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Doctoral Dissertation
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Engineering knowledge management with the use of the „Digital Twins” method

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Summary of the PhD thesis: Engineering knowledge management with the use of the „Digital Twins" method

The PhD thesis is related to engineering knowledge management of an automotive supplier's research and development centre. The knowledge about the product performance is gathered during each project development of an automotive shock absorber. The car manufacturer provides technical product requirements that must be fulfilled. The engineering group of the supplier is optimising design concepts in order to meet those requirements and validate prototypes. The design optimisation tasks are frequently done in various simulation techniques. However, it must be stressed that simulation results may differ from the test results, which leads to excessive verification tests. The selected design solution validated against requirement is valuable engineering knowledge that shall be gathered and used for other projects in the future. The PhD project aims to implement the digital twins method into the development process to strengthen engineering knowledge management. The digital twins concept refers to the simulation that replicates physical asset in predefined characteristics.

The PhD project concentrated on a pilot project related to the durability performance of the stabilizer bar bracket, which is one of the shock absorber elements responsible for the transfer of suspension loads. The first step of the project was to map the development process with a special focus on understanding the design parameters classification and status of data digitalization. The FEA numerical model was selected for the implementation of the digital twins concept. The data collection application was developed to digitalize simulation and testing processes. As the next step, the correct representation of the physical part in the simulation was ensured. The optimisation of the material properties allowed to minimise differences between simulation and test results, which allowed to achieve digital twin. The durability analysis application was developed to digitalize the analysis of the results and then also review available historical data. The final process is to use validation test results to improve the simulation accuracy and predict design solutions excluding expensive design verification tests. Additionally, a second pilot project was finalized to implement digital twin for rod bending test.

The digital twins method was successfully implemented into the development process, directly supporting engineering knowledge management and significantly reducing development and testing time.

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