A study on the spine layout for semiconductor manufacturing facility using simulated annealing

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Abstract

The construction cost for the wafer fab. of a semiconductor manufacturing is about NT$ 50 to 70 billions. Owing to the higher reentrant characteristics of the manufacturing process routing, the *Automated Material Handling System* (AMHS) and the layouts of the manufacturing fab. will determine the manufacturing efficiency at the earlier planning stage. The current wafer fab. layouts are their basis on the spine layout concepts. The spine layout is to allocate the material handling system at the center (like the spine of human body) of the manufacturing facilities, with the rest of the bays assigned to areas along the spine. This layout can reduce the material handling distance (time) and decrease the collision and vibration of the material handling systems.

The benefits of this concept can utilize the modularized function area to form the desired construction for use. A bay configuration arranged along a central spine and served by an AMHS is common for the layout and material handling system in the semiconductor wafer fabrication facilities. The purpose of adapting AMHS is to seek the best layout with low transportation cost and an efficient flow to reduce shock and vibration during the material handling, and the best use of manufacturing resources.

This paper applies the simulated annealing algorithm to the problem of spine layout, and considers four different material flow directions (clockwise, round way, clockwise with

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a short cut, and round way with a short cut) in the design process. The material handling cost and time are two evaluation criteria for this problem. Experiments were conducted to investigate the control parameters of the simulated annealing process so that the best solution and time can be found. The results show that the flow directions, cooling rate (r) and replicates (L) are significant factors.

Keywords : *Spine layout, simulated annealing, semiconductor facilities.*

1. Introduction

Simulated Annealing Algorithms (SA) and Spine Layout are two subjects, of this research, whose objective is to apply Simulated Annealing Algorithms to Spine Layout.

Studies on spine layout in the past offered only the spine layout concepts, and had only limited discussion on the spine layout methods. Regarding researches of the application of SA to facility layout, most concentrated on ordinary facility layout with relatively few on spine layout. As a result, this research, by borrowing past experiences of facility layout of manufacturing system, attempts to find a layout model suitable for spine facility layout by combining the strengths of the simulated annealing algorithms to accomplish the spine facility layout design.

This research uses semiconductor fabrication facilities as a real example, and discusses the practicality as well as strengths and weaknesses of the spine facility layout. The traditional Heuristic Algorithms adopts the Greedy Strategy, only accepting the new status which can largely reduce the objective function. As a result, solutions and initial solution are related, and solutions are likely to fall into the Local Minimum so that the Global Minimum is difficult to obtain (Egles (1990)). In view of the above reasons and taking into consideration the time and quality of solution, a new heuristic algorithm is adopted to obtain the optimum solution or the approximate optimum solution.

Since the domestic economy changes rapidly, the modern facility planning is viewed as a dynamic one. The critical need of facility planning is its adaptability, so facilities need to have the capabilities of accommodating new functions. As far as the facility planning personnel is concerned, the idea of constant improvement is a must component in terms of facility planning cycle.