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The FMECA method in LEVEL-UP project

Failure Mode Effects and Criticality Analysis (FMECA) is an extension of the Failure Mode and Effects Analysis, performed in a bottom-up way either on the whole system or on part levels. A crucial part of the FMECA is the Criticality Analysis, which correlates the probability of the Failure Mode with the severity of their consequences and the detection and occurrence of the Failure Modes. The produced results are presented according to the highest probability and indicates mitigation actions to address the possible issues in the system.

A typical FMECA analysis has nine logical steps: 1) System definition, 2) Identification of the failure modes, 3) Failure effects and causes analysis, 4) Failure effects classification based on the severity, 5) Criticality calculation, 6) Rank failure mode's criticality, 7) Definition of the occurrence and detection levels of a failure mode, 8) Computation of the RPN to measure the risks of each of the failure modes and 9) Presentation of the analysis' results in heat matrixes for the user convenience. The FMECA analysis (quantitative and/or qualitative) is usually performed in a part or a system level while a combination of these two is possible by creating the analysis tree. Within, the root is defined as the whole system while the branches are the sub-system and the leaves on the tree, where the first failure modes are defined, are the parts.

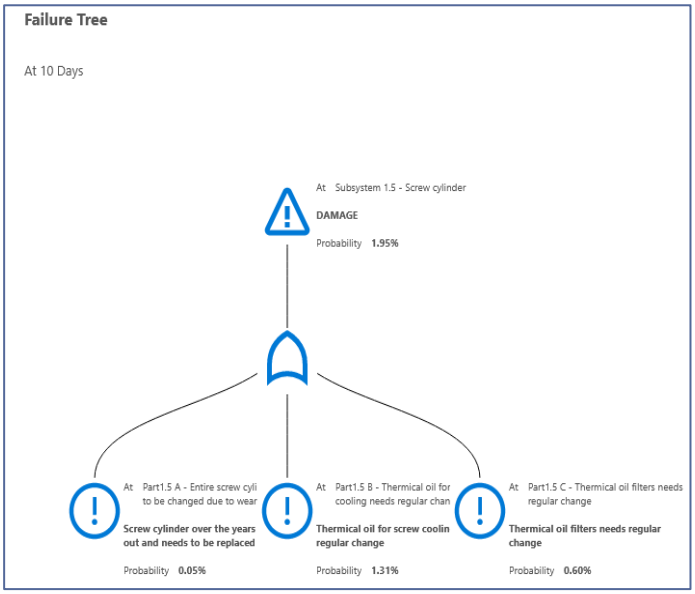

Figure 1: Failure tree with the probabilities for each Failure Effect.

The system developed in LEVEL-UP is based on the FMECA method where several modifications have been implemented as well. The aim was to better understand the system's failures and how to solve them on the shop floor with less disturbances in the production procedures. Thus, focus was in performing a Failure Tree analysis in combination with the FMECA analysis where the end-users acquired a digital application to help them compute all the failure analysis and prolong the life cycle of the system's assets

scheduling the maintenance procedures. Finally, the FMECA analysis also has the potential to send the results to the DSS and further support the decisions of an end user. Figure 1 shows a failure tree with the probabilities for each Failure Effect.

Furthermore, all the results are provided to the end user via a friendly user interface offering information about the failures and their probability of occurrence. In Figure 2, the results as presented to the user are illustrated based on heat matrices and tables. Both the quantitative and the qualitative results are analyzed supporting the user in taking reliable decisions.

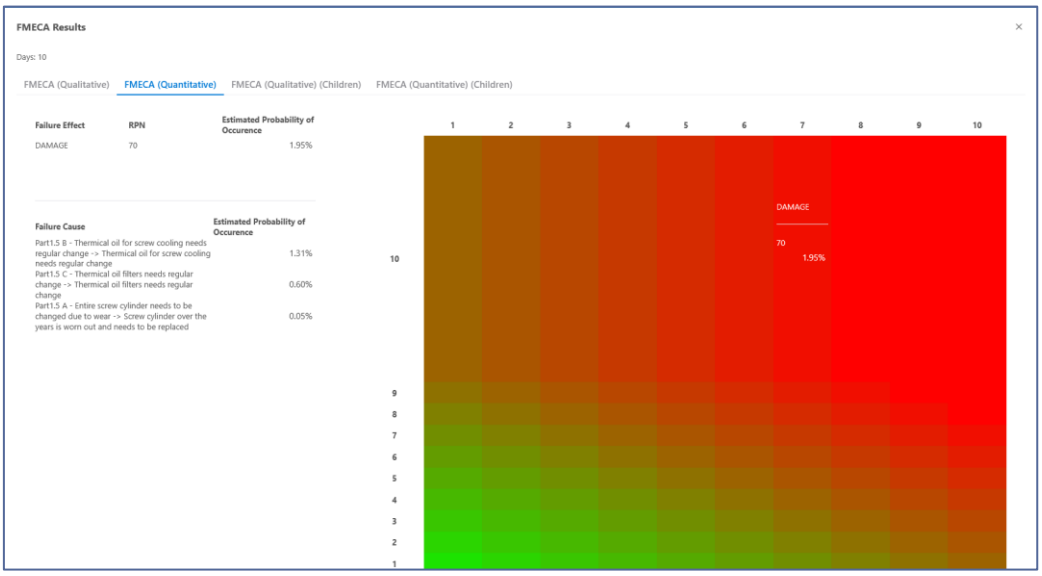

Figure 2: FMECA results in Heat Matrixes

The first step which included the development of the FMECA tool was achieved with close cooperation with ISOKON, in which it was first implemented. The hierarchical approach of the application was followed, as well the first test case and evaluation. Following, TOSHULIN pilot has also implemented the FMECA application, making reasonable changes in the machine structure. For the next stages of the LEVEL-UP project, LUCCHINI is also evaluating the interest for the application and its implementation.

About the project

LEVEL-UP will offer a scalable platform covering the overall lifecycle, ranging from the digital twins' setup, modernisation actions to diagnose and predict the operation of physical assets, to the refurbishment and remanufacturing activities towards end of life. In-situ repair technologies and the redesign for new upgraded components will be facilitated through virtual simulations for increased performance and lifetime. LEVEL-UP will therefore comprise new hardware and software components interfaced with the current facilities through IoT and data-management platforms, while being orchestrated through eight (8) scalable strategies at component, workstation and shopfloor level. The actions for modernising, upgrading, refurbishing, remanufacturing, and recycling will be structured and formalised into ten (10) special Protocols, linked with an Industrial

Digital Thread weaving a seamless digital integration with all actors in the value chain for improved future iterations. LEVEL-UP will be demonstrated in 7 demo sites from different sectors.

Details

Project title: Protocols and Strategies for extending the useful Life of major capital investments and Large Industrial Equipment

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Project Duration: 48 months

Project Consortium:

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