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Contribution of Industry 4.0 to OEE Improvement

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Abstract

Nowadays, it is judiciously important to make production systems Industry 4.0 compliant. This would be achieved with cyber-physical production systems or through the merging of real and virtual world. In addition, building an Artificial Intelligence environment considering data storage and communication capacities can be envisaged. As such, the Total Productive Maintenance (TPM) implementation can be facilitated by monitoring in real time manufacturing performance. In addition, actions can be taken timely to avoid overproduction, poor quality, and to carry maintenance activities. TPM is one of the lean manufacturing approaches that help to improve the equipment performance by increasing production rate, equipment availability, and enhancing the overall productivity of manufacturing. Overall Equipment Effectiveness (OEE) is a metric to monitor and assess the effectiveness of equipment, operation or the manufacturing process. OEE is also a tool to measure the success of TPM implementation. A major loss in production process can result from poor maintenance, faulty equipment or inefficient operation. Therefore, OEE is the product of the Availability Rate (VR), Performance Rate (PR), and Quality Rate (QR), OEE%= EV % ×PR % × QR %.
In this study, the TPM program has been applied to a heavy-duty equipment manufacturing for quarries and mining applications located in Ontario, Canada. After TPM implementation and achieving the results in two production lines, the OEE was significantly improved. Furthermore, The average monthly OEE was 55% but after TPM implementation OEE increased to 74% in just six months. The simulation approach helps in determining the predicted OEE value over the production shifts. Therefore, to predict the OEE after implementing TPM at a future time, one can use the Monte Carlo experiments. VR, PR, and QR data for production shifts are measured for the goodness of fit. Therefore, random variates were generated for OEE factors based on their distribution for an average of 1000 production shifts. The benchmark OEE value based on the average of improvement after implementing TPM is 0.74. The simulation results are assessed by considering the ratio of observations above 0.74 to the total number of observations. This prediction helps TPM teams to monitor the changeability of OEE. Accordingly, the number of observations above 0.74 is 40, and the total number of observations is 50. Simulation results are 80%, which means the production lines will be constantly improving, and it is better to follow up in real time manufacturing performance. Thus, in Industry 4.0, monitoring and controlling the production lines by collecting data in real time with the help of wireless sensors that can be installed where required on the production floors. This allows to track production, identify and minimize losses in a production process, and make more informed strategic decisions that would increase OEE values consistently.

Keywords
Total productive maintenance (TPM), Overall Equipment Efficiency (OEE), Monte Carlo experiment.

Biographies
Abdullatif Ben Hassan received a Ph.D. degree in Industrial and Manufacturing Systems Engineering from University of Windsor, Ontario, Canada. He is Research Assistant in the Department of Mechanical, Automotive & Materials Engineering at the University of Windsor. His research activities focus on the assessment of the Total Productive Maintenance (TPM) implementation in industrial environment. Mr. Ben Hassan obtained his M. Phil in Mechanical Engineering from Bradford University, UK.

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