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# Simulating a Semiconductor Packaging Facility: Sustainable Strategies and Short-time Evidences

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**Abstract**

Semiconductor packaging plays a crucial role in semiconductor manufacturing because it is among the closest steps to the end customers. However, the complexity of production conditions makes controlling a semiconductor packaging facility a challenging task, and dynamic factory simulation has been considered as an effective means to fulfill this task. The large amounts of money, time, efforts, and expertise required to conduct a factory simulation study force a semiconductor packaging firm to pursue the persistent application of the factory simulation model (i.e., the sustainability of the factory simulation model). This challenge has rarely been discussed in previous studies. This study proposed several strategies to enhance the sustainability of a factory simulation model. In addition, the effectiveness of these strategies were examined by identifying short-time evidence rather than observing for a long duration to enhance efficiency. According to the experimental results, the adoption of the quick start-up, scaled-down, and OOAD strategies reduced the requirement of money, time, and effort in building the factory simulation model, and enhanced the sustainability.

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## 1. Introduction

Semiconductor packaging involves encasing a semiconductor device to protect the device against impact and corrosion, hold the contact pins or leads connecting to external circuits, and dissipate the heat generated in the device [1]. Various semiconductor packages, such as plastic lead frame-based packages, plastic ball grid array (PBGA), hermetic packages, and system in package have been used [1-2]. The process flow of PBGA packaging is illustrated in Fig. 1.

Semiconductor packaging is a backend operation in semiconductor manufacturing. Compared with the frontend operations (i.e., wafer fabrication and wafer sort), the backend operations require substantially less time and expenditure. In addition, because the backend operations are closer to the end customers than the frontend operations, marketing time is more critical for the backend operations. Furthermore, semiconductor packaging is less automated than the frontend operations, which results in higher uncertainty and variation in operations and difficulty in collecting real-time information. These challenges become inherent to scheduling a semiconductor packaging facility [1].

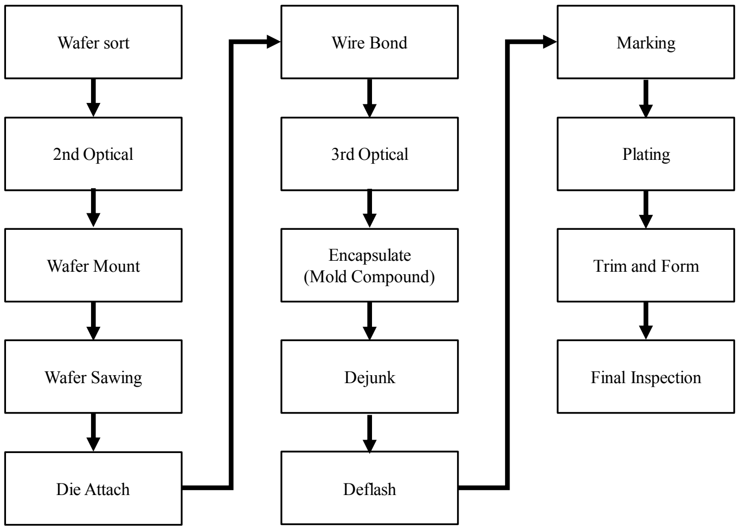


Fig 1. Process Flow of PBGA Packaging

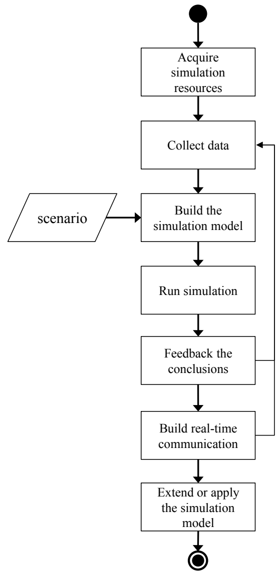


Fig 2. Factory Simulation

*Procedure*

Factory simulation is a well-known tool to diagnose a factory. For example, Chen and Romanowski [3] proposed a fuzzy data mining method that applied the principal component analysis (PCA), fuzzy c-means (FCM), and fuzzy back propagation network (FBPN) to preprocess the data, classify jobs, and estimate the job cycle time, respectively. Factory simulation has been applied to generate test data. Moreover, it has been applied to evaluate the effectiveness of a new scheduling method. Xiong et al. [4] conducted a factory simulation study to compare the performances of some dispatching rules in a dynamic job shop scheduling problem with batch release and extended technical precedence constraints that considered the sequence of steps of various jobs that would be combined later. However, developing a simulation model for large-scale factories such as a semiconductor fabrication or packaging facility is extremely difficult [5]. Such large-scale factories usually have thousands of jobs, hundreds of machines, and complex routings. Therefore, some firms seek assistance from factory simulation consultants or employ cloud-based factory simulation services instead of building factory simulation models on their own [5]. Chen [5] considered factory simulation as a basic and practicable function of cloud manufacturing. However, cloud-based factory

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