PHD COURSE MATHEMATICS AND COMPUTER SCIENCE

MAT-09 OPERATIONS RESEARCH

TITLE: Vendor Managed Inventory in the last-mile delivery: an application to an industry case and future challenges

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Abstract: The thesis is focused on the implementation of a Vendor Managed Inventory setting in a large urban environment and on the study of the Inventory Routing Problems. In particular, the thesis is inspired by applying the VMI paradigm in the last-mile delivery according to the needed of an Industry Company. We focus on two main variants of the IRP: the Multi-depot IRP and the Multi-attribute IRP. In the first part of the thesis the MDIRP is formulated. A simple Branch-and-cut algorithm is designed to solve the problem, and some valid inequalities are introduced. To reduce the complexity of the problem, a clustering method inspired by the Capacitated Concetrator Location Problem is used to pre-assign customers to the depots. This method allows to simplify the problem that takes place in a large urban space, while obtaining good solutions within a computational time smaller than the one required by the branch-and-cut algorithm. Indeed, the branch-and-cut algorithm combined with the clustering is faster than the simple version, while the resolution method remains very slow in general. This evidence is the starting point for the next analysis. Secondly, a complex Matheuristic is designed for solving the problem, it is divided in three main steps: a clustering optimization phase (in order to group the customers around each depot), a route generation phase (in order to build a set of feasible routes), a final optimization phase (in which a simplified version of the model is solved on the basis of feasible paths). Finally, the matheuristic is compared with the branch-and-cut algorithm, getting better solution quality within a computational time shorter than the one of the exact algorithm. This evidence allows us to propose to the Industry Company to test this algorithm on real case benchmarks. In the second part, a more complex version of the MDIRP is designed. We added the possibility to deliver multi-product by using a heterogeneous fleet of vehicles. In this way, we modified the problem to make it as close as possible to the real scenario in which the Company works. In this case, a Variable MIP Neighborhood Search algorithm is designed to solve the problem. We present preliminary results for some classical benchmark instances. Finally, an application of the matheuristic for the MDIRP using real data for Surabaya city (Isle of Jackarta) is presented. The aim is to show the effectiveness of the VMI setting applied to the last-mile delivery of the Nanostores in a real context. We are able to prove that the VMI has a good impact on the business of the Company, because it is able to reduce a big portion of the transportation costs that the Company actual pays to ship freights to the stores in a wide area.