

# Planning for the Integration of Ride-Hailing Services with Transit: The Case of Small Transit Agencies

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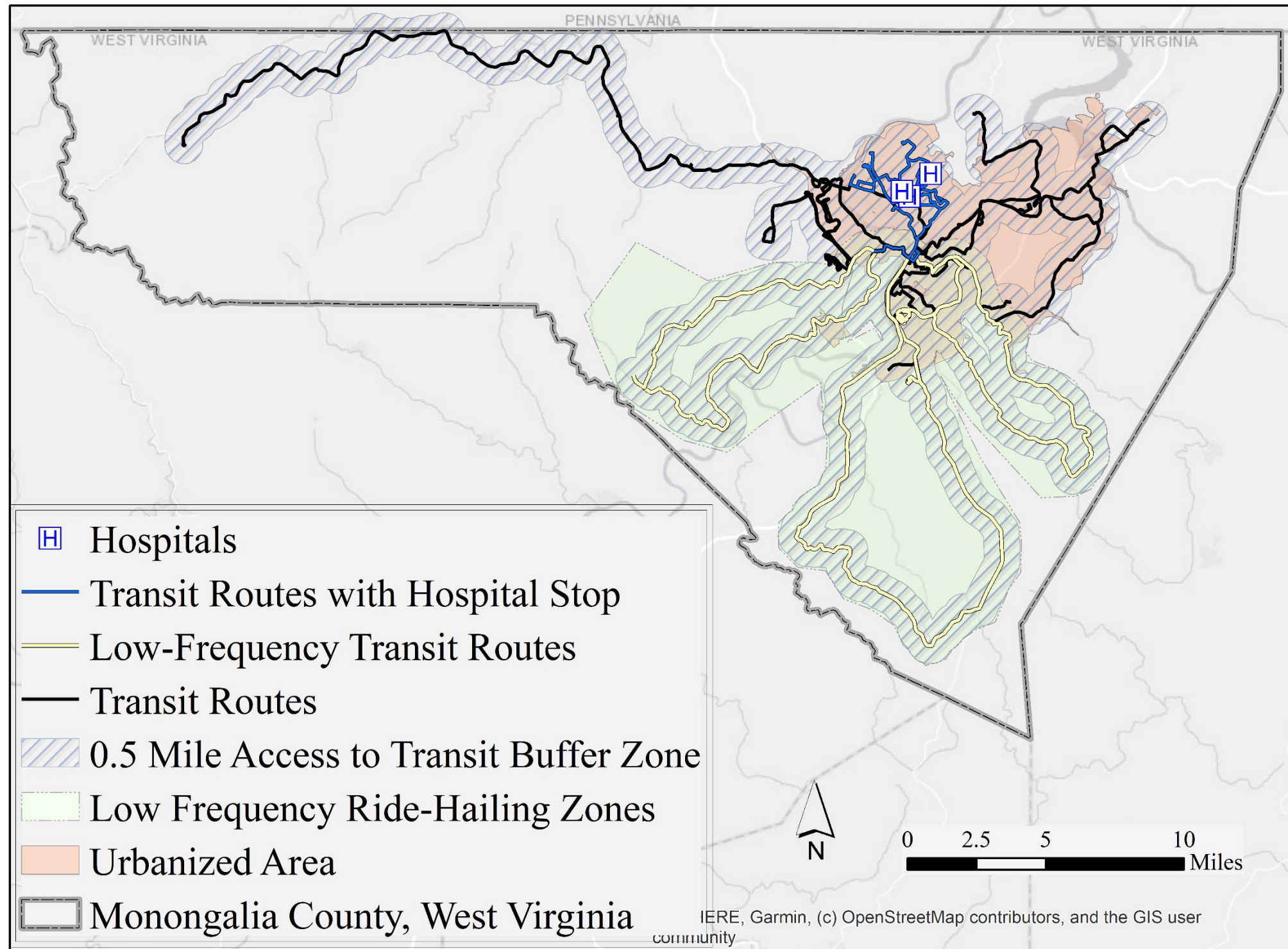
## INTRODUCTION

- Ride-hailing programs established through partnerships between transit agencies and transportation network companies (TNCs) is an emerging innovative practice in public transportation.
- Recent reports have produced how-to guides and other material to guide transit agencies through the various stages involved in exploring, understanding, defining, and establishing such a program.
- However, these materials lack adequate representation of programs established within small transit agencies, because very few of the existing case studies are of ride-hailing programs operating in rural and small urban areas or small University/College/campus towns.

## RESEARCH OBJECTIVE

- To address the lack of specific guidance are resources that can be used by small transit agencies, we focus on the early planning stages of establishing a ride-hailing program within a small transit agency. We, specifically
- Establish a framework based on multi-criteria decision analysis (MCDA) methods that can be used to assess the perceived and actual potential benefits and performance of different ride-hailing service models.
  - Illustrate the framework using the case study of Mountain Line Transit Authority (MLTA), operating in Monongalia County, WV.
  - Explore and compare the ranking of specified ride-hailing service models, using as an input the stakeholders' perceived performance of the models.
  - Explore the differences between perceived and actual potential benefits and performance of the models.

## EMPIRICAL SETTING



- 89% of Monongalia County is classified as rural area and 11% as urbanized area.
- MLTA's primary services are fixed-deviated routes, with opportunities for customers to apply in advance for deviated locations along routes.
- MLTA is a small urban agency and classified as a reduced reporter for National Transit Database (NTD) reporting purposes.

## DATA AND METHODS

### Data Collection Methods

#### Pre-interview Survey

- Several alternative service models were presented.
- The participants selected the ones currently being explored as possible models and provided additional specific alternatives.

#### Alternatives

The following five alternatives were identified by MLTA as pertinent:

- A0: Do nothing**, current as-is coverage (without a new program)
- A1: First/Last-mile**, providing first/last-mile connections to and from different locations where a passenger can transfer to a fixed-route
- A2: Late night/Early morning**, overnight door-to-door rides anywhere in the county
- A3: On-Demand (option 1)**, substituting low-frequency fixed routes.
- A4: On-Demand (option 2)**, providing services anywhere in the county where there is no access to fixed-routes.

#### Final Evaluation criteria

- 18 initial criteria were identified based on literature.
- The following 15 criteria were selected by MLTA as relevant: Other operating expenses ( $C_1$ ), Cost of the ride-hailing program ( $C_2$ ), System-wide ridership ( $C_3$ ), Geographic coverage (i.e., service area) ( $C_4$ ), Accessibility (i.e., population with access to services) ( $C_5$ ), First/last mile services ( $C_6$ ), Access to health services ( $C_7$ ), Service hours ( $C_8$ ), Passengers' waiting time ( $C_9$ ), Customer satisfaction ( $C_{10}$ ), Providing peak-hour mobility services ( $C_{11}$ ), Providing off-peak-hour mobility services ( $C_{12}$ ), Providing mobility options in suburban/rural areas ( $C_{13}$ ), Demographic makeup of customers ( $C_{14}$ ), Impact on traffic congestion and/or parking demand ( $C_{15}$ ).

#### Interview

- The interview collected information on three main topics
  - Selection of criteria that would be consider when assessing a potential ride-hailing program.
  - Perceived importance of each criterion.
  - Assessment of potential ride-hailing programs with respect to the identified criteria.

#### Weighting of Criteria

- The weights of each criterion represent the perceived relative importance of the various evaluation criteria.
- Decision-makers assigned a relative weight to every criterion by responding to the question "*How important is (criterion xxx) in selecting a ride-hailing partnership program*" ([1] not at all important to [5] extremely important).

#### Multi Criteria Decision Analysis Methods

- The following well-established MCDA methods were used

	Strength	Calculation	Scaling
<b>WSM</b>	Simple and easy	Easy	Max Scaling
<b>TOPSIS</b>	Accounts for both the ideal-best and ideal-worst solutions.	Medium	Vector Scaling
<b>VIKOR</b>	Maximize group benefits and minimize individual regret facilitating consensus solutions	Medium	Linear Normalization

#### Measured Benefits

- Four objective measures of potential spatial-related benefits were also estimated (i.e., geographic coverage,  $C_4$ , accessibility,  $C_5$ , health services access,  $C_7$ , serving suburban/rural areas,  $C_{13}$ ).
- GTFS data and data from the 2018 5-year American Community Survey (ACS) were used to estimate these measures

## CASE STUDY RESULTS

MCDA Results-Based on Perceived Benefits/Costs					
$C_j$	Av. $C_j$ Rating	Performance Assessment			
		$A_1$	$A_2$	$A_3$	$A_4$
$C_1$	4	3.5	3	4	3
$C_2$	4	3	2	4	2
$C_3$	3.5	4	4	4.5	4.5
$C_4$	2	4	4	4.5	4.5
$C_5$	4.5	4.5	4	4	4.5
$C_6$	4.5	4	2.5	3.5	4
$C_7$	2.5	4	4	4.5	4.5
$C_8$	3.5	3.5	4.5	4.5	4.5
$C_9$	2.5	4	4	5	5
$C_{10}$	4	4	4	5	5
$C_{11}$	1.5	4.5	3.5	4.5	4.5
$C_{12}$	2	3.5	4	4	4
$C_{13}$	4	3.5	4	4	4.5
$C_{14}$	3	4	4	4.5	4.5
$C_{15}$	1.5	4.5	3.5	3.5	3.5

MCDA Results-Based on Perceived Benefits/Costs & Spatial Measures					
$C_j$ (Unit)	Av. $C_j$ Rating	Performance Assessment			
		$A_1$	$A_2$	$A_3$	$A_4$
$C_1$ (point)	4	3.5	3	4	3
$C_2$ (point)	4	3	2	4	2
$C_3$ (point)	3.5	4	4	4.5	4.5
$C_4$ (mi <sup>2</sup> )	2	365.88	117.52	147.69	365.88
$C_5$ (%)	4.5	100	74.71	79.54	100
$C_6$ (point)	4.5	4	2.5	3.5	4
$C_7$ (%)	2.5	100	100	35.05	100
$C_8$ (point)	3.5	3.5	4.5	4.5	4.5
$C_9$ (point)	2.5	4	4	5	5
$C_{10}$ (point)	4	4	4	5	5
$C_{11}$ (point)	1.5	4.5	3.5	4.5	4.5
$C_{12}$ (point)	2	3.5	4	4	4
$C_{13}$ (%)	4	100	25.40	34.59	100
$C_{14}$ (point)	3	4	4	4.5	4.5
$C_{15}$ (point)	1.5	4.5	3.5	3.5	3.5

- Based on the above ratings and estimated measures, the ranking of the alternatives for the different MCDA methods are shown below.
- Equal weights were assigned to each expert (i.e., the opinion of each participant was considered as of equal importance).

MCDA Results-Based on Perceived Benefits/Costs						MCDA Results-Based on Perceived Benefits/Costs & Spatial Measures					
MCDA Methods	Alternatives					MCDA Methods	Alternatives				
	$A_0$	$A_1$	$A_2$	$A_3$	$A_4$		$A_0$	$A_1$	$A_2$	$A_3$	$A_4$
<b>WSM</b>	5	3	4	1	2	<b>WSM</b>	5	2	4	3	1
<b>TOPSIS</b>	5	3	4	1	2	<b>TOPSIS</b>	5	1	4	3	2
<b>VIKOR</b>	5	2	4	1	3	<b>VIKOR</b>	5	1	4	2	3

- Results were overall consistent regardless the MCDA method used.
- There were, however, discrepancies among the results when perceived benefits/costs were exclusively considered and when spatial measures were also incorporated
- The substitution of low performing routes ( $A_3$ ) is perceived to be the most attractive alternative.
- The on-demand service model offered to all non-covered areas ( $A_4$ ) and the first/last-mile program ( $A_1$ ) are perceived as almost equally attractive alternatives.
- Nevertheless, when spatial measures are incorporated, a first/last mile service ( $A_1$ ) seems more beneficial under most methods.
- The late night/early morning service model was consistently found the least beneficial program, regardless the MCDA method used and whether spatial measures were considered or not.

## CONCLUSION

- ★ Results highlight the need for local explorations of perceived *and* actual measures of benefits/costs.
  - Although two of the most cited motivations are enabling people to connect to traditional transit services and addressing late-night travel needs, various characteristics of small urban or rural areas might make such alternatives less attractive or beneficial.
- ★ A stand-alone spread-sheet-based tool has been designed for this research (available upon request), and the analysis can be easily performed by non-experts that have basic Excel skills.
- ★ The proposed framework can assist small transit agencies in early stages of exploring and planning innovative transit services. For example, the framework can be used
  - as an internal collaboration tool. All involved stakeholders complete the rating and ranking of the criteria and alternatives. Exploration of the results can provide insights on different perspectives and opinions.
  - to (1) more clearly define the problem agencies are trying to address and the associated goals and (2) articulate the problem, goals, and intentions of potential partnerships.
  - to consider different perspectives. Assessing the results of an analysis that incorporates objective measures allows the stakeholders to re-evaluate their empirical perspective that often comes from practice.
    - Example: in light of the findings of the second part of this analysis, MLTA can rethink either their perceptions of the benefits of each service alternatives, or their perceptions and articulation of the importance of specific criteria.

## STUDY AND METHODS LIMITATIONS

- When analysis involves only qualitative variables (i.e., perceived benefits/costs), the results may be highly subjective and dependent on the number, position, and opinions of the stakeholders participating.
- In our case study, only two experts participated, and therefore, results may not represent MLTA as a whole.
- Our estimates may be conservative, leaning towards an overestimation of the performance of the base scenario.
  - The inclusion of A0 and the wording used to solicit information on the performance of the alternatives, resulted in a left-skewed distribution of the performance ratings.

## FUTURE WORK

- Future research can explore different designs of the data collection instrument that
  - do not involve current services' performance evaluation
  - use of a measurement scale with more than 5-points
- Additional objective measures can be calculated to provide a more accurate comparison between the stakeholders' perceptions and objective measures of program performance.

## ACKNOWLEDGMENTS

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- The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Mountain Line Transit Authority (MLTA).