Grant Deliverables and Reporting Requirements for UTC Grants

UTC Project Information	
Project Title	Design of a Hybrid Rebalancing Strategy to Improve Level of Service of Free-Floating Bike Sharing Systems
University	University of South Florida
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Funding Source(s) and Amounts Provided (by each agency or organization)	USDOT: $176,257 USF: $88,129
Total Project Cost	$264,386
Agency ID or Contract Number	Sponsor Source: Federal Government CFDA #: 20.701 Agreement ID: 69A3551747119
Start and End Dates	Start date: 10/01/2018 End date: 09/30/2019
Brief Description of Research Project	It is known that for bike sharing systems, the flow of customers can completely change the temporal and spatial distribution of the bikes and cause an imbalance of demand and supply in the system. Thus rebalancing/redistribution of bikes is critical to ensure the efficiency of bike sharing systems. Rebalancing of bikes can be done either by users with incentive program or by operator with a fleet of rebalancing vehicles. In an operator-based rebalancing method, the operator collects and repositions bikes in order to balance certain number of bikes to predetermined locations. The rebalancing can be static or dynamic or a combination of the static and dynamic. Static rebalancing means that the bikes are rebalanced without the interference of users' activities. Such rebalancing is usually operated during the night when no customers borrow or return bikes. In contrast, dynamic rebalancing is operated periodically in the day when the borrowing and returning of bikes continuously occur. Recently, a new type of bike sharing systems, the dockless/free-

	floating bike sharing system, has emerged which does not need docking stations, and therefore, it cuts a large percentage of start-up investment. With the built-in GPS device, the free-floating bike sharing system allows users to leave a bike almost anywhere which, beside the flexibility, makes the rebalancing of these systems more challenging than typical station-based ones. In light of the above, a hybrid rebalancing method is developed in this project by combining user-based incentive program and operator-based rebalancing to take the advantage of both in free floating bike sharing systems. This method has been featured by a multi-objective technique to optimize the system based on two objectives, cost and service level, which helps decision makers have a better knowledge about the trade-off between these two objectives caused by their decision. In addition, capability of used tools in this method guarantees its applicability on real world scale problems. This technique has been successfully applied on the data collected from ShareABull system at USF.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	We expected to implement this hybrid rebalancing strategy to the bike sharing program at USF and the City of Tampa. However, in May 2019, the City launched an e-scooter sharing program which attracted users and reduced the usage of the bike sharing program. What we have developed through this research could be implemented for bike sharing in other cities, those which have more registered users and a higher utilization ratio.
Impacts/Benefits of Implementation (actual, not anticipated)	Hybrid strategy is an innovation in solving the rebalancing problem of bike sharing. This research increased the body of knowledge in this direction. The study was presented in international conferences and encouraged follow-up research from bout US researchers and those worldwide. The student who worked on this project gained knowledge of sharing mobility and used that knowledge to work on a sponsored research project supported by the City of Tampa on the e-scooter sharing program.
Web Links • Reports • Project website	http://ctech.cee.cornell.edu/final-project-reports/