A STUDY ON RBM IN MANUFACTURING AND SERVICE SECTORS

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ABSTRACT

At current scenario of globalization in market more competition in manufacturing sectors. Productivity and quality are the most important crucial factors to be considered to take an edge in the market. Health and safety is one of the most important aspects of an Organization's smooth and effective functioning. For continuous production it is necessary to run the machines without any interruptions. This study is an effort to analyze the outcomes of Risk based maintenance (RBM) in manufacturing sectors. The case studies are taken from peer reviewed journals.

Keywords: Risk based maintenance (RBM), continuous production, quality, productivity, hazards

I. INTRODUCTION

A Risk Based Maintenance (RBM) is a risk assessment tool that can be used to assess which hazards pose the greatest risk in terms of how likely they are to occur and how great their potential impact may be. It is not intended to be used as a prediction tool to determine which hazard will cause the next emergency. Risk analysis approach incorporates probability and analysis at diverse stages of analysis. It assists in reducing machinery failure rate and managing actions priorities. This methodology consists of four modules namely Identification of Scope, risk assessment, risk evaluation and maintenance planning. This method cracks to answer the questionnaires like

• What can go wrong that could lead to system malfunction?

• How can it go incorrect?

• What would be the cost if it occurs?

Risk based maintenance methodology provides a tool for maintenance planning and decision making to reduce the probability of failure of equipment and the consequences of failure.

Identification of scope

The plant is separated into major systems, each system is separated in subsystems and the components of each subsystem are identified. Data required to analyze the potential failure scenarios for each system are collected.
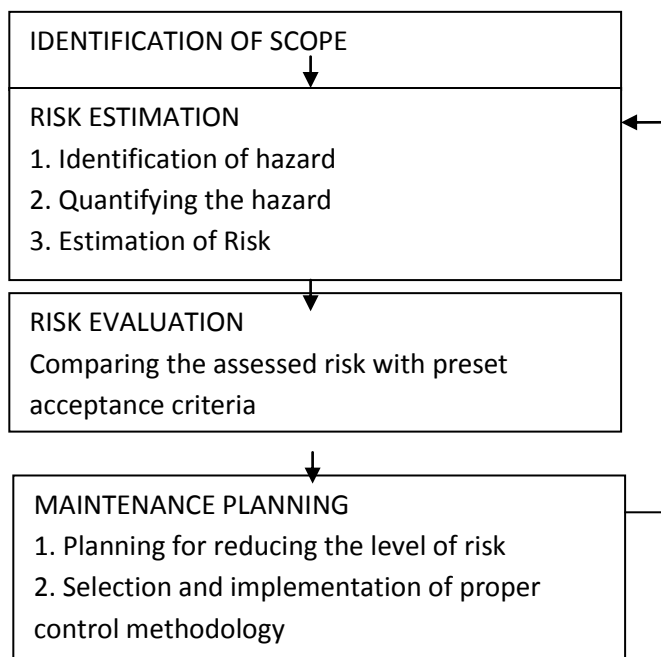
Risk assessment

Risk assessment starts with the identification of major potential hazards that each failure scenario may lead to a system failure. A fault tree is used to quantify the effect of the occurrence of each failure scenario.

Risk evaluation

A satisfactory risk measure is determined and used to decide whether the estimated risk of each failure scenario is acceptable or not.

II. METHODOLOGY

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IDENTIFICATION OF SCOPE
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RISK ESTIMATION
1. Identification of hazard
2. Quantifying the hazard
3. Estimation of Risk
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RISK EVALUATION
Comparing the assessed risk with preset
acceptance criteria
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MAINTENANCE PLANNING
1. Planning for reducing the level of risk
2. Selection and implementation of proper
control methodology
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Maintenance planning

A proper control methodology is projected to trim down the level of risk. To meet the projected level of risk the control methodologies for each failure scenario should be implemented.

III. RISK BASED MAINTENANCE IN CASE INDUSTRIES

EhsanArzaghi,Mohammad Mahdi Abaei, RouzbehAbbassi, VikramGaraniya, Christopher Chin and Faisal Khan (2017) [1] has focused the work on risk based maintenance to demonstrate the applicability of the methodology in subsea pipelines, three cases with different fatigue crack incidents on a pipeline are considered. The model will be able to determine whether the maintenance planning should be implemented or not based on the monitoring results. The revised methodology is developed based on the monitoring planning and results, the developed method can be adopted to integrate real life utility functions enables to apply the tool on industrial problems. The developed model can be readily used to incorporate the level of uncertainty of maintenance outcome.

R. M. Chandima Ratnayake and Katarzyna Antosz (2016) [2] have used Risk based maintenance methodology integrated with computer aided maintenance management system in a domestic usage plastic products manufacturing industry to overcome unexpected failures, the loss of production and higher maintenance cost.

Based on the assessment of hazards and risks, they developed a risk matrix to overcome the existing problems. They have suggested RBM approach together with fuzzy inference process which enables to minimize suboptimal calculations, when the input values are at the boundaries of the particular ranges. Based on their work, they concluded that future research shall be carried out to examine the potentiality for developing membership functions with the support of artificial neural network (ANN).

Kiran S., Prajeeth Kumar K.P., Sreejith .B And Muralidharan.M(2015) [3] in their work has used risk based maintenance and reliability evaluation in a cement plant to increase the performance of the machineries without compromising safety or environmental issues. Their work discusses the importance of evaluating reliability and risk of failure in planning a maintenance schedule and thereby improving availability of the plant and proposed a model for improving plant availability. They considered demonstrating the proposed model in the case of a material handling system in a cement plant. The calculated availability of the plant before implementing the model was 0.652. The recalculated availability after employing the risk based maintenance is 0.77. Based on their work, they concluded that an increase in availability of 12.3% can be achieved by applying risk based maintenance. Their work has proved the importance of reliability evaluation and maintenance planning in a process plant. The proposed model can be generalized for any process plant. The model suggested for carrying out the maintenance plan is effective in proposing a maintenance schedule.

Amin Moradkhani, Mahmoud R. Haghifam andSeyedMostafaAbedi (2015) [4] have used risk based maintenance integrated with reward penalty scheme introduced to motivate the distribution system operator to improve the efficiency and decrease the cost. Although the proposed system motivates the distribution system operator to increase the efficiency and cut their costs, they also lack incentives for service quality and reliability. In their work, the risk-based maintenance management method was presented. This method allows distribution system operators to consider financial risk, which arises from reward penalty scheme, in the maintenance scheduling. To show the practicality of the proposed methods, the maintenance of overhead line feeders of Dehloran was scheduled using the method proposed in this paper. The results show that the risk based maintenance management provides distribution system operators with various risk-profit scenarios according to their risk aversion degree.

AfshinJamshidi, Samira Abbasgholizadeh Rahimi, DaoudAit-kadi and Angel Ruiz (2015) [5], in their paper they have proposed a risk-based maintenance framework for prioritization of medical devices. In their study, the two main contributions are development of a comprehensive framework for prioritization of critical medical devices and proposing a method to select the best maintenance strategy for each device. Based on their work, the proposed approach offers strengths and main features such as possibility of converting traditional factors of the FMEA into quantitative and objective factors, based on economic aspects. In the proposed framework, several multidisciplinary experts can scale on both importance of criteria and evaluation of alternatives. A multidisciplinary team ensures that various opinions are taken into consideration. The proposed framework is able to consider both qualitative and quantitative criteria/sub criteria. The proposed framework produces precise and reliable prioritization results also it is able to select the best maintenance policy for each medical device based on its criticality. In future works,risk based maintenance software can be developed based on the framework to facilitate implementing the proposed frame-work in healthcare organizations.

Feargal Brennan (2013) [6], in his paper has focused on methodologies to optimize life-cycle costs using probabilistic risk based design, inspection and maintenance approaches for offshore wind support structures. In his work, has described the use of inspection reliability information in fitness-for-service and criticality assessments for offshore structures. The paper illustrates the use of probability of detection and confidence levels for predicting remaining life due to corrosion and fatigue and also how to incorporate sizing statistical performance characteristics of the inspection system into remaining life assessments. The results showed that probability of detection should be used within fracture mechanics based criticality or defect assessments following inspection irrespective of whether or not a defect is found. It is imperative that a probability of detection with a known confidence level is used and that the confidence level in the probability of detection estimate is always reported and levels of uncertainty should be calculated and reported quantitatively.

HaijunHua, Guangxu Cheng, Yun Li and Yiping Tang (2009) [7]have focused their work on risk based maintenance strategy for developing a cost effective maintenance plan to make financial safety improvements in a petrochemical system. They proposed an improved risk based maintenance approach based on the proportional age reduction model and they estimated the parameters of the failure distribution and maintenance effect of equipment using maximum likelihood estimation. They have applied the improved risk based maintenance approach to the reforming reaction system in Sinopec's Luoyang Petrochemical Plant. They have assessed the risks using the improved model and used risk criteria to schedule maintenance to save capital and guarantee safety. The results show that most equipment in the system is improperly repaired and three subsystems have intolerable risks. Based on their work, it is of benefit to the implementation of RBM strategy in various industries when equipment maintenance is not always perfect.

IV. CONCLUSION

Risk based maintenance methodology has been used in the manufacturing industries like automotive part manufacturing, wind support structures, cement manufacturing plant. In one of the papers the risk based maintenance is used for safety level improvement. Risk based maintenance methodology also has been used in the service industries like hospital and educational institute. There is also thorough literature review done by many authors on the risk based maintenance methodology. From the literature review conducted it was found that there is not sufficient work carried out using risk based maintenance in a steel industry especially in continuous casting processes. Thus there is a scope to use risk based maintenance tools for hazard and risk assessment in a steel industry undertaking continuous casting processes. By using these RBM tools hazards and risks can be assessed and reduced in the steel industry. Also by reducing the risks the availability of the machineries can be increased and it will leads to the improvement in the productivity.

V. REFERENCES

[1] EhsanArzaghi, Mohammad Mahdi Abaei, RouzbehAbbassi, VikramGaraniya, Christopher Chin and Faisal Khan (2017) "Risk-based maintenance planning of subsea pipelines throughfatigue crack growth monitoring" Engineering Failure Analysis 79 (2017) 928–939

[2] R.M.ChandimaRatnayake and KatarzynaAntosz (2017) "Development of a Risk Matrix and Extending the Risk-based Maintenance Analysis with Fuzzy Logic" 7th International Conference on Engineering, Project, and Production Management, Procedia Engineering 182 (2017) 602 – 610

[3] Kiran S., Prajeeth Kumar K.P., Sreejith B.and Muralidharan M. (2016) "Reliability evaluation and Risk based maintenance in a process plant" International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015),Procedia Technology 24 (2016) 576 – 583

[4] Amin Moradkhani, Mahmoud R. Haghifam and SeyedMostafaAbedi (2015) "Risk-based maintenance scheduling in the presence of reward penalty scheme" published by Electric Power Systems Research 121 (2015) 126–133

[5] AfshinJamshidi, Samira AbbasgholizadehRahimi, DaoudAit-kadi and Angel Ruiz (2015) "A comprehensive fuzzy risk-based maintenance framework forprioritization of medical devices" published by Applied Soft Computing 32 (2015) 322–334

[6] Feargal Brennan (2013) "Risk Based Maintenance for Offshore Wind Structures"   2nd International Through-life Engineering Services Conference, Procedia CIRP 11 (2013) 296 – 300

[7] Haijun Hu, GuangxuCheng, Yun Li and Yiping Tang (2009) "Risk-based maintenance strategy and its applications in a petrochemical reforming reaction system" Journal of Loss Prevention in the Process Industries 22 (2009) 392–397

[8] FaishalI.Khan, Mahmoud M.Haddara,"Risk – based maintenance (RBM): a quantitative approach for maintenance/inspection scheduling and planning,Journal of loss prevention in the process industries 16(2003)561-573

[9] Lognathankrishnasamy, Faisal khan, Mahmoud Haddara,"Development of a risk –based maintenance (RBM) Strategy for a power – generating plant, Journal of loss prevention in the process Industries 18 (2005) 69-81

[10] Aymen Mill, Samuel Bassetto, Ali siadat , Michel Tollenaere, Dynamic risk management unveil productivity improvements , Journal of loss prevention in the process Industries 22 (2009) 25-34

[11] RobertasAlzbutas, Roman Voronov, Reliability and safety analysis for systems of fusion device, Fusion Engineering and design 04(2015)31-41

[12] Zurainijusoh , NoristisarahAbd shatter , HayatiAdilinMohd , NurDalilaAdenan, Determination of hazard in captive Hotel laundry using semi Quantitative Risk Assessment Matrix Procedia- social and Behavioral Sciences 222 (2016) 915 - 922