ABSTRACT

As India is the 4th largest economy in the world and aiming towards the top three spot, we have to focus on the Manufacturing and service sectors. The topic **"Study of Reliability, Availability, Maintainability (RAM) of Industry 4.0 in INDIAN perspective"** is associated with the digitalization of the Indian Industry, especially the Manufacturing and service sectors and their quality improvement. Industry 4.0 is referred to as the fourth industrial revolution, where the machinery is smart, i.e. different systems and subsystems of machines are connected through different sensors and actuators, and a seamless communication has been established among them for smooth operation. Such a system should be reliable enough for delivering better output as well as available for operation over a stipulated period. To operate such a system seamlessly, the management should have a vast knowledge of the different types of failures associated with the systems, modes and effects of failures, severities of failures, remaining life before the failures and adaptation of necessary maintenance strategies to overcome such failures. The prime goal of the research work is to provide a framework for better operation of a smart system and also to identify its probable faults and necessary maintenance tasks. Different works have already been carried out in this regard. Based on the limited scope, the research work has focused on three different domains. First one based on the theoretical architecture of a smart factory, where A layer-wise reliability and Availability analysis has been carried out using expert elicitation. The second study has considered a SMART Arsenic Iron removal plant (AIRP), where a Rough set-based Reference Ideal Method (R-RIM) has been implemented on the system for its Failure assessment. Based on the holistic failure assessment, the criticality of the failure Modes has been identified, and respective ranks have been assigned to them. Lastly, the sensitivity analysis has been conducted to analyse the effects of the criteria on the failure mode. The last case study has been taken from an Aluminium smelting plant, where a detailed study has been conducted on an IoT-based weight data communication system (WDCS), and based on its architectural overview, the potential faults have been identified, and a fault tree diagram has been constructed in this regard. Considering the uncertain environment, the Fuzzy fault tree (FFTA) analysis has been conducted for the reliability assessment of the system, and Reliability-centred Maintenance (RCM) has been implemented on the system for its reliability improvement. Secondly, the FFTA has been upgraded by incorporating the Fermatean-Fuzzy Set (FFS), and the combined approach has been applied for further reliability assessment, where superior results have been achieved. Based on the obtained results, a Bayesian Network (BN) has been constructed for fault diagnosis of the system and identification of the most critical subsystem. Based on the outcome, the Autoregressive Integrated Moving Average (ARIMA)

time series model has been implemented to predict the Remaining Useful Life (RUL) of the critical subsystem. In this study, only the RUL predicting equation has been developed.

Considering all the past and present research works, the prime aim has been set to implement the appropriate maintenance strategies as well as to improve the life of a system associated with Industry 4.0. Along with that, the reliability and availability assessment and their application in the maintenance policy have been structured in a single frame. The work has been carried out considering the Indian perspective for the well-being of the Indian society.