

FUTURE WIP LEVEL FORECASTING IN A WAFER FABRICATION FACTORY WITH A HYBRID FUZZY AND NEURAL APPROACH

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Received March 2010; revised August 2010

ABSTRACT. For an efficient work-in-process (WIP) control in a factory, accurately forecasting the future WIP level in the factory is an important task. For this purpose, a hybrid fuzzy linear regression (FLR) and back propagation network (BPN) approach is proposed in this study. In the proposed approach, multiple experts construct their own fuzzy multiple linear regression models from various viewpoints to forecast the future WIP level. Each fuzzy multiple linear regression model can be converted into two equivalent nonlinear programming problems to be solved. To aggregate these fuzzy WIP level forecasts, a two-step aggregation mechanism is applied. At the first step, fuzzy intersection is applied to aggregate the fuzzy WIP level forecasts into a polygon-shaped fuzzy number, in order to improve the precision. After that, a back propagation network is constructed to defuzzify the polygon-shaped fuzzy number and generate a representative/crisp value, so as to enhance the accuracy. A real example is used to evaluate the effectiveness of the proposed methodology. According to experimental results, the proposed methodology improved both the precision and accuracy of WIP level forecasting by 53% and 24%, respectively.

Keywords: Work in process, Forecasting, Fuzzy linear regression, Back propagation network, Hybrid approach

1. **Introduction.** Work in process (WIP) or in-process inventory indicates the set of unfinished items for products in a manufacturing process. These items are being fabricated or waiting in a queue for further processing or in a buffer storage. WIP is considered to be one of the most important causes of factory inefficiency that must be closely monitored, accurately forecasted, and controlled as good as possible. Besides, WIP also represents capital investment that cannot be realized in time, i.e., the so-called sunk costs. As a result, the accumulation in WIP adds to the financial risk of the company. Operations, marketing, and finance, all have interests in good WIP management.

Controlling the WIP in a factory is a critical task to the factory because of the following reasons. First, according to Little's law [1], the cycle time of a job through a factory is proportional to the average WIP level in the factory. In addition, the storage and transportation of WIP make facility layout a complicated task. The material flows in