

Chapter 12

Benchmarking of Advanced Manufacturing Machines Based on Fuzzy–TOPSIS Method

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ABSTRACT

The evaluation of the most appropriate Computer Numerical Control (CNC) machine tool is found foremost issue for sustaining the advanced manufacturing production units at competitive global market place. In last years, many evaluation parameter/ criteria/ issues (i.e. Cost [C], Tool Length [TL], Tool Diameter [TD], Metal Removal Rate [MRR], X-Y-Z-Axis Movement of Tool [AMT], etc.) carried out into account besides productivity, precision, accuracy, reliability etc prior to purchasing/electing CNC machine tools amongst preferred alternatives. This chapter exhibited a hypothetical case research pertaining to election of CNC machine tool under the qualitative parameter/criteria/issues excluding quantitative, where, subjective (qualitative) criteria are considered beside objective (quantitative) criteria and complexity to elect the best CNC machine tool is solved via subjective assessments of expert's panel also called the group decision making. In present research, TOPSIS algorithmic technique conjunction with Trapezoidal Fuzzy Number set (TFNs) is explored for appraising and benchmarking the preferable CNC machine tool options/ alternatives. Finally, a hypothetical case research is carried out to check the validity of proposed algorithmic technique for proposed module and exhibit the path for benchmarking alternative machine tools. The preferences orders are carried out in accordance with descending value of the 'collective index'. Higher value of 'collective index' reflects higher degree of performance.

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AT A GLANCE

The proposed chapter serves a Fuzzy-TOPSIS (Technique for order Preference by Similarity to Ideal Solution) approach towards learners to solve their real life problems i.e. appraisal, evaluation and benchmarking of Cars, Buses, Trucks, Plant Layouts, Aero Planes, Material Handling Equipments, Robots etc in the context of Multi-Criteria Decision Making. Apart from this, many dilemmas pertaining to advanced and traditional manufacturing realms can be solved with short computing by exploration of proposed Fuzzy-TOPSIS methods in empire of MCDM. The proposed chapter dealt with application of Fuzzy-TOPSIS to solve computer numerical control advanced manufacturing machine tool evaluation and benchmarking problems.

INTRODUCTION: DECISION MAKING

Decision making is actually insightful when considering single criteria problems, since the personnel solely need to elect the alternative/ choices in accordance with highest preference ratings. However, when expert's panel evaluate alternatives under multi criteria, then many problems such as significance (importance) against criteria, preference dependence, and conflicts amongst criteria take an occurs. Then, problems are seemed difficult to be beaten by more complicated techniques.

PREVALENT OVERVIEW ON MULTI-CRITERIA DECISION MAKING

Multi-Criteria Decision Making is the well renowned branch of decision making. It is a division of a common class of Operations Research (OR) models, which deal with decision making problems under chain of multiple criteria. MCDM also deals with economic theory (cost/benefit analysis), applying mathematical modeling in attempts to support decision making involving tradeoffs. MCDM received winning journey, as it deals with a so difficult problems such as evaluation of more economic alternative amongst preferred alternatives under chains of multiple criteria.

Prevalently, MCDM is concerned with structuring and solving decision and planning problems involving multiple criteria. The agenda of MCDM is to support decision makers, facing problems i.e. evaluation of more economic alternative amongst preferred alternatives under chains of multiple criteria. Usually, MCDM does not bring a unique optimal solution for such problems in case of using decision maker's preferences. MCDM bring a unique optimal solution for such problems in case of using experimental / observed data. It could correspond to choose the 'best' alternative from a set of available alternatives.

Decision Making (DM) is divided into two parts: Multi-Objective Decision Making (MODM) and Multi-Criteria Decision Making (MCDM). In MODM, the perusals / learners studies about decision problems in which the decision space is continuous. A classical example is mathematical programming problems with multiple objective functions. While, in MCDM the perusals / learners studies as to decision problems with discrete data. In these problems, the set of decision alternative is predetermined. But, it is indeed necessary in order to understand the meaning of both term i.e. alternatives and criteria, which are the core terms of MCDM.

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