Motorcycle courier systems based on hybrid hub-and-spoke and point-to-point schemes in metropolitan area

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Motorcycle courier systems have become an efficient means to deliver small packages in metropolitan areas due to its high mobility and low hardware investment on vehicles. Although the Hub and Spoke (HS) courier networks are shown to complete more consignments and provide better service than the Point to Point (PP) courier networks, the high utilization and dependence on the Hub increases the risk and fixed cost investment. In order to find suitable courier networks that are cheaper and less risky than HS but more efficient than PP, this thesis proposes four hybrid courier networks based on balancing the pros and cons of HS and PP networks. All of these four networks hire transhippers and consignees, where each service zone is served by a consignee who stays in his zone all the time to collect and deliver consignments, while a transhipper takes charge of one or more service zones by transhipping consignments between these zones.

Two PP-like networks, denoted by RPP and APP, are designed as variants of hybrid PP networks, in which a transhipper travels to an adjacent zone either following the same orientation (i.e. a ring-like traversal) or alternatively following different orientations (i.e. an arc-like traversal). On the other hand, two HS-like networks that exploit smaller hubs, denoted by FHS and SHS, are designed as variants of hybrid HS networks. In FHS, a transhipper traverses along a fan-like orientation by visiting a few zones, returning the Hub to exchange consignments, and then going back to his first zone. In SHS, several service zones are grouped as a satellite HS system, and all the satellite hubs exchange consignments in a central Hub.

We analyze the theoretical total cost and amount of delivered consignments within a given service time limit and entire day, whether considering the employee's capacity or not, for each of the four hybrid courier networks. Computational experiments are conducted with different settings on the number of service zones and employee's capacity. The results indicate that both RPP or APP may give total amount of delivered consignments and average delivery time similar to HS. FHS and SHS give more total amount of delivered consignments than HS. Moreover, when further considering the employee's capacity, SHS can deliver more consignments but it also comes with higher cost.

***Keywords*:** Motorcycle courier system, Hub and Spoke, Point to Point

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