



FAILURE ANALYSIS AND AVAILABILITY ASSESSMENT OF STADLER FLIRT EMU 413/417 TRAINS IN SERBIA

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Abstract – The reliability and availability of modern electric multiple units (EMUs) are essential for ensuring safe, efficient, and sustainable railway transport. This research presents an analysis of the maintenance process, failure characteristics, and operational availability of Stadler FLIRT 413/417 EMUs operating on the Serbian railway network. The research is based on maintenance records and failure data collected during the warranty period between April 2024 and September 2025, comprising 113 recorded failure events provided by Srbija Voz. The study examines the frequency, distribution, and root causes of failures, identifies the most critical vehicle subsystems, and evaluates their impact on train immobilization and overall fleet availability. Maintenance procedures, including scheduled inspections and corrective interventions, are analyzed to assess their effectiveness in maintaining operational performance. Statistical analysis and data visualization were applied to identify recurring failure patterns and maintenance trends. The most frequent failures by subsystem are concentrated in transformer-related components, information systems, and climate/heating systems. These results indicate that these three subsystems represent the dominant contributors to overall system downtime and reliability issues. The findings provide practical recommendations for improving maintenance strategies, reducing unplanned downtime, and increasing fleet reliability and availability. The proposed approach supports the transition toward more efficient, data-driven, and predictive maintenance practices in modern railway systems.

Keywords – critical subsystems, maintenance evaluation, statistical analysis data visualization.

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