ABSTRACT

During the recent years, foundries have been functioning under the globally competitive environment. Hence foundries are required to enhance their performance to offer world class quality products and services. Seldom efforts are made in foundries to achieve this imperative. On the other side, in order to achieve this imperative, several strategies are adopted by different kinds of companies situated in various parts of the world. One of those strategies is failure prevention. According to this strategy, failures are identified and analyzed and then their causes are pinpointed so that failure recurrence is prevented in future. In order to carryout these tasks, researchers and practitioners deploy frequently the technique called Failure Mode and effects Analysis (FMEA). Although, many researchers have reported the achievement of failure prevention through the application of FMEA, some drawbacks of it have been reported in literature arena. One drawback is that, FMEA is too general that it cannot be applied effectively in specific industries like foundry.

After simultaneously observing the power and deficiencies of FMEA technique, researchers have been developing the modified versions of FMEA. All these new versions are depending on experts’ opinions to enable the
FMEA for aiding the organizations to meet world class quality requirements. As the experts’ opinions are subjective in nature, an approach is required to be adopted for reducing the fuzziness occurring in them. Hence it has become the need of the hour to incorporate fuzzy logic in the FMEA technique. In order to fulfill this need and also after realizing the absence of a modified FMEA for achieving failure prevention exclusively in foundries, a modified FMEA model named Failure Effects And Resolution Of Modes (FEAROM), was developed during the doctoral work reported in this thesis.

This doctoral work was started by studying the various modified FMEA models developed by earlier researchers by referring to the literature. After this, three different private steel foundries located in Coimbatore city of India were visited to study the foundry practices adopted in practice. By utilizing the theoretical and practical knowledge gained from literature and foundry arenas respectively, the FEAROM model incorporated with fuzzy set was designed. Then, the FEAROM model was subjected to application in the above mentioned three foundries. In one foundry, investment casting method is adopted. In other two foundries, CO₂ sand casting method is followed. Finally experiences of applying FEAROM in three foundries were analyzed and thus the practicality of the FEAROM model was investigated.
Currently in the traditional foundries, mould designs are examined by applying trial and error based approach. According to this approach, a mould design is made on receiving the drawing of the component whose casting is to be produced. This mould design is applied in the foundry practice. The castings produced using this mould design are examined. Based on the result of this examination, the mould design currently used is refined and modified to produce a new mould design. The new mould design thus obtained is subjected to again examination. This cycle continues till optimality in the mould design is achieved. This approach consumes longer time and high cost towards obtaining a mould design that will aid to achieve continuous quality improvement and productivity enhancement in the production of castings in foundries. This deficiency is overcome by carrying out the doctoral work reported in this thesis which has resulted in the contribution of FEAROM model.

FEAROM model is incorporated with fuzzy subset that enables the consideration of uncertainty while quantifying the indices namely S, O and D. Besides a procedure for validating the FEAROM model was developed. This procedure has been incorporated with the MFTOPSIS method hybrid with AHP. This MFTOPSIS method hybrid with AHP contributed in this doctoral work facilitate to check the validity of the FEAROM model. Thus, the decision making under multi-criteria situations has been made possible by making use of FEAROM model for choosing the best mould design by
consuming least time and cost. On the whole, it is stated that, FEAROM model will facilitate the foundry engineers and managers to choose the best mould design that will aid in achieving continuous quality improvement and productivity enhancement in the case of producing castings in foundries.