Evaluation of Bus Operations with ETM and GPS Data

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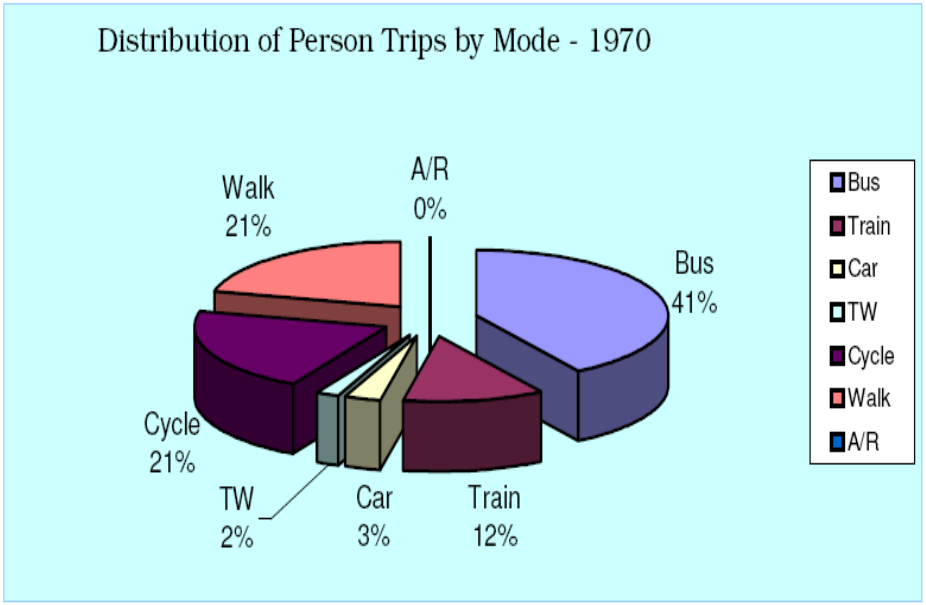
Introduction

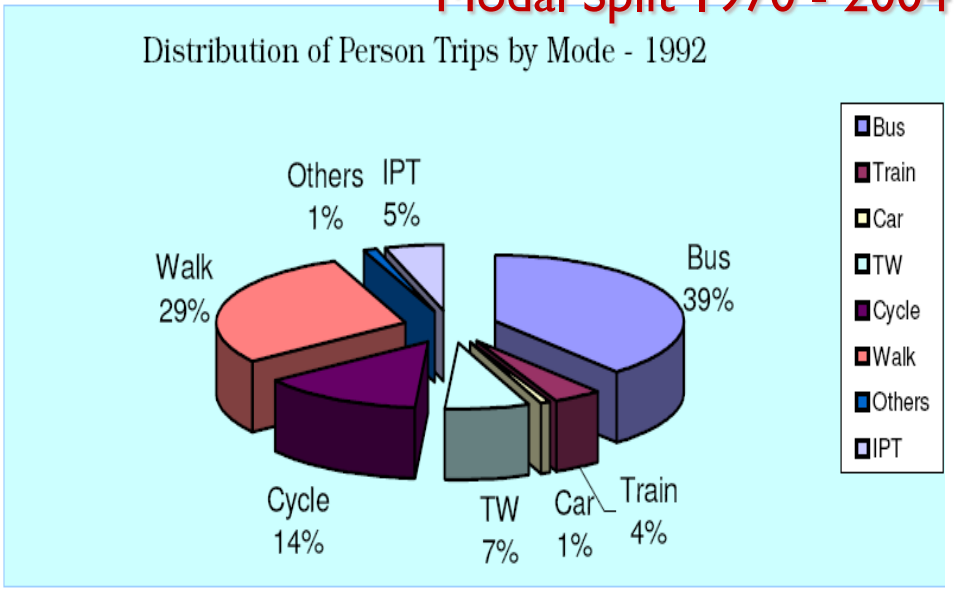
- Bus Transport is the most preferred Public Transport System in many cities.
- Recently the passenger patronage for bus transport is on the decline .
- Reasons reported are increased travel time, low reliability and low frequency of services in urban fringe areas.
- Regular monitoring of bus operation by the operators on daily and hourly basis in terms of duration, schedule adherence is essential, as these aspects have a greater influence on passenger ridership level.

Decline of Modal Share of Bus in Chennai

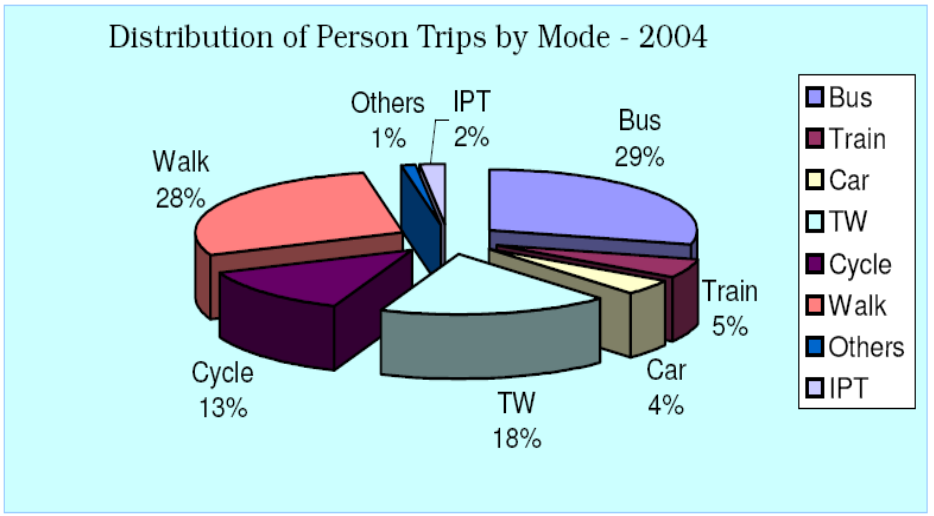
Modal Split 1970 - 2004



Source: MATS (1969)



Source: CTTS (CMDA, RITES, KCL& PTCS, 1992-95)



Source: Short term study to update CTTS (1992-95)(CMDA, RITES & PTCS, 2004)

A healthy and efficient public transit system is indispensable to reduce congestion, emissions, energy consumption, and car dependency in urban areas

Bus patronage drastically reduced from 41% to 29%,

Bus Transport Scenario in Chennai

The Metropolitan Transport Corporation operates the public transport buses in Chennai.

It transports nearly 5.7 million passengers every day with a fleet of 3421 buses covering a maximum distance of 50 km from city centre.

Bus Travel in Chennai

❖Maximum 73 persons can travel in a bus, but at present upto 85 to 125 peoples travel in city buses daily during peak hours

❖It is required to optimise bus routes and bus operations for improving ridership and effective utilisation of available buses.

❖Data collection by manual methods for optimisation is time consuming, and involves huge cost and manpower.

GPS is mounted in the bus with two basic functions

1. To transfer the location about the bus to the server
2. To communicate with the driver

Server will receive the data for every 4 to 10 sec via GPRS

It is mounted at bus stop and give basic information about arrival of bus

Fleet managers collect the details and store as backend information

PASSENGER INFORMATION SYSTEM

- Route length is 32.6 Kilometers
- Route is designated as 21G by MTC
- Average bus stop spacing within city 1km whereas in suburbs 3.75 km

Study Route

Methodology

- AVL is used as a Passenger Information System – vehicle location
- Electronic Ticketing Machine (ETM) used for issuing tickets- travel pattern of the commuters.

- The inputs from AVL and ETM are integrated and analysed using TRITAPT software developed by Delft University.

- Punctuality deviation, loading profile, schedule adherence and trip duration of the buses were evaluated to understand the level of existing operations.

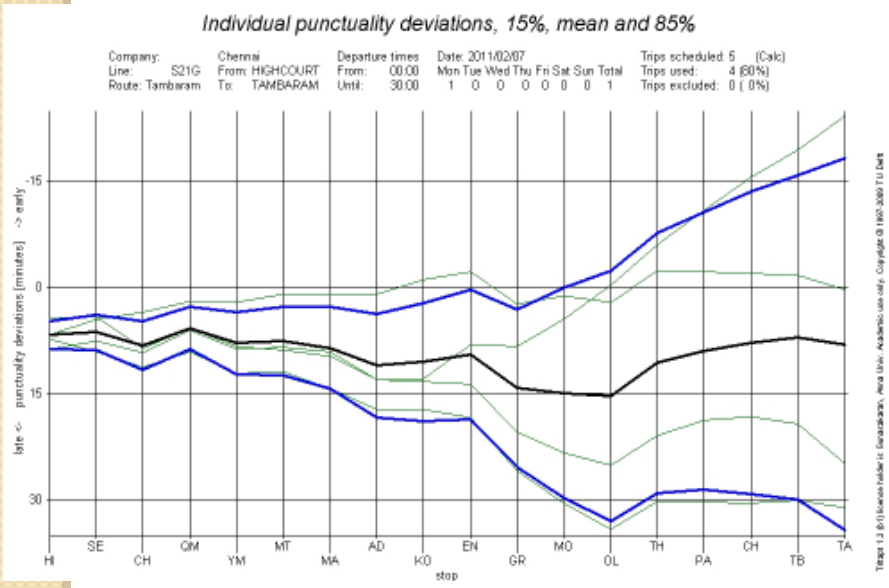
GPS Data

TIME	SPEED	DISTANCE	LATITUDE	LONGITUDE
25-dec-2011 12.00.01 am	0	0	12.932278	80.12055
25-dec-2011 12.00.11 am	0	0	12.932274	80.12056
25-dec-2011 12.00.21 am	0	0	12.932272	80.12056
25-dec-2011 12.00.31 am	0	0	12.932269	80.12056
25-dec-2011 12.00.41 am	1	0	12.93227	80.12057
25-dec-2011 12.00.52 am	1	0	12.932266	80.12057
25-dec-2011 12.01.02 am	1	0	12.932269	80.12057
25-dec-2011 12.01.12 am	0	0	12.93228	80.12056
25-dec-2011 12.01.22 am	0	0	12.932285	80.12056
25-dec-2011 12.01.33 am	0	0	12.932284	80.12055
25-dec-2011 12.01.43 am	0	0	12.932284	80.12055
25-dec-2011 12.01.53 am	1	0	12.932274	80.12056
25-dec-2011 12.02.03 am	0	0	12.932265	80.120575
25-dec-2011 12.02.13 am	0	0	12.9322605	80.12058
25-dec-2011 12.02.23 am	0	0	12.932257	80.12059
25-dec-2011 12.02.34 am	0	0	12.932252	80.12059
25-dec-2011 12.02.44 am	0	0	12.932247	80.1206
25-dec-2011 12.02.54 am	1	0	12.932244	80.1206
25-dec-2011 12.03.04 am	0	0	12.932241	80.1206
25-dec-2011 12.03.14 am	0	0	12.9322405	80.1206
25-dec-2011 12.03.24 am	0	0	12.9322405	80.12059
25-dec-2011 12.03.35 am	0	0	12.9322405	80.12059
25-dec-2011 12.03.45 am	1	0	12.932239	80.12059

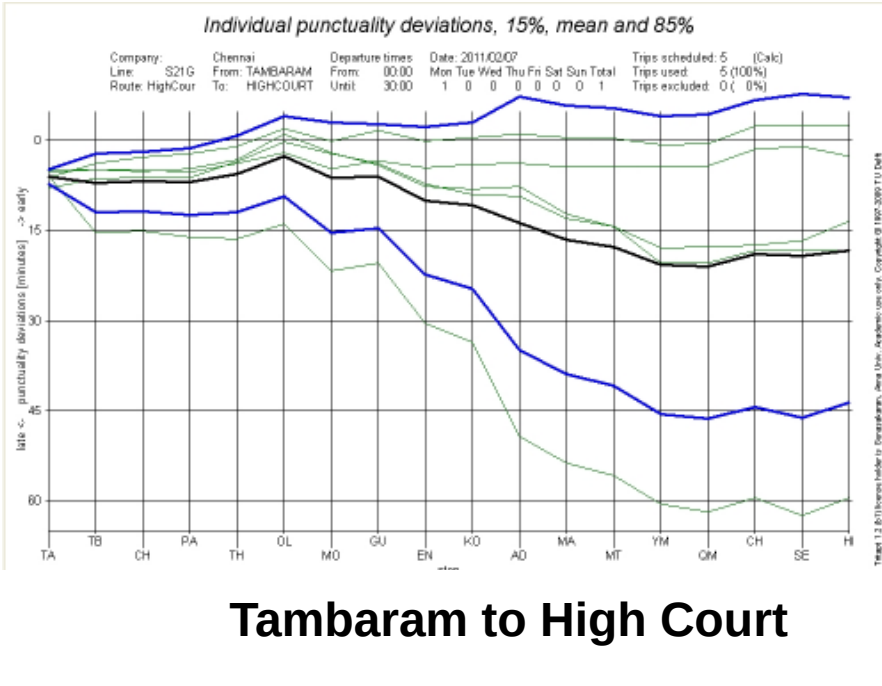
ETM data

Driver No	Fleet Number	Machine Number	Route Number	Trip Number	Ticket Number	Boarding Stage Number	Alighting Stage	From1	To1	Number of Passengers	Fare Per Passenger	Ticket Value	Date1	Time1	Total Amount
D14528	I2444D AMD	50079868	Y21G	23	221110	17	3	TAMBARAM	CHEPAUK	1	19	19	25/12/2011	6:58:49	19
D14528	I2444D AMD	50079868	Y21G	23	221111	17	10	TAMBARAM	GUINDY	1	13	13	25/12/2011	6:59:38	32
D14528	I2444D AMD	50079868	Y21G	23	221112	17	4	TAMBARAM	Q.M.C	2	19	38	25/12/2011	6:59:51	70
D14528	I2444D AMD	50079868	Y21G	23	221113	17	13	TAMBARAM	THIRUSULAM	4	11	44	25/12/2011	7:00:21	114
D14528	I2444D AMD	50079868	Y21G	23	221114	17	8	TAMBARAM	KOTTURPURAM	1	15	15	25/12/2011	7:00:50	129
D14528	I2444D AMD	50079868	Y21G	23	221115	17	6	TAMBARAM	MANDAVELI	1	17	17	25/12/2011	7:01:13	146
D14528	I2444D AMD	50079868	Y21G	23	221116	17	8	TAMBARAM	KOTTURPURAM	1	15	15	25/12/2011	7:01:40	161
D14528	I2444D AMD	50079868	Y21G	23	221117	15	5	CHROMEPET	V.M.STREET	1	17	17	25/12/2011	7:07:10	178
D14528	I2444D AMD	50079868	Y21G	23	221118	15	8	CHROMEPET	KOTTURPURAM	1	13	13	25/12/2011	7:07:43	191
D14528	I2444D AMD	50079868	Y21G	23	221119	15	6	CHROMEPET	MANDAVELI	1	15	15	25/12/2011	7:08:09	206
D14528	I2444D AMD	50079868	Y21G	23	221120	14	8	PALLAVARAM	KOTTURPURAM	1	13	13	25/12/2011	7:11:56	219
D14528	I2444D AMD	50079868	Y21G	23	221121	14	1	PALLAVARAM	HIGHCOURT	7	19	133	25/12/2011	7:12:32	352
D14528	I2444D AMD	50079868	Y21G	23	221122	10	5	GUINDY	V.M.STREET	1	13	13	25/12/2011	7:26:32	365
D14528	I2444D AMD	50079868	Y21G	23	221123	9	5	ENG.COLLEGE	V.M.STREET	1	11	11	25/12/2011	7:39:03	376
D14528	I2444D AMD	50079868	Y21G	23	221124	6	4	MANDAVELI	Q.M.C	2	9	18	25/12/2011	7:47:15	394
D14528	I2444D AMD	50079868	Y21G	23	221125	4	1	Q.M.C	HIGHCOURT	1	11	11	25/12/2011	7:59:31	405
D14528	I2444D AMD	50079868	Y21G	12	221126	1	2	HIGHCOURT	SECRETARIT	1	7	7	25/12/2011	8:33:48	412
D14528	I2444D AMD	50079868	Y21G	12	221127	1	5	HIGHCOURT	V.M.STREET	1	11	11	25/12/2011	8:34:33	423
D14528	I2444D AMD	50079868	Y21G	12	221128	3	4	CHEPAUK	Q.M.C	1	7	7	25/12/2011	8:42:47	430
D14528	I2444D AMD	50079868	Y21G	12	221129	3	15	CHEPAUK	CHROMEPET	2	17	34	25/12/2011	8:42:55	464
D14528	I2444D AMD	50079868	Y21G	12	221130	4	10	Q.M.C	GUINDY	1	13	13	25/12/2011	8:47:19	477
D14528	I2444D AMD	50079868	Y21G	12	221131	5	6	V.M.STREET	MANDAVELI	1	7	7	25/12/2011	8:49:03	484
D14528	I2444D AMD	50079868	Y21G	12	221132	5	10	V.M.STREET	GUINDY	1	13	13	25/12/2011	8:50:07	497
D14528	I2444D AMD	50079868	Y21G	12	221133	5	14	V.M.STREET	PALLAVARAM	1	15	15	25/12/2011	8:51:52	512
D14528	I2444D AMD	50079868	Y21G	12	221134	5	10	V.M.STREET	GUINDY	1	13	13	25/12/2011	8:51:59	525

Punctuality Deviation



High Court to Tambaram

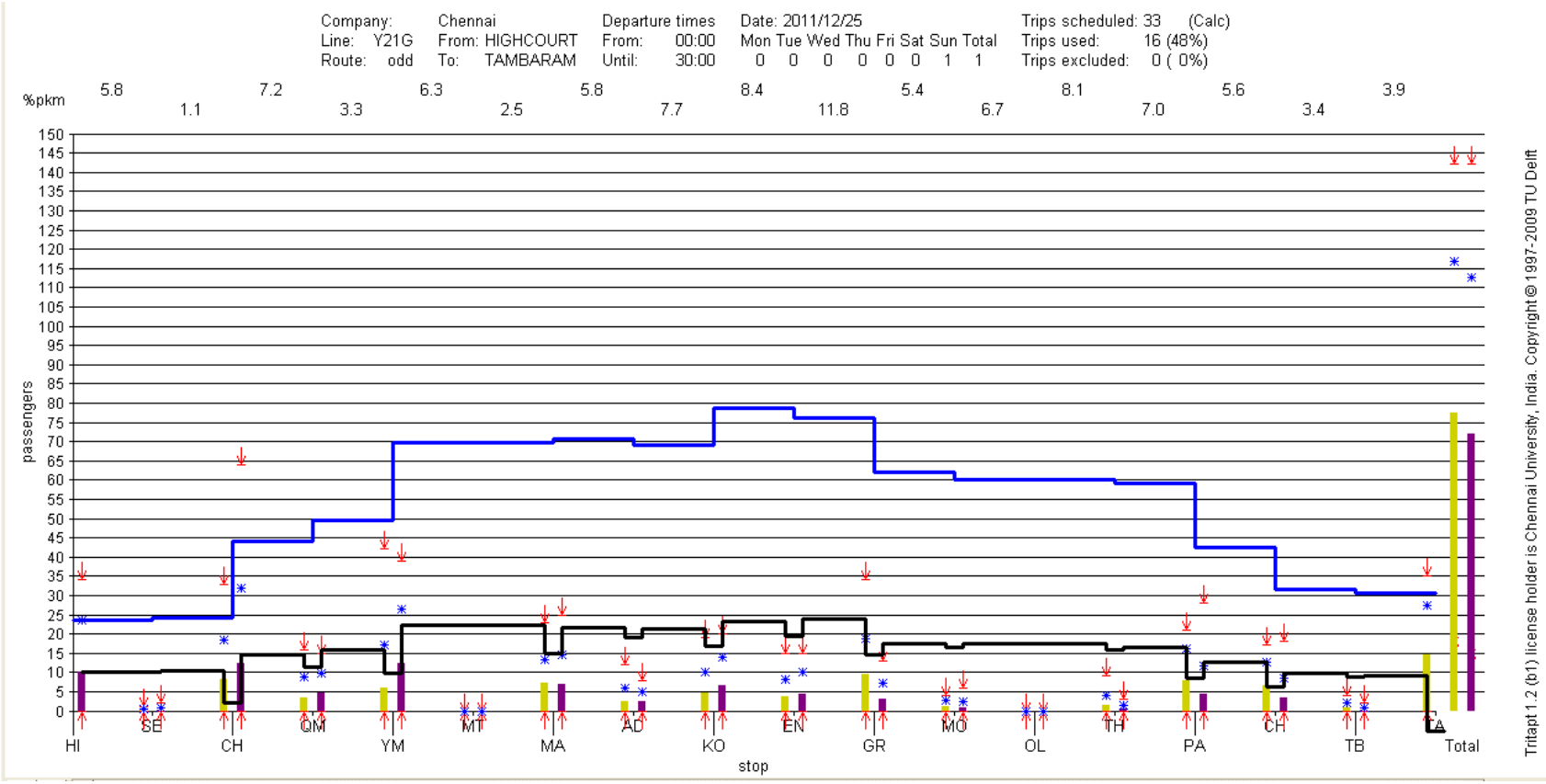


Tambaram to High Court

Punctuality Deviation is the time difference between scheduled time and the observed time of buses at the bus stops

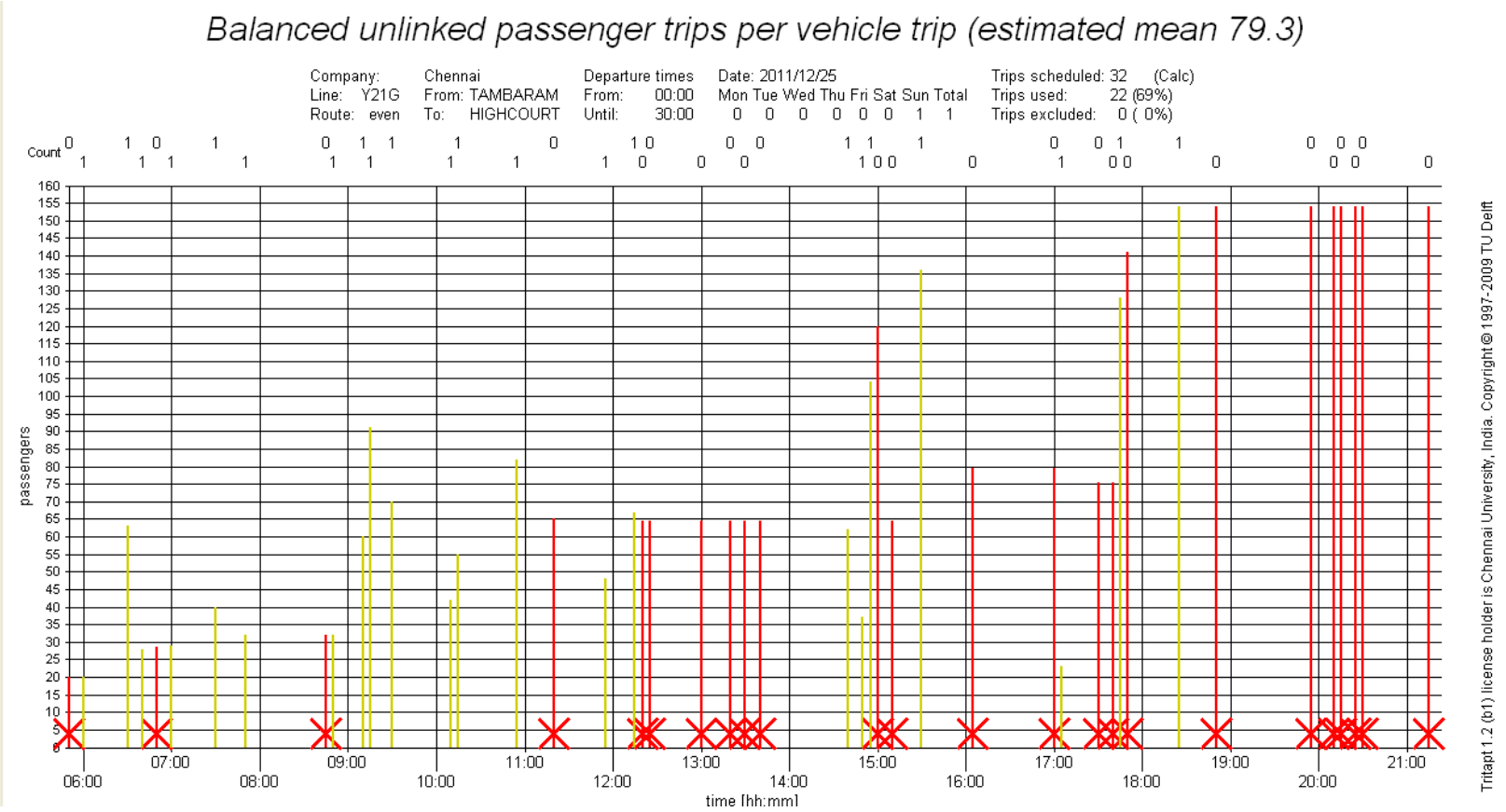
The buses reached 15 minutes early in non-peak hours and 30 minutes later in peak hours

Passenger Loading Profile

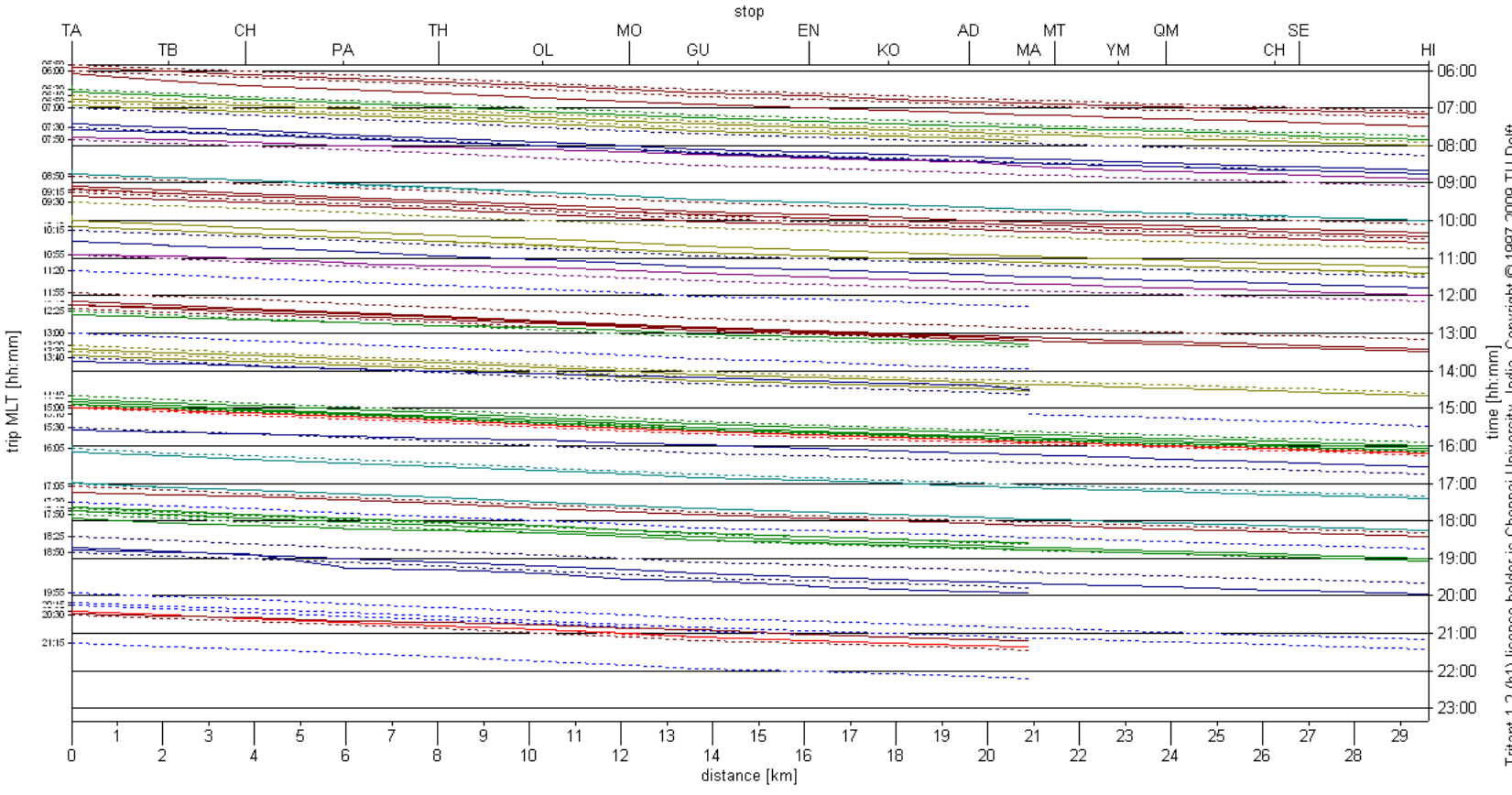


- The load profile -identify the sections having maximum passenger load.
- Review of length of operation and modification in number of buses required direction wise and time wise to carry the passengers.
- Deploying the required number of buses would enable passengers to travel comfortably without overcrowding and the operator to pull out the extra buses if any.

Passengers Carried Tripwise

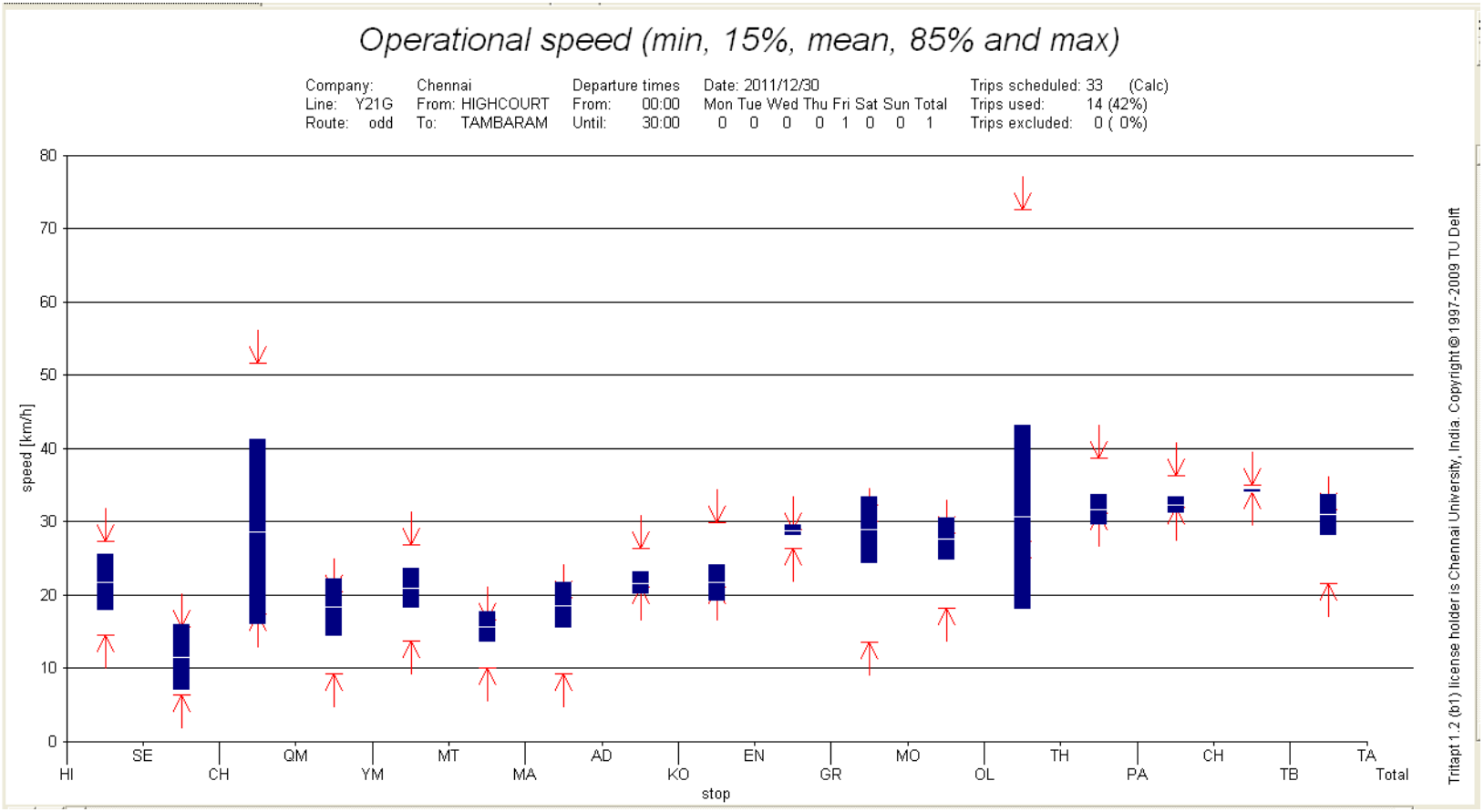


Schedule Adherence



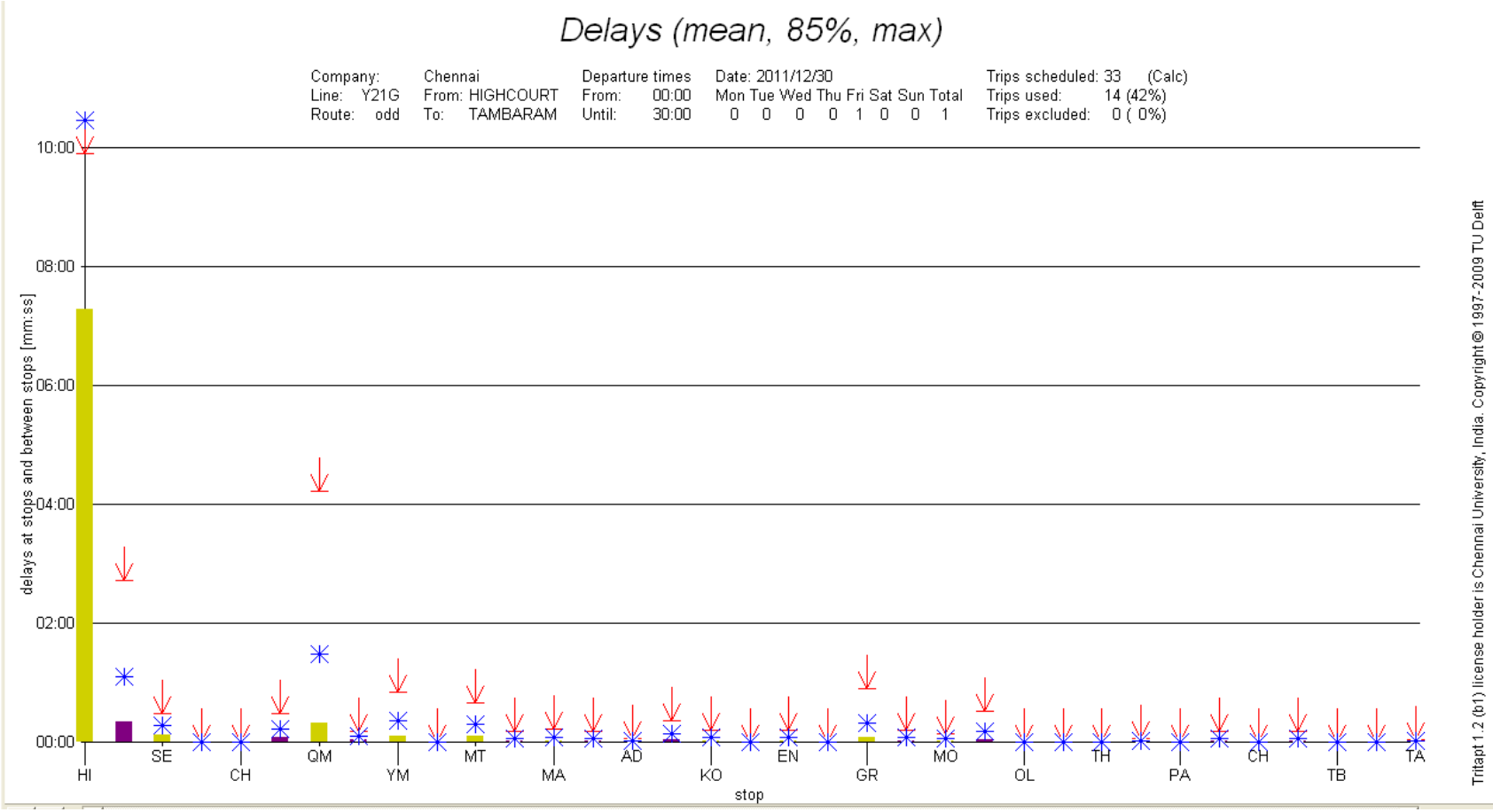
The trajectory plot of bus movements helps to verify that whether the buses run as per schedule and whether time headway between buses is maintained throughout the route.

Operational Speed Sectionwise

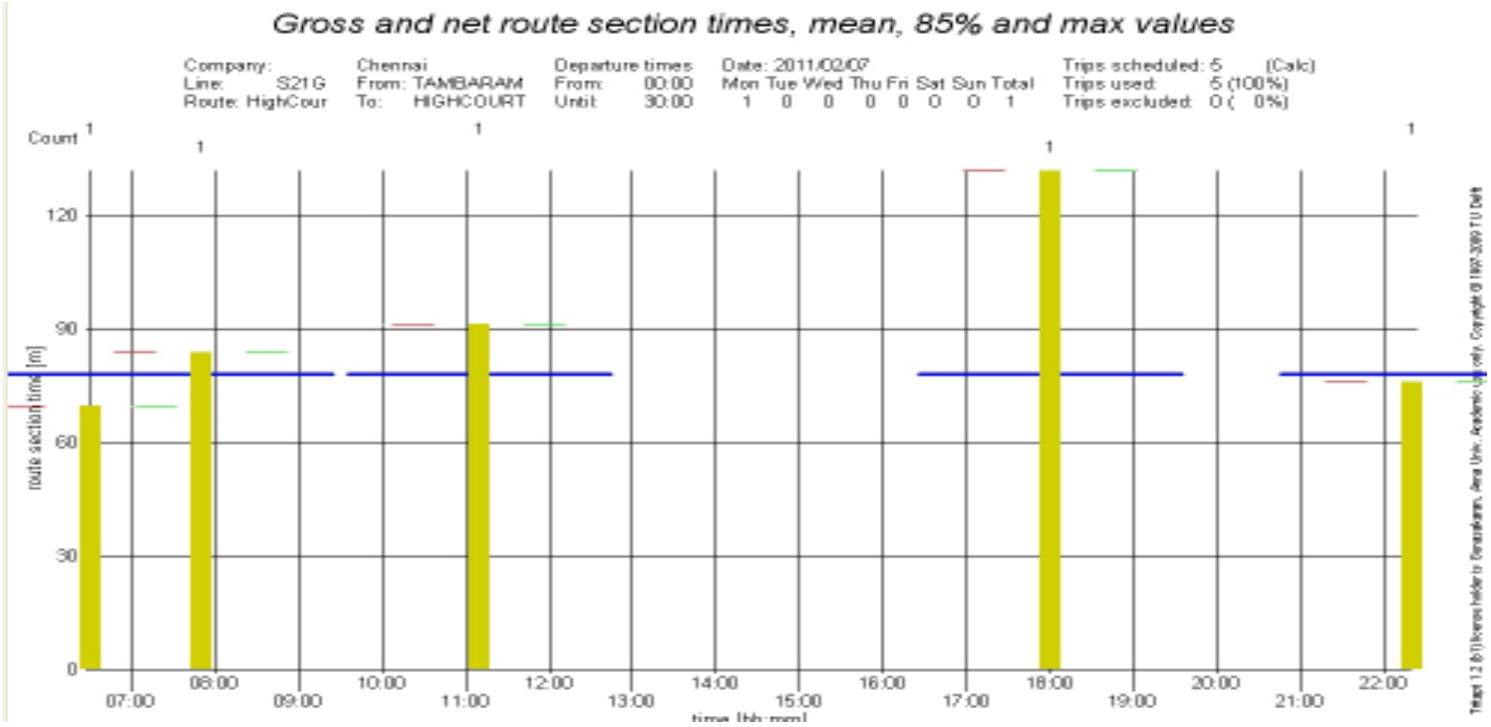


- Sectionwise speed helps to arrive the bus schedule accounting the variations in speed during peak and non peak hours on working days and holidays

Dwell time at Bus stops and Delay Sectionwise



Route Section Times for various time periods



Conclusion

AVL and ETM are devices that provide valuable inputs for bus transit planning and optimization.

Optimisation of bus operations could be done effectively and quickly with the output obtained from VTS and ETM.

Real time monitoring of the fleet operations and fleet deployment by Transit managers could be performed with automatic data collection systems.

Acknowledgement

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Thank You