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RELIABILITY AND AVAILABILITY OF FREIGHT WAGON COMPONENTS: A COMPARATIVE RELIABILITY BLOCK DIAGRAM ANALYSIS WHEN INTRODUCING SENSING SYSTEMS

Rita Sousa[(1)], Sandra Fernandes[(1)], Paulo Alves[(2)], António Andrade[(3)], Virgínia Infante[(3)]

[(1)]ISQ, Instituto de Soldadura e Qualidade, Oeiras, Portugal
[(2)]MEDWAY, M&R, S.A., Entroncamento, Portugal
[(3)]LAETA, IDMEC, Instituto Superior Técnico, Lisboa, Portugal

rmsousa@isq.pt, sifernandes@isq.pt, paulo.alves@medway.com, antonio.ramos.andrade@tecnico.ulisboa.pt, virginia.infante@tecnico.ulisboa.pt

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Summary: Freight wagon sensing systems show potential to boost reliability and lower failure rates and improve availability. This research examines Reliability Block Diagrams (RBDs) of a critical freight wagon components before and after the addition of sensing systems and whether the integration of these systems will improve the previous metrics. The analysis shows how condition-monitoring technologies influence operational efficiency together with safety performance.

Historical data together with statistical modelling methods were used to determine the traditional configuration's component failure rate and reliability values. The RBD model represented the component operational structure by combining series and parallel arrangements to represent system dependencies and redundancy. The new RBD model integrating sensing capabilities adopted predictive maintenance systems instead of reactive techniques. Nevertheless, the reliability of the sensing system itself must be considered. If the sensors are prone to failure or provide false readings, this could negatively affect reliability.

This research makes use of a simulation to assess the benefits of adding sensing systems or not, alongside a systematic framework for employing reliability block diagrams (RBD) to measure the effects of sensors on freight wagons components. The findings demonstrate important implications for freight transportation industry adoption of sensing systems because reliability and availability remain primary concerns.

To address the uncertainty around the sensing system's reliability, this research will include a sensitivity analysis of the sensing system's failure rate. Through their research the authors demonstrate how RBD-based methods generate useful data to improve freight wagon system performance and reliability.