

ABSTRACT

The bolt tightening process on the cylinder head nut runner machine is an important stage in vehicle engine assembly that can affect the quality of the engine connection. Although historical data shows that the end torque value is within the specification limits with a coefficient of variation (CV) of 7.95%, the company still experiences a defect rate of 4.19% per month. The company continues to experience defects, indicating that monitoring end torque alone is insufficient, necessitating analysis of other parameters that may affect joint quality. This thesis aims to classify bolt tightening process conditions based on machine parameters using the K-means algorithm and design machine parameter recommendations to reduce defect rates. The CRISP-DM approach was employed, encompassing data exploration, feature selection, and clustering stages. Four main features were retained: SEAT TRQ, TL TIME, END ANG, and RDWN ANG, while END TRQ was the target parameter. The clustering results showed that cluster 1 had poor process characteristics, suggesting it as the cause of defects, while cluster 0 indicated stable and good parameters. Based on the analysis results, machine parameter recommendations were designed to reduce defect rates. Validation was conducted by comparing clustering results with actual conditions and specification limits. This final project demonstrates that a historical data-based approach can identify process risks and serve as a reference for machine parameter settings.

Keywords: Nut runner, End torque, K-means, Clustering, Cylinder head nut runner, Defect, Data mining.