

# Applying Hybrid Machine Learning Models to Assist Small and Medium Enterprises in Achieving Quality Prediction and Adaptive Digital Transformation: A Case Study of Injection Molding Industry

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**Abstract.** With the rapid development of smart manufacturing in Industry 4.0, many companies, especially small and medium enterprises (SMEs), face the challenge of transformation. Compared to large corporations, SMEs often face more constraints in terms of resources and technology. Therefore, this study provides effective digital transformation strategies for SMEs. While previous research has utilized machine learning methods for product quality prediction, there is still a need for further exploration of digital transformation strategies that combine adaptability and quality prediction, specifically for SMEs. In this study, the injection molding industry is taken as a case study. A method framework is proposed, which combines feature selection using Xgboost, machine parameter prediction using GRU time series models, and quality classification models using SVM. This framework integrates these three methods to achieve quality prediction and adaptability as part of the digital transformation strategy. In the case study, this method framework demonstrates good accuracy in predicting machine parameters and yield. Furthermore, after the small and medium-sized enterprise adjusted their processes based on the optimization recommendations from this study, the process capability index improved significantly by 41%. In addition to the practical contributions mentioned above, this study fills the research gap in the field of quality prediction and adaptability. It provides an digital transformation strategy for SMEs manufacturing companies.

**Keywords.** Digital Transformation, Adaptability, Deep Learning, Quality Prediction, Small and Medium Enterprises(SMEs)

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