Routematic

MOVING TOWARDS SLA GUARANTEE DRIVEN ROUTE OPTIMIZATION

Zeroing in on Deviation to Direct Travel Time as an SLA for Route Optimization

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About the Author

Surajit Das is the CEO of Routematic, India's leading employee commute solution provider. He has been closely involved with product management at Routematic, business development, post sales implementation and has also led Routematic's foray into fleet operations. Surajit is an SME on Routing, transport and logistics network optimization and driver incentive management.

Surajit has over 16 years of experience at the intersection of business and technology. He holds a B. Tech degree in Telecommunications and a Post Graduate Degree in Information Technology. He is an MBA in Finance and Marketing from ISB Hyderabad, India's premier B-School.

Moving towards SLA Guarantee driven Route Optimization

All discussions on employee transport automation invariably and rightly lead to route optimization. As the CEO of Routematic, India's leading employee transport solution, I have had the privilege of innumerable in-depth interactions with operations teams of organizations trying to automate their employee transport process.

One strikingly consistent theme that stood out in all discussions on Route Optimization was that, in principle everyone agrees routing is an employee comfort vs cost optimization problem. However, with deeper probing I have identified three gaps in how organizations approach route optimization:

1. Organizations do not have a well thought out metric for measuring employee comfort i.e. transport process are being run without a well-defined measurable metric to govern route quality
2. Routers have a mind map of the localities they can club together (often translated to excel macros) which is referenced when they manually route for any shift. This is a very subjective process hostage to the router's personal preferences and delivers sub-optimal results when scored on the employee comfort vs cost optimization curve. This unscientific process can also potentially expose the organization to audit risk since there is no justification for the number of routes generated for a shift
3. In the absence of a well-defined route quality metric in their transport policy, when evaluating routing output of different automation solutions, organizations end up focussing only on cost optimization without articulating the employee comfort parameters which would govern the quality of routes generated by the automation tool

Evaluating the effectiveness of existing route quality metrics

We studied the employee transport policy handbook of 23 different organizations and found that none of them captured an effective and measurable route quality SLA which could apply to all routes and all employees taking company provided transport.

The only route quality metric which was consistently articulated in the transport policy documents we studied was the *upper limit to travel time for any route* (all the organizations studied had this metric).

The problem with the upper limit on travel time SLA is that it addresses only the extremities and is not relevant for all routes. For e.g., employees who can reach office directly in 30 mins cannot be made to travel for 100 mins even if the upper limit for travel time is not violated.

1 out of the 23 transport policy handbooks studied had articulated a **maximum distance deviation policy per employee** while the other organizations verbally communicated a distance deviation policy of 3-5 Kms.

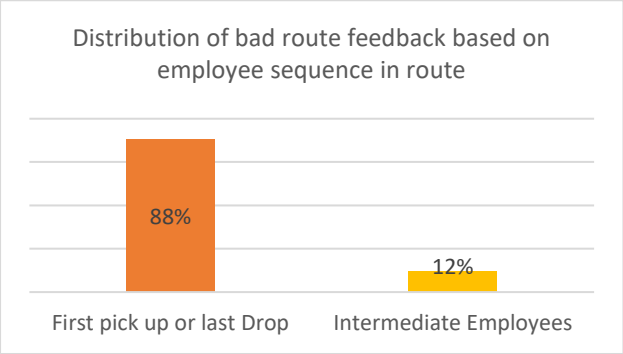
To understand whether distance deviation is an effective metric for measuring employee comfort and route quality we analysed over 8 Lakh trip feedbacks submitted over a six month period through the Routematic mobile app.

THE TRANSPORT TEAM WILL AT ALL TIMES PLAN TO ENSURE THAT THE TRAVEL TIME SHOULD NOT EXCEED MORE THAN 120 MINUTES. HOWEVER, THERE MAY BE EXCEPTIONS TO THIS DURING PEAK HOURS, TRAFFIC CONDITIONS / WEATHER CONDITIONS AND ALSO THE LOCATION OF THE EMPLOYEE RESIDENCE BEING CLOSER TO THE BOUNDARY LIMITS.

IN SOME LOCATIONS, THIS MAY BE REDUCED FURTHER BASED ON THE CITY SIZE AND GENERAL TRAVEL CONDITIONS, HOWEVER, THE UPPER LIMIT SHOULD NOT EXCEED 120 MINUTES OF TRAVEL TIME FOR ANY TRANSPORT USER, EXCEPT IF THE LOCATION OF THE EMPLOYEE IS CLOSE TO BOUNDARY AREA AND THE KMS ARE BEYOND THE ACCEPTABLE KMS, FOR THE COMMUTE TIME TO BE RESTRICTED TO 120 MINS. MAXIMUM DEVIATION OF 5 KMS PER EMPLOYEE (ONE WAY) WILL BE CONSIDERED BASED ON GEOGRAPHIC CONDITIONS OF THE RESPECTIVE LOCATIONS.

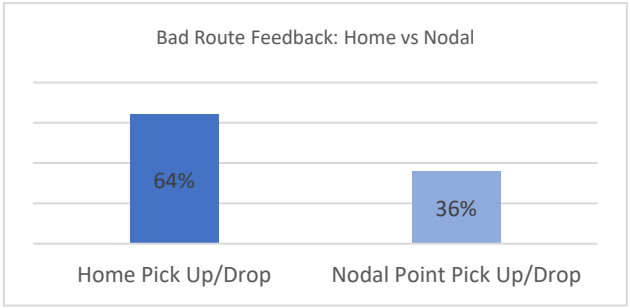
Excerpt from the transport policy handbook of a customer

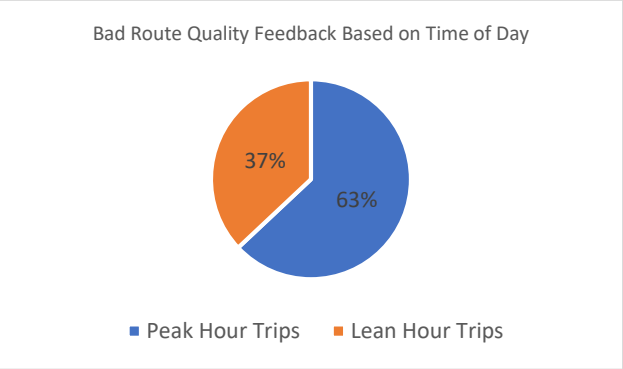
Some key observations that came out from this study:



1. Bad route feedback was being submitted almost entirely by employees who belonged to the last drop or first pick up locality in their trip.

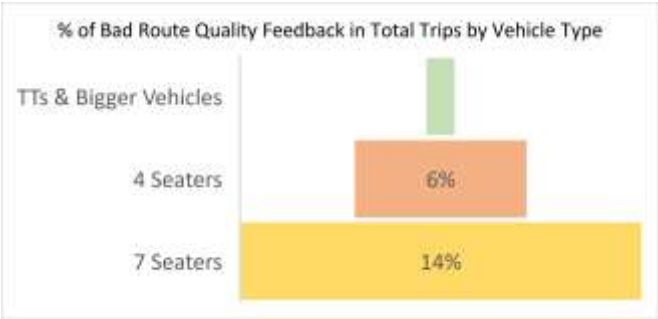
2. Bad route feedback was much higher in case of home pick up and drop as compared to nodal. Assuming that routers would adhere to the distance deviation metric irrespective of home or nodal pick-up/drop, if distance were to be a valid route quality metric this data is counter intuitive. This leads us to question whether the real employee dissatisfaction stems from increased travel time added by the first/last mile journey.



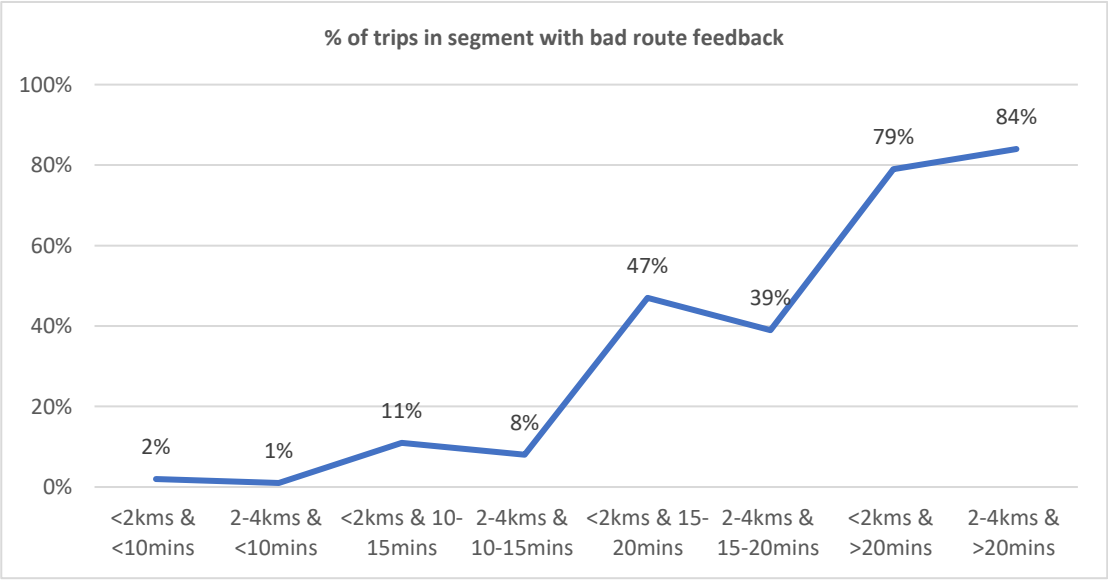


3. Peak hour routes had a much higher share of the bad route quality feedback clearly indicating that for the same travel distance, the increase in travel time due to traffic conditions leads to employee dissatisfaction and distance is not the key metric governing employee comfort. Instead it is travel time.

4. If distance deviation is the correct metric for measuring route quality, one would think that there would not exist a visible relationship between bad route quality feedback from employees and the vehicle type. However, the data shows that SUVs which have more intermediate stops as compared to 4 seaters generate higher bad route feedback since the travel time of the employees being picked up first or dropped last is affected by each intermediate stop. While this is true for 4 and 7 seater comparison, the aberration was that bad route quality feedback was low for TT routes. However, on deeper analysis of the data we found that the TT routes were used predominantly for nodal pick up and drops where bad route quality feedback is inherently low (refer observation 2).



5. Finally, we analysed routes with bad feedback on two dimensions - **deviation to the employee's direct travel distance** and **deviation to the employee's direct travel time** to/from office. A striking observation was that the bad route feedback did not have a strong correlation to distance deviation. On the other hand, the correlation of bad feedback to the employee's deviation to her direct travel time was very high clearly **indicating that for the employee, the only thing that matters is the travel time**.



To understand the employee viewpoint, in addition to the data analysis, we also scanned feedback submitted by employees against routes they reported as bad. Some of the feedback is reproduced here.

Not sure why pimple nilakh drop is clubbed in dhanori route everyday. We as it is take too much time to reach home reason this being one of the longest routes. This is taking us additional 15-20 mins to reach our destination. The clubbing should make sense and such drops shall be accommodated in other cabs.

There were 12 people in the vehicle and has to go to inside narrow roads to door drop every one which ultimately takes longer time. It may be good idea to club many people for nodal pick up considering not door pick up. Kindly address this

Clubbing with a person from inside of murgeshpalaya for Indiranagar cab. This is not the route i need to travel. This adds an extra 30 minutes, as the way is a high traffic area even if short distance. please change this clubbing

The clubbing was incorrect I was still roaming in a half a km radius for one hr after boarding the cab

Note the highlighted sections of the feedback. The employee anguish is always for the additional travel time. All these routes were created manually by modifying the system generated output.

Finally, as a thought exercise consider these two scenarios:

Scenario 1: Consider two routes both 18 kms long where the last employee in both routes is made to deviate a total of 4 Kms (2 Kms one way) for an intermediate drop. In route 1 the 4 KM deviation is through a high traffic area and results in 20 mins of additional travel time while the deviation for Route 2 is through a low traffic area resulting in only 8 mins of additional travel time. The last employee in Route 1 has a clear reason to be aggrieved with the clubbing and will be most likely to submit a bad feedback on route quality.

EMPLOYEES ALWAYS MEASURE BAD ROUTES IN TERMS OF ADDITIONAL TRAVEL TIME. DISTANCE IS NOT REALLY A MATERIAL ISSUE FROM THE EMPLOYEE PERSPECTIVE.

Scenario 2: Consider a 20 km long route where the last employee is made to deviate a total of 4 Kms (2 Kms one way) for an intermediate drop. It takes 80 mins to execute this route during peak traffic hours but if the same route were executed during a lean traffic hour it takes only 40 mins. The employee would clearly accept the intermediate clubbing during the lean traffic hour but reject the same during peak traffic hours.

With these insights we are able to confidently conclude that **Distance Deviation is not an effective route quality metric** since it fails to address the real concern that employees have, which is the increase in their travel time due to the clubbing of additional employees en-route.

Introducing DDTT as an effective route quality metric

A measurable and effective route quality metric which accurately captures employee comfort is the additional travel time which can be added to an employee's direct travel time due to clubbing of employees en-route. At Routematic we call this the **DDTT** (Deviation to Direct Travel Time) route quality metric.

Consider the last employee in any route. If the employee were given a cab with no en-route pick up/drops, the travel time for the employee in this route is her direct travel time. Due to clubbing of additional employees during the routing process, the employee's direct travel time increases. Organizations need to articulate a policy around what is the acceptable increase to the employee's direct travel time due to clubbing of en-route employees.

DDTT as a route quality metric has many advantages:

1. It is the most relevant route quality metric truly representative of employee expectations
2. It takes into account the difference in traffic pattern at different hours in different parts of the city
3. It eliminates subjectivity from routing and allows the organization to put together an SLA driven framework for route optimization which can also be communicated to employees to set expectations
4. It allows for democratization of routes i.e. once the organization defines the route quality SLA, all routes can adhere to this parameter which is most important to employees

At Routematic we have designed the industry's first DDTT routing algorithm. Routematic's DDTT routing algorithm is the only algorithm to give a route quality and shift cost optimization guarantee.

We ask our customers to articulate their DDTT route quality metric as part of their transport policy. This metric is articulated both in minutes and percentage (the % specification ensures that employees in short routes are treated fairly). Once the DDTT policy of the organization is set, Routematic's routing algorithm gives a guarantee that all the routes generated will adhere to the organization's DDTT policy and the cost of the shift cannot be reduced further through manual edits without violating the DDTT policy.

In God we trust but routers need to bring data

Routers in every transport team have a mind map of localities that they want to club together. This manual routing process does not account for variation in traffic conditions at different hours of the day for different areas in the city and results in sub optimal output. Since the manual routing process does not use a well-defined route quality metric representative of employee comfort, routing becomes subjective and an attempt at cost optimization without any guarantee on employee comfort.

While evaluating various transport automation tools, human routers have for long been asked to pass judgement on the accuracy of routing output generated by the tool. This evaluation strategy is fraught with confirmation bias i.e. the tool which gives an output closest to the router's personal preference is rated higher.

So, we decided to study shifts which were routed/edited manually by routers and analyse the DDTT distribution (Deviation to the Direct Travel time) for these shifts. We pitted Routmatic's DDTT routing

algorithm output head on against the manual routes created by the routers of one of our largest clients in an across the table shootout (Clint Eastwood western classics anyone?).

This across the table contest was governed by the following set of rules

1. The shootout was for a peak traffic login shift (10:00 AM login) and a lean traffic login shift (6:00 AM login)
2. The shifts were routed for home pick ups manually by the router and also through Routematic's DDTT routing algorithm
3. The DDTT policy articulated by the client was 20 mins or 40% whichever is lower i.e. all routes should be created such that the first employee in the route should not be made to travel for more than 20 mins of her direct travel time

Peak Hour Shift Analysis

10:00 AM Peak Traffic Login	Manual Routing	DDTT Algo. Based Routing
DDTT policy articulated by the client	20 mins or 40% whichever is lower	20 mins or 40% whichever is lower
No. of Employees	627	627
No. of Routes	171	173
4-Seater Routes	131	151
6-Seater Routes	40	22
Min. Deviation to Direct Travel Time	0 min	0 min
Max. Deviation to Direct Travel Time	45 min	17 min
Average Deviation to Direct Travel Time	12.81 min	10.69 min
Std Deviation of DDTT distribution	7.65 min	4.93 min
Avg. Travel Time of employees	53 mins	49 mins
Routes with 0-10 mins deviation over 1st employee's direct travel time	40%	45%
Routes with 10-15 mins deviation over 1st employee's direct travel time	29%	36%
Routes with 15-20 mins deviation over 1st employee's direct travel time	13%	19%
Routes with 20-25 mins deviation over 1st employee's direct travel time	11%	0%
Routes with >25 mins deviation over 1st employee's direct travel time	7%	0%
Shift Cost Comparison +	INR 1,19,150	INR 1,16,850

+ Blended rate of Rs. 650 per trip for Sedans and INR 850 per trip for SUV

A look at the data above shows that the manual routing process reduces routes only by grossly violating the travel time policy of the organization.

1. Routers reduced 2 routes for the peak traffic shift as compared to our algorithm's output
2. Our algorithm gave a superior fleet mix which would result in a lower fleet cost as compared to the manual routing process
3. Routers violated the articulated travel time policy for 17.5% of the routes while our algorithm ensured 100% compliance to the policy
4. Employees travel less in terms of time with our algorithm generated routes
5. Our algorithm generated a much more compact distribution for the Deviation to Direct Travel Time (standard deviation of 4.93 mins as opposed to 7.65 mins with manual routing)

Lean Hour Shift Analysis

6:00 AM Lean Traffic Login	Manual Routing	DDTT Algo. Based Routing
DDTT policy articulated by the client	20 mins or 40% whichever is lower	20 mins or 40% whichever is lower
No. of Employees	773	773
No. of Routes	213	191
4-Seater Routes	184	143
6-Seater Routes	29	48
Min. Deviation to Direct Travel Time	0 min	0 min
Max. Deviation to Direct Travel Time	30 min	19.96 mins
Average Deviation to Direct Travel Time	13.1 mins	12.97 mins
Std Deviation of DDTT distribution	7.29 mins	5.37 mins
Avg. Travel Time of employees	59.65 mins	59.05 mins
Routes with 0-10 mins deviation over 1st employee's direct travel time	34%	28%
Routes with 10-15 mins deviation over 1st employee's direct travel time	30%	26%
Routes with 15-20 mins deviation over 1st employee's direct travel time	29%	46%
Routes with 20-25 mins deviation over 1st employee's direct travel time	6%	0%
Routes with >25 mins deviation over 1st employee's direct travel time	1%	0%
Shift Cost Comparison+	INR 1,44,250	INR 1,33,750

+ Blended rate of Rs. 650 per trip for Sedans and INR 850 per trip for SUV

A look at the data above shows that the manual routing process grossly underperforms during lean traffic shifts.

1. Routematic's DDTT algorithm found better clubbing opportunities and generated 22 less routes as compared to the manual routing output
2. Routers violated the articulated travel time policy for 7% of the routes even during lean traffic hours while our algorithm ensured 100% compliance to the policy
3. Our algorithm generated a much more compact distribution for the Deviation to Direct Travel Time (standard deviation of 5.37 mins as opposed to 7.29 mins with manual routing)
4. Also note that in the peak traffic shift Routematic created less number of 6-Seater routes to reduce employee travel time while in the lean traffic shift Routematic created higher number of 6-seater routes to deliver better cost optimization without compromising on route quality

Analysis of the manual routing process for both peak and lean traffic scenarios clearly shows that the locality based routing approach of human routers is neither scientific nor democratic and does not pass muster on the employee comfort vs cost optimization curve. There is no clear employee comfort parameter which governs the router's output and the quality of routes is dependent on the preferences of the router routing the particular shift. Also, significant optimization opportunities are lost particularly in lean traffic hours.

We have observed that across organizations routers work with a primary target in terms of the number of routes with which they want to execute the shift. To achieve the target, routers violate constraints for ~10% to 30% of the routes. These routes then become candidates for bad feedback.

Conclusion

Our study indicates that the prevalent manual routing process is very subjective and does not enforce a stringent route quality metric representative of employee comfort when trying to optimize on cost. Organizations need to reduce the risk of human errors and omissions from routing by articulating an effective and measurable route quality metric which can form the boundary condition for cost optimization. **Deviation to Direct Travel Time (DDTA)** is an effective metric which delivers on employee satisfaction and is the ideal candidate to govern the quality of routes in any organization's transport process.

Research Team

Anurag Khemka *is the Chief Product Officer at Routematic. He has extensive experience in building products for logistics network optimization. He has in the past setup the PAN India delivery logistics network for Myntra. He is an alumnus of IIM Lucknow.*

Suneet Kumar *is the Head of Customer Success at Routematic. He has over 15 years of experience in handling B2B engagements with organizations such as SAP, HP etc. He is an MBA in Marketing and Finance from ISB Hyderabad.*

About Routematic

Routematic (www.routematic.com) is India's leading employee commute solution provider. Routematic offers transport automation software, fleet services as well as managed transportation solutions to organizations providing employee transportation. With 6 patents, Routematic has been continuously driving the industry towards complete end-to-end automation with innovations such as DDTT routing algorithm, learning based routing algorithm, AI based predictive fleet dispatch, automated vehicle deployment and the industry's first in-vehicle hardware neutral solution built around Routematic's IoT platform for the connected vehicle marketplace which allows organizations to automate their transport process without incurring CAPEX/OPEX on hardware.

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