HEURISTIC SOLUTION TO MULTI-SITE PICKUP AND DELIVERY PROBLEM WITH MULTIPLE-PRIORITY REQUESTS

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ABSTRACT

Due to the complexity and cost of transportation and distribution activities, a multi-site manufacturer needs to schedule vehicles for pickup and delivery effectively and efficiently to increase a company’s competition edge. This project considers the multi-site pickup and delivery problem with multiple-priority requests (MPDPMP), which has many real-world applications, particularly, in the IC manufacturing industry. This study is motivated by a practical MPDPMP from a semiconductor manufacturing company. In the facility under study, transportation activities, arisen from pickup-and-delivery of wafer, mask, or finished-goods, are frequently and complicated. In addition, vehicle-scheduling decision for each request is based on its priority. Since the MPDPMP involves constraints on multiple-priority requests, pickup and delivery, multiple vehicles, and vehicle capacity constraints, it is more difficult to solve than the classical pickup and delivery problem. In this study, we describe the MPDPMP in detail and present a heuristic algorithm for resolving the MPDPMP. An example is used to illustrate the performance of the proposed algorithm.

INTRODUCTION

Multi-site investment has been a popular way to increase capacity, particularly, in the semiconductor manufacturing industry. As a result, in many of today’s multi-site companies, transportation and distribution activities emerge as one of the central issues owing to their complexity and costs. Due to the relative magnitude of the transportation and distribution costs is associated with the routing and scheduling of vehicles, enterprises have shown a growing interest for efficient vehicle-scheduling because of the good chance of getting large savings on such expenses (Stray et al. 2006; Dondo et al. 2008). Hence, there is a genuine need for effective multi-site pickup and delivery methods.

A vehicle route is a sequence of pickup and/or delivery points which the vehicle must traverse in order, starting and ending at a depot or domicile. A vehicle schedule is a sequence of pickup and/or delivery points together with an associated set of arrival and departure times (Bodin and Golden, 1981). One of the importance classes of vehicle routing and scheduling problems is pickup and delivery problems, in which commodities or people have to be collected and distributed (Berbeglia et al. 2007). In the pickup and delivery problem, a set of routes has to be constructed in order to satisfy transportation requests. A fleet of vehicles is available to operate the routes. Each vehicle has a given capacity, a start location, and an end location. Each transportation request specifies the size of the load to be transported, the locations where it is to be picked up and the locations where it is to be delivered. Each load has to be transported by one vehicle from its set of origins to its set of destinations without any transshipment at other locations (Savelsbergh and Sol, 1995).

Due to the prevalence and importance in the practical applications, a number of papers addressed the pickup and delivery with time windows (PDPTW). The survey papers (Bodin et al. 1983; Soloman and J. Desrosiers, 1988; Berbeglia et al. 2007) provide a comprehensive review of the literature on PDPTW. In the cases, the transport requests are known in advance, the problem is known as static PDPTW. In the cases, the transport requests are received in real-time and eligible for consideration, the problem is known as dynamic PDPTW. In this study, we focus on the static PDPTW. For static PDPTW, Nanny and Barnes (2000) use hierarchical search methodology. Xu et al. (2003) present column generation based solution approaches. Lu and