



Study of the Product Failure Modes and Effects Analysis (PFMEA) on Welding Process- A Review

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ABSTRACT: The success of any organization depends on the quality of product especially right product produced because of manufacturing defects or errors are always the key concerns of any manufacturing industry. One of the successful tools for finding the failure mode and its effect in manufacturing process is PFMEA (Product failure mode effect analysis). By PFMEA we can find out how critical the process is and we can take action to reduce the failure in product and improve the manufacturing process.



An attempt is made in the present paper to provide a brief review of the Product Failure Modes and Effects Analysis (PFMEA) of welding to improve product quality. After the complete study of the manufacturing process and production data – failure causes, failure rate, & other relevant data etc., FMEA discovered the weak processes in the form of higher risk priority number in the manufacturing of product, which required reducing by identifying and implementing mitigation actions and this will improve the process and product quality & productivity.

Keywords-- Quality improvement, FMEA, PFMEA

INTRODUCTION

Failure mode and effects analysis (FMEA)—also "failure modes," plural, in many publications—was one of the first highly structured, systematic techniques for failure analysis. It was developed by reliability engineers in the late 1950s to study problems that might arise from

malfunctions of military systems. An FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded in a specific FMEA



worksheet. There are numerous variations of such worksheets. An FMEA can be a qualitative analysis, but may be put on a quantitative basis when mathematical failure rate models are combined with a statistical failure mode ratio database.

Failure Modes & Effects Analysis

The Failure Modes and Effects Analysis (FMEA), also known as Failure Modes, Effects, and Criticality Analysis (FMECA), is a systematic method by which potential failures of a product or process design are identified, analyzed and documented. Once identified, the effects of these failures on performance and safety are recognized, and appropriate actions are taken to eliminate or minimize the effects of these failures. An FMEA is a crucial reliability tool that helps avoid costs incurred from product failure and liability.

The FMEA process is an on-going, bottom-up approach typically utilized in three areas of product realization and use, namely design, manufacturing and service. A design FMEA examines potential product failures and the effects of these failures to the end user, while a manufacturing or process FMEA examines the variables that can affect the quality of a process. The aim of a service FMEA is to prevent the misuse or misrepresentation of

the tools and materials used in servicing a product.

The failure mode that describes the way in which a design fails to perform as intended or according to specification;

- The effect or the impact on the customer resulting from the failure mode; and
- The cause(s) or means by which an element of the design resulted in a failure mode.

It is important to note that the relationship between and within failure modes, effects and causes can be complex. For example, a single cause may have multiple effects or a combination of causes could result in a single effect. To add further complexity, causes can result from other causes, and effects can propagate other effects.

LITERATURE REVIEW

The main focus of literature survey is to understand the process of PFMEA implementation, major implementation issues and to identify the scope for improvement in PFMEA implementation. The study covered many PFMEA works undertaken so far world over.

Tejaskumar S. Parsana and Mihir T. Patel(2014) attempted to present an effective tool for solving the problem of manufacturing process quality by



executing process FMEA with proposed process control practices. This paper aims to identify and eliminate current and potential problems from a manufacturing process of cylinder head in the company through the application of Failure Mode and Effects Analysis (FMEA) for improving the reliability of sub systems in order to ensure the quality which in turn enhances the bottom line of a manufacturing industry. Thus the various possible causes of failure and their effects along with the prevention are discussed in this work. Severity values, Occurrence number, Detection and Risk Priority Number (RPN) are some parameters, which need to be determined. Furthermore, some actions are proposed which require to be taken as quickly as possible to avoid potential risks which aid to improve efficiency and effectiveness of cylinder head manufacturing processes and increase the customer satisfaction. The prevention suggested in this paper can considerably decrease the loss to the industry in term of both money time and quality.

Riddhish Thakor, RajatDave, Teja Parsana (2015) attempted to represent the potential tool for evaluates the problem of manufacturing process by implementing the process FMEA. This study has a goal to concentrate and eliminate the potential

problem for manufacturing process of bearing in company through executing the Failure Mode and Effect Analysis. Various possible causes of failure and their effect of sub system has been evaluated for improving the reliability of the product as well as bottom line of the manufacturing can be improved. Process FMEA having some parameters needed to define which are Severity values, occurrence number, Detection and Risk priority Number (RPN). On the basis of the parameters some of the suggestions are proposed for avoiding the possible risk and ultimately decrease the loss to the industries in terms of money, time and quality

Swapnil Ambekar, AjinkyaEdlabadkar, VivekShrouty(2013) argued that quality and reliability of products and manufacturing processes are critical to the performance of the final products. They are also important indices for meeting customer satisfaction. In order to fulfill customer's requirements for quality and reliability, some actions for assuring the quality and reliability of products or processes should be taken by all the persons involved. One of the most powerful methods available for measuring the reliability of products or process is FMEA. Probably the greatest criticism of the FMEA has been its limited use in



improving designs. Customers are placing increased demands on companies for high quality and reliable products. FMEA provides an easy tool to determine which risk has the greatest concern and therefore an action is needed to prevent a problem before it arises. The development of these specifications will ensure the product will meet the defined requirements. Before starting the actual FMEA, a worksheet needs to be created, which contains the important information about the system, such as the revision date or the names of the components. On this worksheet all the items or functions of the subject should be listed in a logical manner. The initial output of an FMEA is the prioritization of failure modes based on their risk priority numbers and this alone does not eliminate the failure mode. Additional action that might be outside the FMEA is needed. This paper will definitely enhance the knowledge of researchers who really want to carry their research in this area.

Mehrzad Ebrahemzadih, G. H. Halvani, Behzad Shahmoradi, Omid Giahi1(2014) assess potential hazards by failure modes and effect analysis (FMEA) method in Yazd Steel Complex. Methods: In this descriptive study, we evaluated the risks in different parts of the complex by using FMEA method and by using FMEA

Worksheets (PFMEA) derived from the standard (MIL_STD-882). Failure modes and the various components and effects as using quantitative score to the risk priority (RPN) were obtained. PFMEA worksheets were completed and, we reevaluated the weaknesses part of the system. Activities related to each from the different parts of Yazd Steel Complex by using the scores risk priority (RPN) were evaluated. Then the results obtained by using SPSS software were performed by evaluation and analysis. Results: The findings showed that the steel maker lime unite and steel making ingot casting achieved the highest of RPN before and after corrective actions measures (490, 168) and environmental health unite and roll styles unite achieved the lowest of RPN before and after corrective actions measures (28, 20). Conclusions: The results show that the FMEA technique can identify a higher number of hazards than any other technique. The important point is that selection of an appropriate technique plays an important role in identifying a higher number of hazards

RACHIERU Nicoleta , BELU Nadia and ANGHEL Daniel Constantin (2013) indicated that the application of fuzzy PFMEA method can solve the problems that have arisen from traditional FMEA,



and can efficiently discover the potential failure modes and effects. It can also provide the stability of product and process assurance. The fuzzy PFMEA approach might be helpful to the management processes. In all the management processes in manufacturing areas it is quite possible to use this tool successfully.

Parikshit K patel, Prof. Vidya Nair, Ashish Patel (2013) did work on a small blow moulding company, which manufactures the Air duct for automobile air conditioners. The initial research shows the past trends of rejection is between 8-9% which includes human error in material removal, wrong fitting of clamp, molding defects, etc. the need is to reduce that to compete in highest competitive market and to continuous satisfaction of customer. One of the successful tool for finding the failure mode and its effect in manufacturing process is PFMEA (Product failure mode effect analysis). By PFMEA we can find out how critical the process is and we can take action to reduce the failure in product and improve the manufacturing process. After the complete study of the manufacturing process and production data – failure causes, failure rate, & other relevant data etc, FMEA discovered the weak processes in the form of higher risk priority number in the

manufacturing of product, which required reducing by identifying and implementing mitigation actions and this will improve the process and product quality & productivity

Shivakumar K M, Hanumantharaya R, Mahadev U M, Kiran prakasha A(2015) determined the risk associated with defects in the injection moulding process using FMEA method and reduce the defects to ensure that the same kind of defects should not arise in the future. Thereby reducing the total cost of production and increasing customer fulfilment. They found that After implementation of FMEA the RPN value has been reduced for each of the defect And the defects are reduced from 48,540 to 31,160 per month and total cost associated with the defects is reduced from 1,20,000 Rs to 77,900 Rs .

Rohit Ravasaheb Shinde, Ramakant Shrivastava, Rupesh B. Morey(2015) made use of Failure Mode Effect Analysis (FMEA) to adopt the innovative technologies integrated with the operational aspects in order to enhance the process capability. The main objective of the study is to improve machinery system reliability and its performance. They applied FMEA approach to capability enhancement. FMEA tend to give the importance to the prevention efforts, at



point combined technical solution and operational precautions are proposed to prevent or decrease the probability of affecting machine performance. Besides specific attempts to analysis capability improvement, the main task behind this paper is to express integrity of operational precautions and process technology in order to produce optimal solutions for process capability enhancement for whole BUSH manufacturing process.. Therefore improving the process system reliability and enhancing operational safety concept and for pressing, facing and grinding machine. In addition to this, in this paper it is seen that FMEA is an adequate risk management tool in order to prevent the problems. As in the study ram speed, pre knuckle bending pressure, bending punch and die selection, bending method, grinding compensation, grinding compensation interval, dressing interval, cutting speed ratio, clamping pressure, work head rpm ,facing machine setting , lapping of tool and tool wear measurement are the crucial inputs to improve the process capability index of BUSH manufacturing process

Sharad S. Pawar, Dr. W. S. Rathod (2013) aimed to identify and eliminate potential and current problems from a manufacturing process of mixed model

assembly line in automobile industry through the application of failure mode and effect analysis (FMEA).A Process Failure Mode Effect Analysis (PFMEA) is a analytical tool used by an organization ,business unit to identify and evaluate the potential failures of a process .PFMEA helps to establish the impact of the failure ,and identify and compute the action items with the goal of mitigating risk. It is a dynamic document that should be initiated before process of production and maintained through the life cycle of the product. In this some parameters needed to define such as severity values ,occurrence number ,detection and risk priority number (RPN).Furthermore ,some actions are proposed which require to be taken as quickly as possible to avoid potential risks which aid to improve efficiency. Thus the various possible causes of failure and their effects along with the prevention are discussed in this work.

Aravinth .P, Subramanian .S.P, Sri Vishnu .G, Vignesh .P(2012) In their work, process failure mode and effect analysis is done on general TIG welding process. A series of welding with different sample pieces are done and the potential failures and defects of the work piece are categorized based on FMEA, risk priority numbers are assigned to each one and by



multiplying the ratings of occurrence, severity and detection. Finally the most risky failure according to the RPM numbers is found and the cause and effects along with the preventive measures are tabulated. This work serves as a failure prevention guide for those who perform the welding operation towards an effective weld.

CONCLUSION

Above study clearly reflects the use of PFMEA process in the industry. Some more effective results can be obtained after the detailed study of this process. Details of literature survey conducted on FMEA technique indicates that it is widely applied in several sectors and countries. Particularly reading of the bibliography literature review on Fuzzy FMEA presented by Wang et al (2009) and survey of the application of fuzzy set theory presented by Wong and Lai (2011) reveal FMEA's widespread application and research. On the whole, the results of this literature survey indicated the need to develop a new method to suit appropriate applications which have its foundation in FMEA.

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