# A Perceptual Computing-based Method to Prioritize Failure Modes in Failure Mode and Effect Analysis and Its Application to Edible Bird Nest Farming

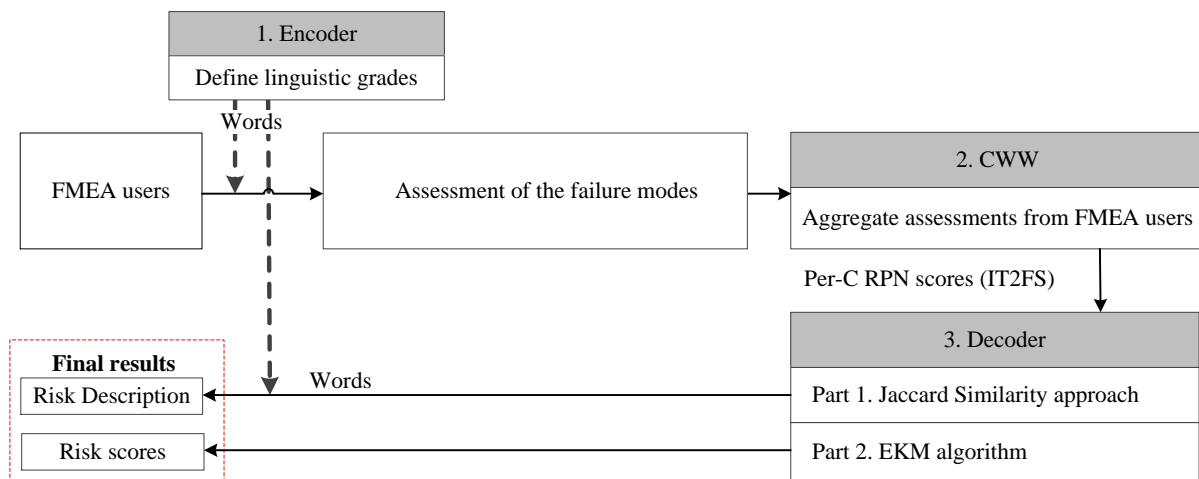[1][*]Kok Chin Chai, [2]Chian Haur Jong, [1]Kai Meng Tay, [3]Chee Peng Lim

[1]Faculty of Engineering, Universiti Malaysia Sarawak, Sarawak, Malaysia

[2]University College of Technology Sarawak, Malaysia

[3]Institute for Intelligent Systems Research and Innovation, Deakin University, Australia

Email: [*]kcchai@live.com

Graphical Abstract



The proposed Per-C-RPN model

Highlights for review

- A new RPN model based on Perceptual Computing is proposed.

- Linguistic uncertainties pertaining to group decision making in FMEA are considered.

- Providing RPN scores in both numerals and linguistic words.

- A better insight pertaining to the risk of a failure mode is provided.

- A case study related to edible bird nest farming in Borneo Island is reported.

**Abstract-** A Failure Mode and Effect Analysis (FMEA) procedure that incorporates a novel Perceptual Computing (Per-C)–based Risk Priority Number (RPN) model is proposed in this paper. The proposed model considers linguistic uncertainties and vagueness of words, because it is more natural to use words, instead of numerals, for an FMEA user to express his/her knowledge when he/she provides an assessment. Therefore, it is important to consider the inherited uncertainties in words used by humans for assessment as an additional risk factor in the entire FMEA reasoning process. As such, we propose to use Per-C to analyze the uncertainties in words provided by different FMEA users. There are three potential sources of risks. Firstly, the risk factors of Severity ($S$), Occurrence ($O$), and Detection ($D$) are graded using words by each FMEA user, and indicated as interval type-2 fuzzy sets (IT2FSs). Secondly, the relative importance of $S$, $O$, and $D$ are reflected by the weights given by each FMEA user in words, which are indicated as IT2FSs. Thirdly, the expertise level of each FMEA user is reflected by words, which are expressed as IT2FSs too. The proposed Per-C-RPN model allows these three sources of risks from each FMEA user to be considered and combined in terms of IT2FSs. A case study related to edible bird nest farming in Borneo Island is reported. The results indicate the effectiveness of the proposed model. In summary, this paper contributes to a new Per-C-RPN model that utilizes imprecise assessment grades pertaining to group decision making in FMEA.

Keywords: Perceptual computing, Failure Mode and Effect Analysis, Edible bird nest, Interval type II fuzzy sets, Linguistic uncertainties, Computing with words, Group decision making

## 1. Introduction

Failure Mode and Effect Analysis (FMEA) is an effective methodology for determining the postulated component failures/errors of a process, system, or design [1]. In