New trends by FMEA

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Abstract

Technological progress has brought a large amount of complex machinery into the work processes, which represents a potential source of serious injuries, accidents, or breakdowns. An important step towards the achievement of the organizations safety is the adoption of adequate strategy and security policy.

The aim of the monograph is to follow new trends in the FMEA (Failure Mode and Effect Analysis) and their use in our study. We have chosen the Turning Machine Doosan V-Puma Doosan PUMA V550R Machining Centre with manufacturing diameters and mechanical machining operations. We have created the FMEA team, which participated in the entire evaluation and analysis. We identified possible failures and causes of failures in the given operations. We applied the conventional PFMEA and identified the RPN risk number. Then we added the costs of failures to the method and applied Extended FMEA (EFMEA). After determining the costs and calculations, we identified the ERPN risk number. We compared the individual methods (PFMEA - EFMEA) and we also compared the proportion of failures in total risk generation (RPN - ERPN). We proposed measures. We also used DEMATEL model (Decision-Making Trial and Evaluation Laboratory). Using DEMATEL matrices, we identified a binding between the individual failures and the causes of the failures. Some failures will become the main cause of other failures and the causes of the failures; some arise as a result of other failures or causes of failures. Finally, we evaluated the applicability of individual methods and models. The ERPN, in contrast to the conventional FMEA, specifies the risk number. In conventional FMEA, we often think about the severity, occurrence, and detection parameters of risk number generation. After including the costs necessary for elimination of the failures and costs arising from malfunctions, we have obtained another risk prioritization. By the DEMATEL model we clarified the significance and bindings between individual failures. We recommend using these methods and models when applying the FMEA method in manufacturing organizations of the manufacturing process.

Key words: FMEA, RPN, ERPN, DEMATEL, Safety, Quality

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INTRODUCTION

In everyday life we assess a risk in a lot of situations, e.g. we assess (unconsciously?) the risk of being run down before we cross the street, the risk that it will rain before we leave home on our bike or the risk in connection with the investments that we make. Almost all decisions in society and in our lives are based on a risk assessment which is then weighed against the benefit which is a result of this assessment.

Industry globalisation and consolidation, product complexity and the increasingly sophisticated requirements of customers were already leading to a greater emphasis on ensuring that losses were not incurred due to adverse market conditions, counter party failure, or inappropriate controls, systems or people.

Risk management is based on so-called quadrangle or 4M. This abbreviation is based on English (machine - material - man - medium) or German (Maschine - Material - Mensch - Mittel). "In our language" we are talking about the interaction between machine - material - man - environment. If an organization has an ISO 9001 (Quality Management System) certificate, it must manage the risks at all levels of the organization. This also applies to standards and legislation, partly mentioned in our monograph. Risk management provides protection mainly from the point of view of machine safety, safety and health at work and prevents environmental pollution. Last but not least, it is also a tool for achieving higher quality end products, the main consumer of which is each of us - as a customer. Customer satisfaction is very important as well as the satisfaction and safety of people involved in the production.

Risk management is formally defined as the process by which an organization assesses and addresses its risks. Historically, the role of risk management has been associated with insurance-buying, occupational safety and health, and legal liability management. In recent years managers and physicians alike have begun to recognize that organizational risks are pervasive, that these risks are extraordinarily diverse and complex, and that these risks are not just confined to "insurable" or accident-related situations.

A risk assessment is not only an important step in ensuring a safe and healthy work environment, it is a legal requirement. It needs to be conducted before employees complete their work on current, new or unknown parts, processes or materials. We must consider possible causes of harm and what steps to take in preventing the harm in the first place. If our business has less than 5 employees, we don’t have to document anything but we must have considered hazards and control measures.

Risk management is the identification, assessment, and prioritization of risks (defined in ISO 31000 as the effect of uncertainty on objectives) followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. Risk management’s objective is to assure that uncertainty does not deviate the endeavour from the business goals.

Action plans begin by preventing risks or reducing the impact of identifiable risks. This ensures the use of correct materials instead of cheap substitutes during a production process. There could be a need to change suppliers or subcontractors. Contingency plans must be put in place for those risks that cannot be prevented, mostly accidents or natural disasters. These will include fire-fighting, flood prevention and emergency evacuation procedures.

We use many risk management methods for risk analysis. The methods are mainly divided according to the method of analysis used. We use qualitative methods (Checklist ...), semi quantitative methods (FMEA, HAZOP, risk matrix, PHA ....) and quantitative methods (FTA, ETA, CPQRA ...).

Failure Modes and Effects Analysis (FMEA) is the methodology for analysing potential reliability problems early in the development cycle where it is easier to take actions to overcome these issues, thereby enhancing reliability through design. FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. A

crucial step is anticipating what might go wrong with a product. While anticipating every failure mode is not possible, the development team should formulate as extensive a list of potential failure modes as possible.

The early and consistent use of FMEAs in the design process allows the engineer to design out failures and produce reliable, safe, and customer pleasing products. FMEAs also capture historical information for use in future product improvement.