The Priority Order and Sensitivity Analysis of Mechanical System Failure Mode Improvement Based on Computer-aided Technology

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Abstract. Failure mode is an analysis method used to determine potential failure modes and their causes. Specifically, through the implementation of FMEA, the weaknesses of the product can be found before the product design or production process is truly realized, and the product defects can be determined at the prototype stage or before mass production. FMEA is the first set of analysis mode formed by NASA. FMEA is a practical method to solve problems, which can be applied to many engineering fields. At present, many automobile manufacturers and electronic manufacturing service providers (EMS) in the world have adopted this mode to manage and monitor the design and production process. In the product design stage and process design stage, it is a systematic activity to analyze each process one by one, find out all potential failure modes, based on computer analysis of its possible consequences, and take necessary measures to improve product quality and reliability.

Keywords: Mechanical System, Improve, Analysis, Failure Mode, Computer-aided Technology

1. Objective

Through the analysis of the potential failure modes in the product design process and manufacturing process, the causes and mechanism of their occurrence, and the evaluation of their risk degree, the necessary measures shall be taken for the failure modes with large risk sequence to prevent the occurrence of failure modes. If the customer has special requirements, the implementation shall be in accordance with the customer's requirements.

2. Working procedure

Sequence the frequency, severity and detection level of the event: Product severity refers to the impact of possible failure modes of products on product sales and outsourcing. Generally speaking, the tenth degree is the most serious and the first is not serious. According to the theory of logistics, the frequency of severe events of products should be recorded as the specific cause and probability of...
occurrence. If it is 10, it means that it is almost certain to happen, and the process capacity is 0.33 or ppm is greater than 10000\(^1\).

2.1. Evaluate the probability of the proposed process control detection failure mode

If it is showed in figure 1, it indicates that it cannot be detected, it indicates that it has passed the defect detection of the current process control. Calculate the risk priority number, RPN. RPN is the product of event frequency, severity and detection level, which is used to measure possible process defects, so as to take possible preventive measures to reduce key process changes and make the process more reliable. First of all, the process correction should focus on the most concerned and the most risky links. According to the relevant theoretical analysis, the worst case value of RPN is 1000, and the best case value is 1. The best way to determine where to start is to use the Pareto chart of RPN to screen projects with cumulative levels below 80\%. Recommend responsible solutions and completion dates. The ultimate goal of these recommendations is to reduce one or more levels. For some serious problems, rescue plans should be considered from time to time, such as the failure mode impact of a product with a risk level of 9 or 10; the occurrence and severity of a failure mode / cause event of a product with a high RPN value, etc\(^2\). After all rescue measures are determined and implemented, during the implementation period, the enterprise allows this working mode to have a stable period. After the stabilization period, enterprises need to reconsider the frequency, severity and detection level of revision events, and rank them\(^3\).

![Figure 1. An example for EFMEA model.](image)

![Figure 2. Set up EFMEA Team.](image)

3. An example of FMEA analysis of mechanical products

Compared with the main content of computer network auxiliary work, people believe in the information of new products that they see with their own eyes. Each unique mechanical system has its own unique production mode and working mode. After these models are brought into the content of the work, enterprises can set up relevant problem solving groups. These groups can be dedicated to solving mechanical system failures. The members of different groups can be centralized by the internal members of the company. In fact, the first solution to the problem of mechanical failure refers to the establishment of the manufacturing process of the product. This process should include the quality control of the product, the specific effect of the product and the final form of the product. These three ways are the basis of mechanical system failure.

The internal personnel of an enterprise can allocate the tasks of members in the group through the mode of meeting. The first step can be the view and inspection of mechanical process drawing. Through the process drawings, experts can find the key causes of mechanical system failure. The second step is to inspect the whole production line. Although one machine is good, others may have
been damaged. In this case, the product line can not work normally. The third step can be the daily wear analysis of the machine. The calculation of fatigue strength and labor wear are good methods to correct mechanical failure. In theory, the team that can solve the failure problem of mechanical system is also called FMEA team. This is also the honorific title of this team.

4. FMEA follow up activities

After the overall structure of the new product is imported, the enterprise can hold a follow-up meeting of FMEA to assess and screen the follow-up tasks. The content of the meeting should consider the overall structure of the new product introduction, the control of the existing process and the quality report. The FMEA team reordered the rps. In each step, the first three defects are considered, and the recommended scheme, responsibility and target completion date are determined. Check screen printing accuracy and placement accuracy of pick and place machines. For tombstone defects, check the screen printing accuracy and the placement accuracy of pick-up and place machines; check the return direction; research terminal. Possibility of contamination[4]. According to the Research Report of process engineer, the rapid rise of reflow temperature is the main cause of solder ball defect. Pollution is the possible cause of tombstone defects. Therefore, a design experiment (DOE) is established for the next design validity verification test structure. The design experiment shows that a supplier's components are more likely to have tombstone defects, so the supplier is required to make further investigation and correction. Any changes to product design, application, environmental materials and production assembly process must be updated in the corresponding FMEA documents. FMEA update meeting is a daily activity before mass production of products. The projects that are not questioned in the FMEA stage are naturally kept on the site of mass production. Pick and place machine accuracy is a major consideration after the process audit[5]. The equipment department must verify the CP / CPK of the layout machine and conduct training to deal with the wrong printed circuit board. The FMEA team needs to closely monitor the first trial production, and the quality verification of the production line should be carried out at the same time. After the trial production, FMEA needs to hold a meeting to check the existing quality control and trial production quality report, mainly to solve the first three problems in each link.

5. Conclusion

Identify risks in early projects using a computer FMEA management model can help mechanical equipment manufacturers improve production capacity and efficiency, and shorten the time to market of products[6]. In addition, through this mode, all sorts of experts can test the production process from all angles, so as to improve the production process. The recommended scheme should be correct correction, and the benefit is considerable. So as to avoid defects, the process and design need to be changed. The production process was studied using computer-aided statistical methods, and constantly feed back to the appropriate personnel to ensure the continuous improvement of the process and avoid defects.

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