ATAL INDORE CITY TRANSPORT: MANAGING VEHICLE SCHEDULING IN PUBLIC TRANSPORTATION

Final project

AD616

Group 3

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Boston University School

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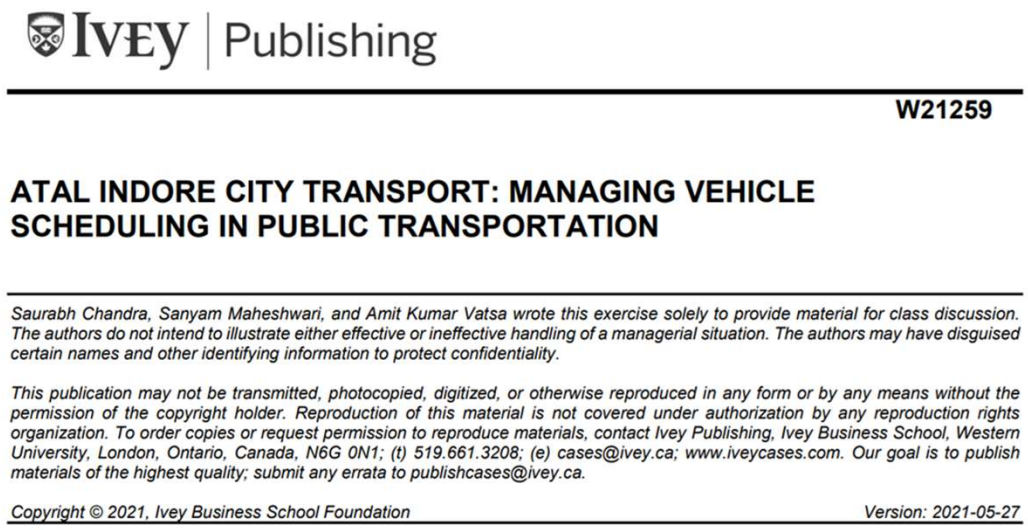
Content

1. Case Overview
2. Assumptions used to solve the case
3. Methodology
4. Results and conclusions
5. Recommendations



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Case Overview

- **Purposes of the Case Study:**
  - Running the simulation to determine the BRT bus frequencies and the number of buses required to meet passenger demand between various stops in Indore city, India.

- **Bus Rapid Transit System (BRT):**
  - BRT aims to combine the capacity and the speed of a metro with the flexibility, lower cost and simplicity of a bus system. Specifically, a BRT system includes railroads that are dedicated to buses.
  - BRT is the most common mode of public transportation in mid-size city.
  - BRT could be an effective transport service in developing countries with large transit-dependent populations and minimal financial capitals.

- **Urban Transit in India**
  - With urbanization increasing, ownership of private vehicles is increasing, leading to congestion and pollution.
  - Buses are the most efficient and easiest mode of transport. India was reported to have over 1.75 million registered buses in 2016.
  - 62% of urban households and 66% of rural households are spending on bus transit.

Case Overview

- **Indore BRTs:**
- Before the development of BRTs: modest road infrastructure,erratic traffic & insufficient public transportation.
- BRTs was initiated in 2007 and was completed in 2013, with funding $13 million.
- The corridor was 11.57km long, with 21 bus stops.
- One route in two directions: from Niranjanpur to Rajiv Gandhi.

- **Problem to be solved:**
- Sufficient capacity to handle expected passenger demand
- Speed of service to minimize travel times.
- Frequency of service to limit waiting time.

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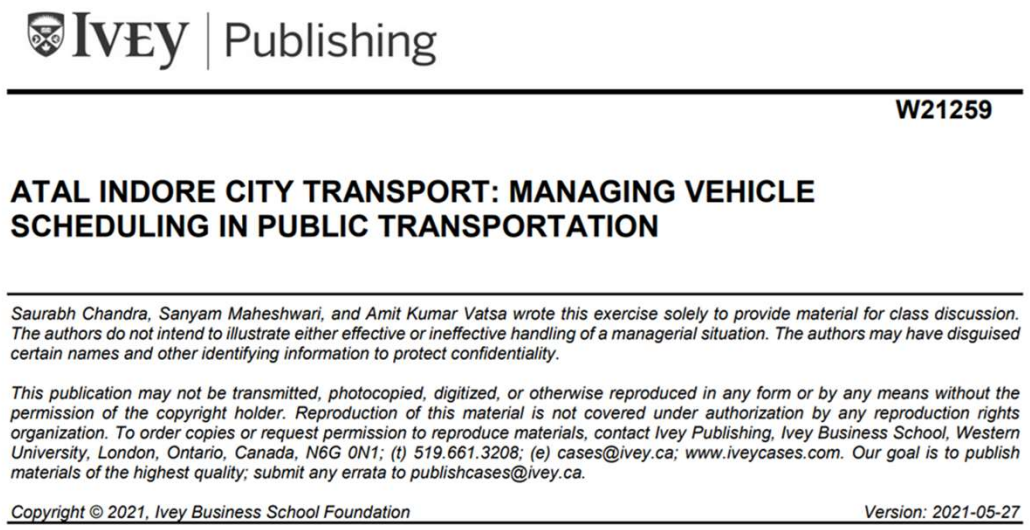

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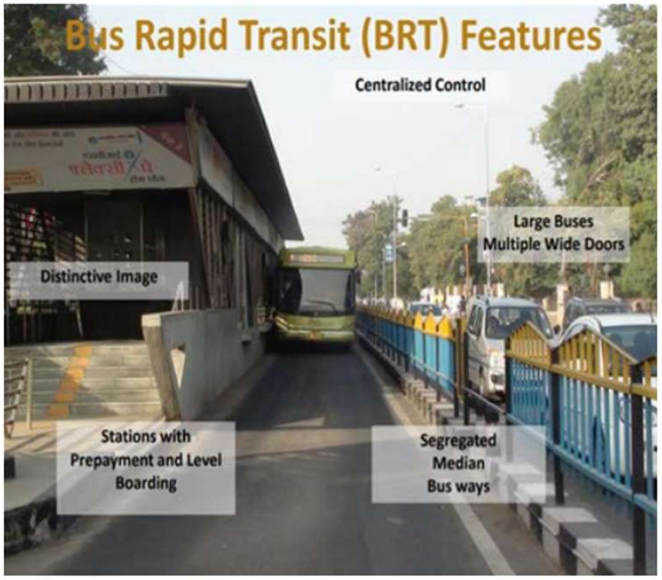
Assumptions

- **Weekly max KM:** 1.200
- **Route Length:** 11.57KM
- **Round trip Length:** 22,8
- **Max rountrips per week:** 52,63
- **Total bus capacity:** 51
- In one hour the bus can do a full one direction route, in two hours a roundtrip.
- The hourly demand for transit followed a normal distribution with a standard deviation close to 20% of the mean.
- **Average speed:** at least 24 KM per hour

EXHIBIT 4: INDORE BUS RAPID TRANSIT SYSTEM BUS STOP FEATURES



Source: Company files.

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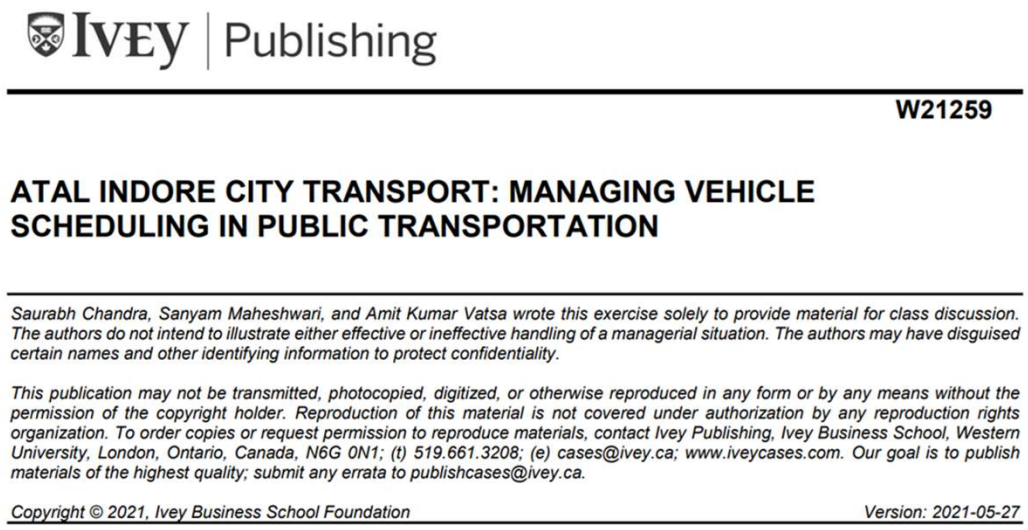

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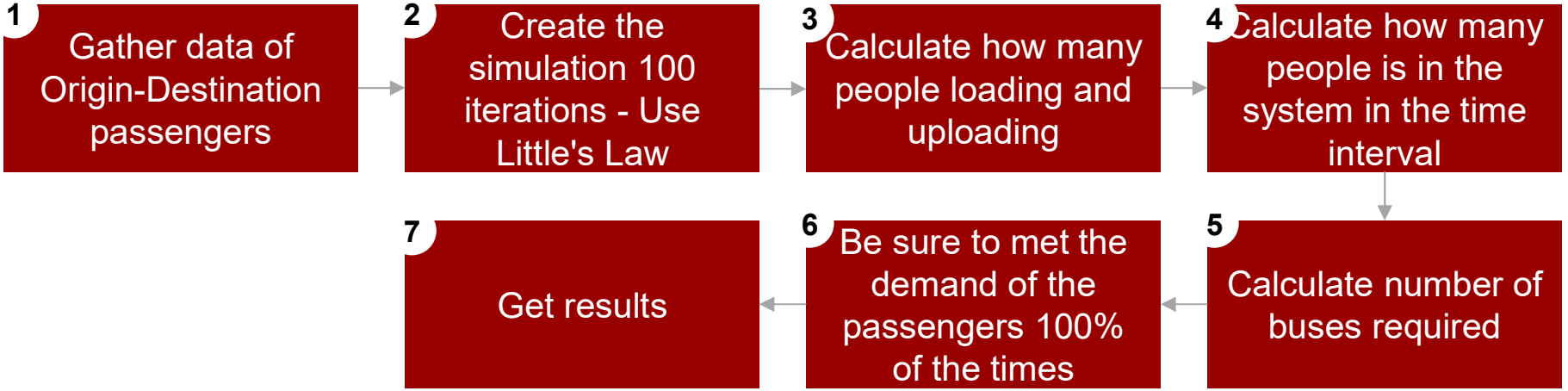
Methodology



Methodology

- Little's law:

$$L = \lambda W$$

L: the long-term average of passengers in this bus system

λ: the long-term average effective arrival rate

W: The average time that a passengers spends on waiting the bus.

Methodology

- Calculate number of buses required

EXHIBIT 5: ORIGIN-DESTINATION DEMAND MATRIX FOR PEAK HOURS (7:30 A.M. TO 11:30 A.M.) IN NUMBER OF PASSENGERS

Bus Stop Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21				
Bus Stop Name	Rajiv Gand	Mata Gujri	Vishnupu	Bhanwarkuan Squa	Holkar Subwa	Navlakha Squa	Indra Pratim	GPC	Shivaji Vatil	AICTSL	Geeta Bhawa	Palasiya	Industry Hou	LIG	Press Comple	MR-9	Vijay Naga	Satya Sai	Shalimar Townsh	Scheme No. 7	Niranjanpur Square				
Distance* (in km)	**0**	**0,75**	**1,2**	**1,7**	**2,0**	**3,0**	**3,3**	**3,7**	**4,4**	**4,9**	**5,4**	**6,1**	**6,6**	**7,2**	**7,5**	**8,2**	**8,9**	**9,5**	**10,4**	**10,9**	**11,4**	Loading	Unloadin	Total people (raw)	
1 Rajiv Gandhi	0	5	5	60	22	30	17	78	24	41	99	65	35	58	17	55	43	7	11	19	21	**712**	0	**712**	177,892344	3,48809
2 Mata Gujri	13	0	3	39	10	26	10	27	16	14	38	39	12	16	4	41	21	7	13	10	9	**353**	5	**1060**	264,992471	5,19593
3 Vishnupuri	9	5	0	19	12	17	8	27	8	17	59	36	0	21	6	23	19	6	5	4	7	**293**	8	**1344**	336,044624	6,58911
4 Bhanwarkuan Square	22	12	7	0	23	62	23	116	32	60	209	212	34	214	12	86	62	15	9	23	29	**1220**	118	**2446**	611,416118	11,9886
5 Holkar Subway	5	4	4	46	0	13	6	16	14	12	17	38	14	31	3	6	13	5	3	6	5	**202**	66	Y12	645,371227	12,6543
6 Navlakha Square	35	22	26	167	45	0	48	158	27	50	236	280	50	211	29	209	136	18	15	53	56	**1577**	148	**4010**	1002,5701	19,6582
7 Indra Pratima	22	10	7	72	19	62	0	79	16	50	73	68	39	95	15	50	39	12	8	20	25	**589**	111	**4488**	1121,96325	21,9993
8 GPO	16	8	6	151	21	93	22	0	23	46	150	163	22	131	13	58	65	6	5	15	14	**713**	500	**4701**	1175,23986	23,0439
9 Shivaji Vatika	5	5	3	28	15	14	7	26	0	10	27	23	15	28	4	8	10	4	6	10	5	**151**	160	**4692**	1172,99843	23
10 AICTSL	16	6	4	71	27	17	14	45	14	0	70	45	16	58	4	15	23	4	5	19	12	**270**	300	**4663**	1165,67591	22,8564
11 Geeta Bhawan	23	9	4	359	30	46	27	100	39	69	0	203	68	150	20	91	31	14	11	13	12	**611**	979	**4295**	1073,82442	21,0554
12 Palasiya	38	18	6	287	39	117	24	119	23	49	172	0	40	123	12	141	76	6	14	16	23	**451**	1172	**3575**	893,704222	17,5236
13 Industry House	7	4	0	53	20	25	11	18	10	28	56	49	0	42	8	13	9	5	5	10	7	**99**	346	**3328**	832,00608	16,3138
14 LIG	16	14	7	136	26	89	23	94	30	59	176	182	46	0	14	105	68	8	7	19	16	**237**	1178	**2387**	596,797929	11,7019
15 Press Complex	10	8	5	26	24	39	13	30	18	20	44	65	17	58	0	31	22	12	9	11	13	**98**	160	**2325**	581,309985	11,3982
16 MR-9	35	18	15	162	28	177	56	149	37	56	300	163	102	198	29	0	148	28	30	43	49	**298**	931	**1692**	423,070485	8,2955
17 Vijay Nagar	32	16	10	118	50	134	47	180	51	69	165	205	57	196	25	172	0	13	35	38	35	**122**	787	**1027**	256,62996	5,03196
18 Satya Sai	9	7	9	30	13	18	13	24	14	14	42	32	26	27	5	26	14	0	14	7	13	**34**	169	**891**	222,765486	4,36795
19 Shalimar Township	13	11	8	26	20	22	10	28	14	23	62	25	8	69	14	32	21	7	0	7	20	**27**	206	**712**	177,911517	3,48846
20 Scheme No. 78	30	10	9	107	19	33	16	39	19	42	36	66	44	57	15	52	34	9	14	0	23	**23**	341	**394**	98,5354681	1,93207
21 Niranjanpur Square	20	7	13	69	31	18	30	59	17	32	92	52	10	49	16	51	38	9	14	36	0	**0**	394	**0**	3,5527E-13	7E-15
	0	**5**	**8**	**118**	**66**	**148**	**111**	**500**	**160**	**300**	**979**	**1172**	**346**	**1178**	**160**	**931**	**787**	**169**	**206**	**341**	**394**				**Required**	**24**
																									Demand met	**1**

=IFERROR(NORMINV(RAND();'Passangers Analysis'!D9;'Passangers Analysis'!D9*0,2);0)

- Function used to randomized with a normal distribution

- Calculate how many people loading and uploading
- Calculate how many people is in the system in the time interval
- Be sure to met the demand of the passengers 100% of the times

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Results & Conclusion

Peak Hours (7:30 am to 11:30 am)

- Assuming that the data is for the 4 hours interval.
- The max number of buses for the peak hours should be 28. With 28 buses 96% of the passengers demand will be covered. Most of the demand pressure comes from southbound commutes (From Niranjanpur Sqr to Rajiv Gandhi) which has a higher concentration in the first stations.

Non-peak Hours (11:30 am to 14:30 pm)

- Assuming that the data is for the 3 hours interval.
- The max number of buses for the non-peak hours should be 9. With 9 buses 98% of the passengers demand will be covered. The demand concentration among stations is very similar between southbound and northbound commutes.

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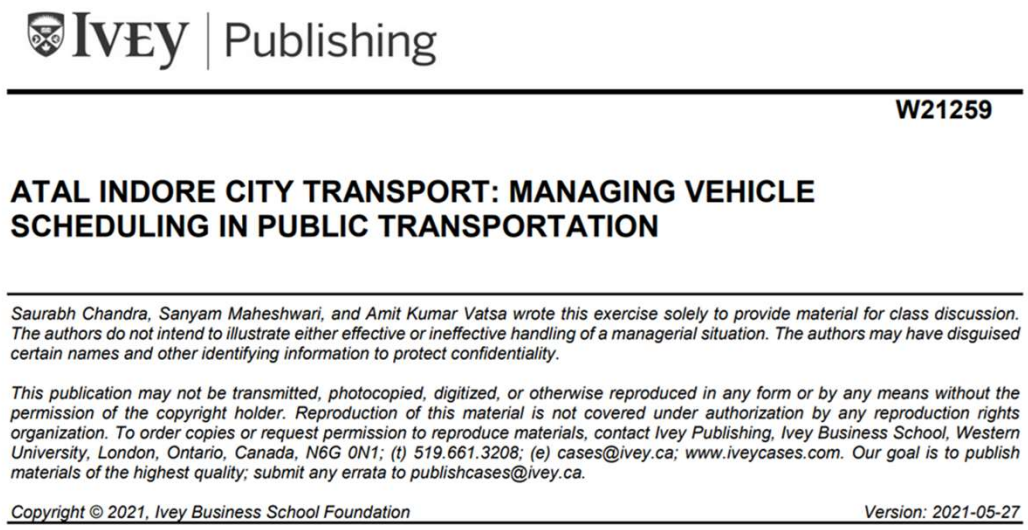

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Recommandation

System Bottlenecks

Accidents

Breakdowns

Weather conditions

Repair work

Fluctuations in traffic

Special events

Safety Related Accidents

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Q&A

Thank you!

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