Vehicle Routing Problem for Semiconductor Supply Chain

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Abstract - In Taiwan’s semiconductor manufacturing, the supply chain has been constructed comprehensively and the performance of this industry is very significant in the market. With the comprehensive and complex supply chain, the transportation activities, arisen form pickup-and-delivery of products between supply-chain members, are very frequently and complicated. Furthermore, vehicle scheduling decision for each request is based on its priority. Since the vehicle routing problem for semiconductor supply chain (VRP-SSC) involves constraints on number-of-vehicle decision, multiple priority, pickup and delivery, and vehicle capacity constraints, it is more difficult to solve than the classical pickup and delivery problem. In this study, we consider the VRP-SSC and formulate the VRP-SSC as an integer programming program to minimize total cost. An example is used to illustrate the performance of the proposed formulation.

Keywords: vehicle routing problem, semiconductor manufacturing, supply chain, integer programming.

1 Introduction

As a semiconductor supply becomes widespread and the competition pressure is very fierce, the cross-company supply chain operations are even more complicated such that a semiconductor manufacturer needs to integrate and manage distribution in supply chain networks effectively and efficiently to increase their competition edge and profitability. The development of effective tools for logistics management has therefore attracted a great attention from both industry and academia on the field of supply chain management [1] [2].

This study is motivated by a practical problem arising in a semiconductor supply chain. The major process stages of the integrated circuits (IC) manufacturing include wafer fabrication, test/sort, assembly and packaging, and final test, as shown in Figure 1. With a comprehensive supply chain structure, the distribution network consists of mask houses, wafer fabs, IC packaging plants, and warehouses, with the products flow following process stages. Sites among each other are connected by transport. Distribution activities (hereafter referred to as requests) arise from wafer-delivery among fabs due to capacity backup, mask-delivery from mask house to fabs, material-delivery from warehouses to fabs, wafer-delivery to packaging plants, finished-goods delivery to warehouse, etc.

![Diagram](image)

Figure 1. Process stages of the semiconductor manufacturing.

A number of papers addressed the transportation planning in a manufacturing supply chain. Lee et al. [3] tackle the vehicle capacity planning for transportation service providing by a Singapore local logistic company. The problem can be classified as VRPTW (vehicle routing problem with time windows) with outsourcing decisions. In this paper, an advanced artificial intelligence method of tabu search heuristic is proposed for solving the problem. Karabuk [4] deals a transportation problem for a textile manufacturing supply chain. The transportation problem involves constraints on pickup and deliveries, multiple depots, time windows, and full truckload (TL) or less than a truckload (LTL). The author solves this problem by defining sub-problems. The proposed approach unfolds in stages which are solved to optimality and the solution one stage is the inputs to the next. Chiang et al. [5] use a combination of model formulation, simulation, and an improvement heuristic for midsize US newspaper comprise two-level and three-level supply chains. Manzini and Bindi [2] propose a combined mixed-integer programming model with