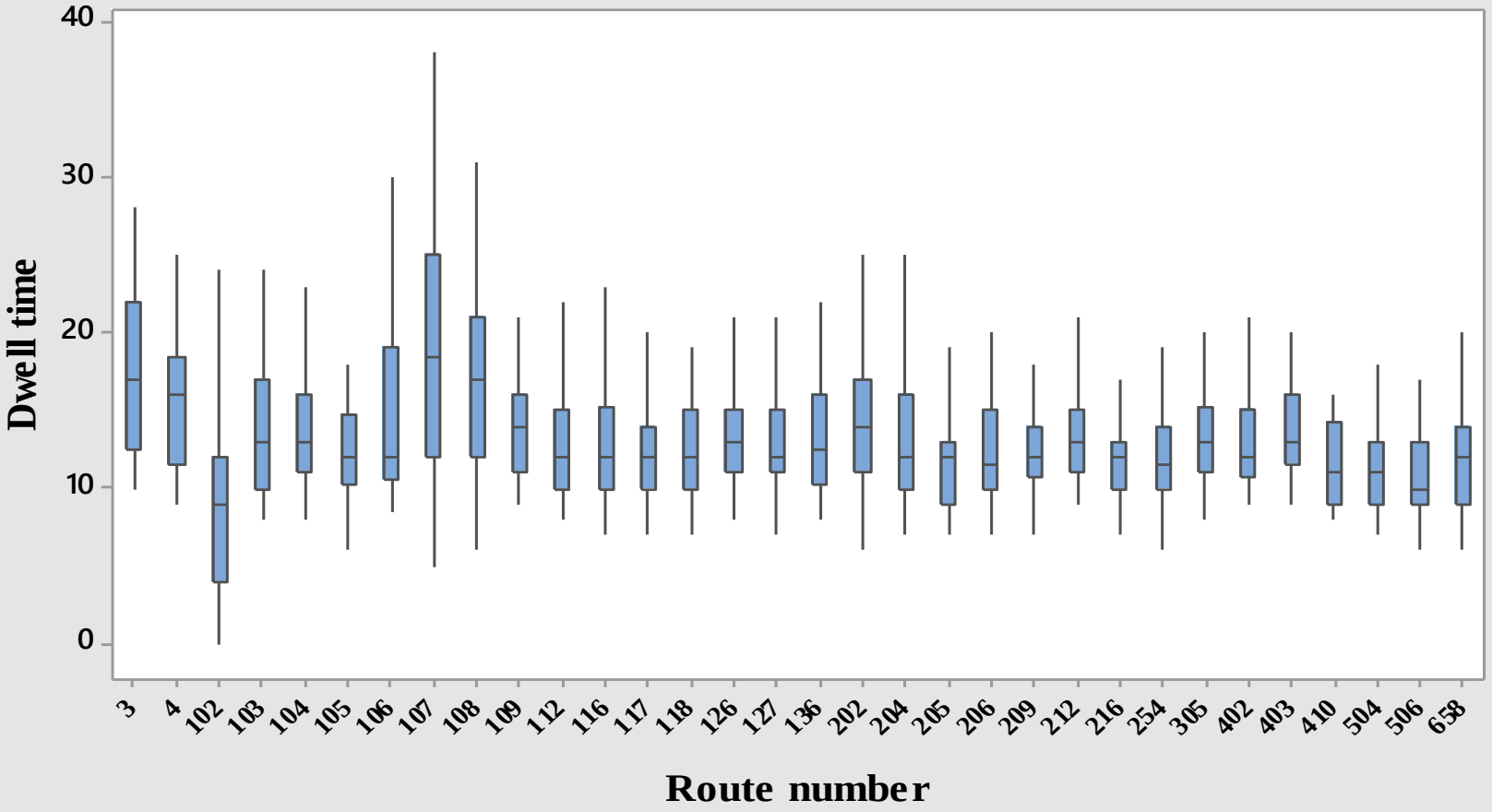
Boarding and Alighting count

SUMMARY OF P STATISTICS VALUE FOR DWELL TIME DISTRIBUTION

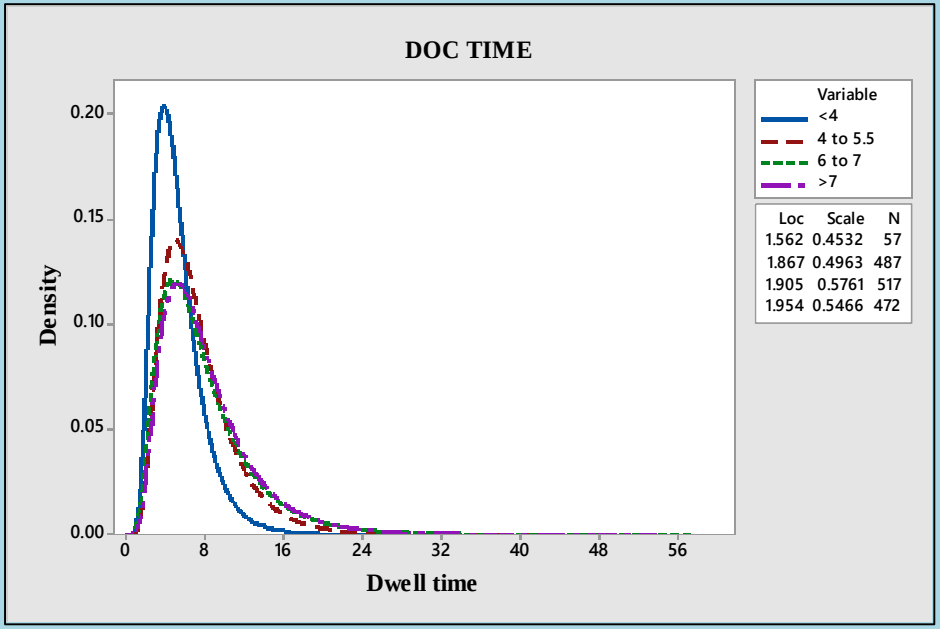
		Log normal	Normal	Weibull
Direction	Up	0.17487	0.21188	0.18434
	Down	0.16925	0.21752	0.18233
Passenger Demand (Persons)	0-1	0.27347	0.28535	0.27443
	2-3	0.22405	0.29152	0.28913
	4-5	0.1864	0.25111	0.24162
	>5	0.10168	0.14498	0.15882
Time of the day	Morning	0.09426	0.13934	0.13963
	Evening	0.13284	0.18359	0.19393
Time for door opening & closing(Sec.)	<4	0.31746	0.35522	0.61745
	4-5.5	0.12867	0.20687	0.1477
	6-7	0.16675	0.22356	0.18015
	>7	0.14323	0.21024	0.20506

Using K-S test in Easy fit software

DWELL TIME VARIATION ON EACH ROUTE

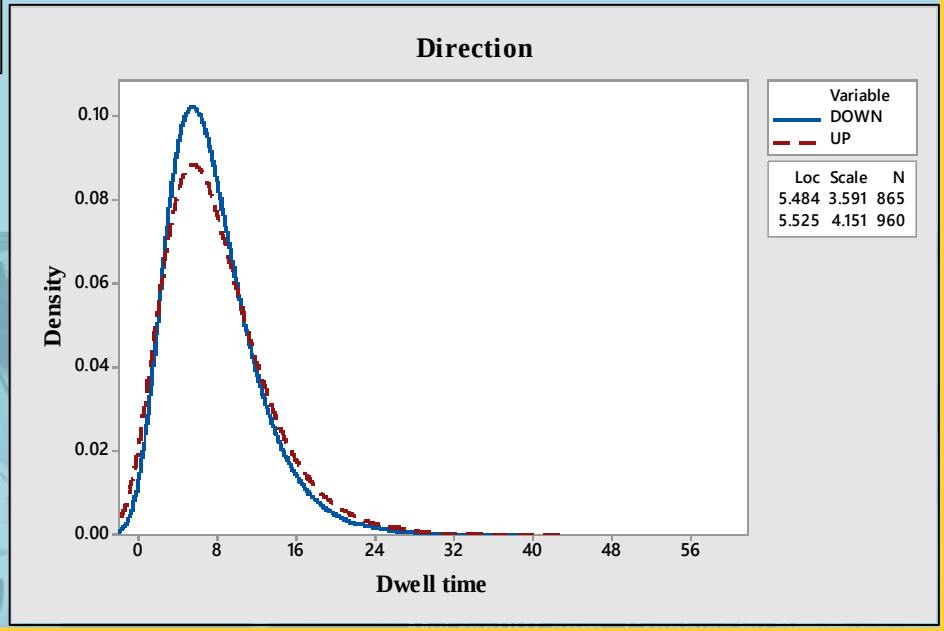


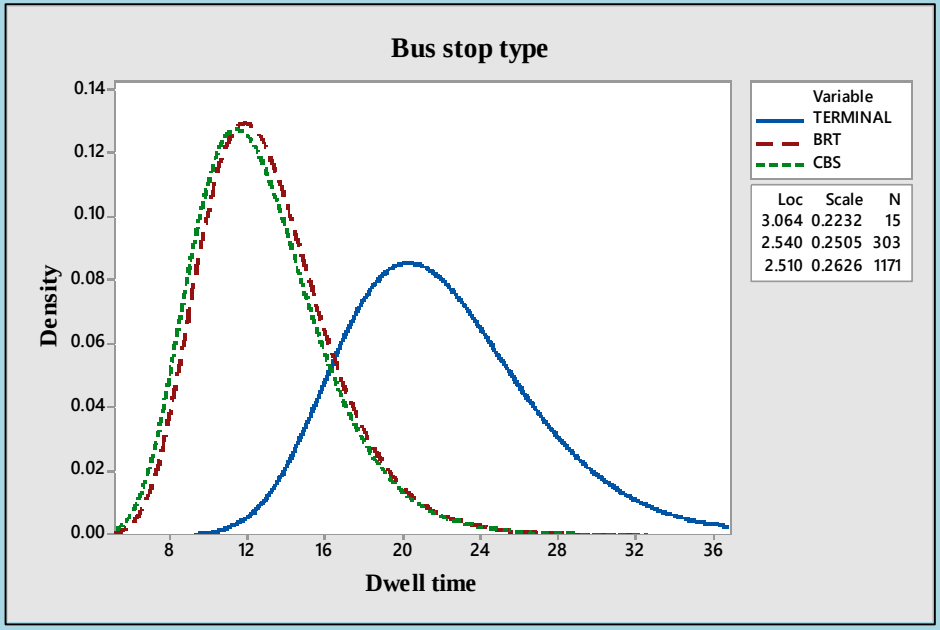
DISTRIBUTION OF INDEPENDENT VARIABLES OF MODEL



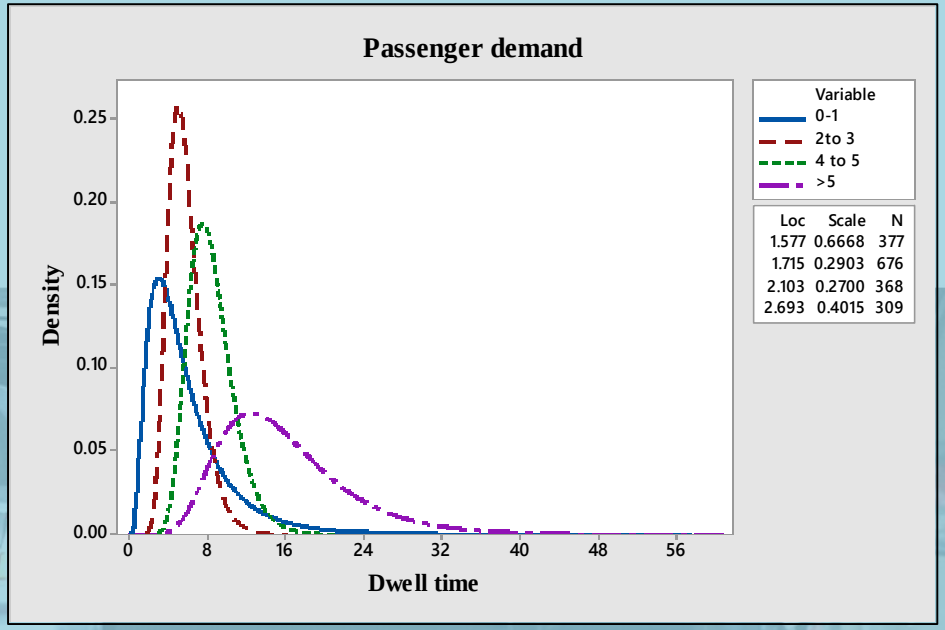
Distribution of Dwell time according to Door opening and closing time

Distribution of Dwell time according to Direction of movement

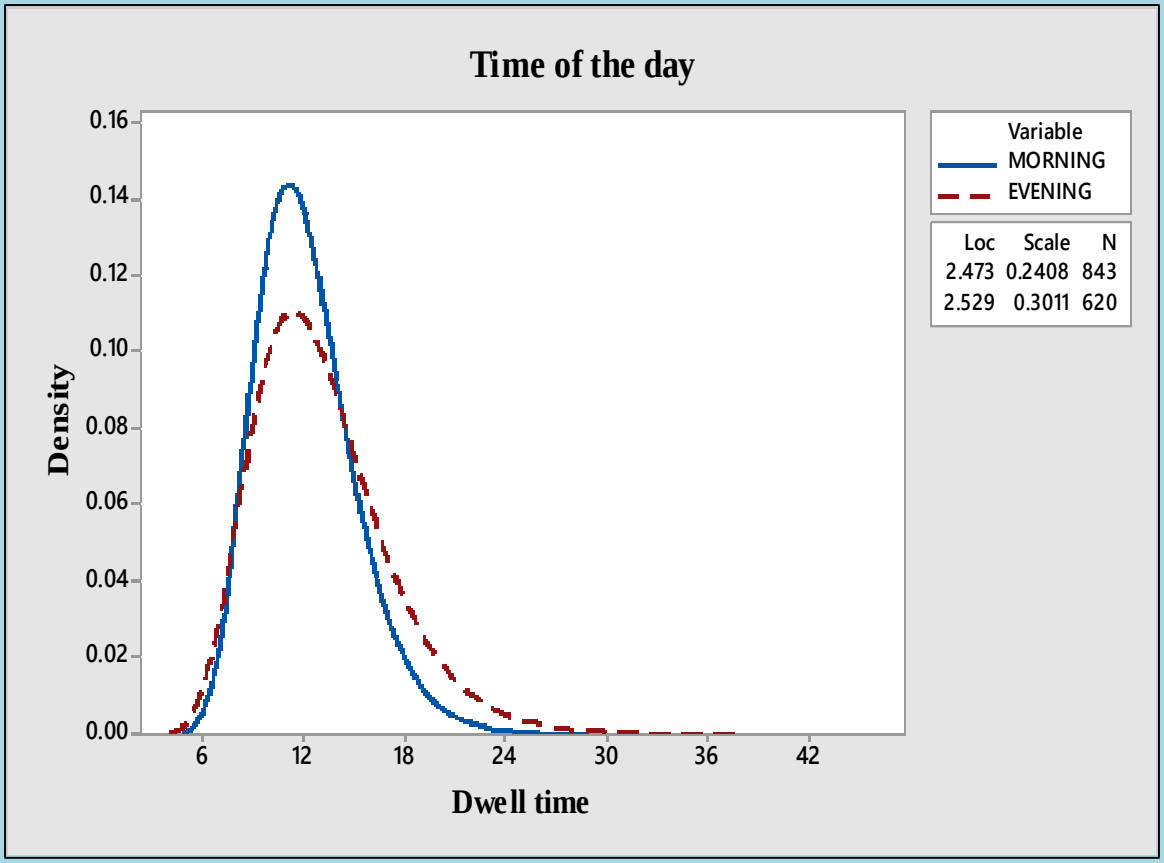




Distribution of Dwell time according to Bus stop type



Distribution of Dwell time according to Passenger demand



Distribution of Dwell time according to Time of the day

LOG LINEAR REGRESSION AND MODEL SUMMARY

	Coefficients	Standard Error	T-Stat	P-value
Intercept	1.6507	0.0284	58.190	0
D.O.C.	0.0761	0.0027	27.802	3.05E-137
Direction	0.0310	0.0067	4.6464	3.67E-06
B	0.0956	0.0016	58.29	0
A	0.1023	0.0022	46.777	4.6E-294
Crowding inside bus	0.0011	0.0005	2.1012	0.0358
Time of day	0.0285	0.0065	4.3926	1.19E-05
BST	0.0138	0.0075	1.8471	0.05014
Model summary				
Multiple R				0.89202
R Square				0.79569
Adjusted R Square				0.79473
Standard Error				0.12036
Observations				1489

DWELL TIME MODEL

$$Ln(Dt) = 1.6507 + (o.o76 * X_1) + (o.o31 * X_2) + (o.o95 * X_3) + (o.102 * X_4) + (o.001 * X_5) + (o.o28 * X_6) + (o.o14 * X_7)$$

Where,

X1= Time for opening and closing door (sec.)

X2= Direction of movement

X3= No. of passengers boarded (B)

X4= No. of passengers alighted (A)

X5= Crowding inside the bus

X6= Time of the day

X7= Bus stop type

EFFECT OF BOARDING AND ALIGHTING ON DWELL TIME

Dwell time variation									
Boarding (%)	Alighting (%)	Mean	Standard Error	Median	SD	Sample Variance	Range	Min.	Max.
0-20	100-80	2.59	0.05	2.27	1.11	1.22	5.82	0.18	6.00
21-40	79-60	2.01	0.04	2.00	0.59	0.35	4.67	1.00	5.67
41-60	59-40	2.13	0.04	2.00	0.67	0.45	5.33	0.67	6.00
61-80	39-20	1.98	0.04	2.00	0.54	0.29	4.09	0.91	5.00
81-100	19-0	2.51	0.05	2.17	1.00	1.01	5.83	0.7	6.00

Dwell time per passenger(Sec.)

EFFECT OF OCCUPANCY ON DWELL TIME

Seats occupied(%)	Less than 50	50-100	More than 100
Passenger demand	2.11	2.54	3.03
Only Boarding	2.55	2.61	2.77
Only Alighting	2.59	2.84	3.33

Dwell time per passenger(Sec.)

FINDINGS

- Log-normal distribution can be considered as best distribution for explaining variations in dwell times compared to other potential statistical distributions.
- Dwell time is significantly influenced by passenger demand (boarding and alighting), crowding inside the bus, time of the day, direction of travel, door opening and closing time and type of bus stops.
- For informal stop (Generally city bus stops), dwell time per passenger is lower compared to dedicated bus stops (BRT) and Terminal stops.
- As crowding inside the bus increases, passenger service time for alighting operation increases rapidly compared to passenger service time for boarding operations and a result dwell time increases.

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