Selection selection of appropriate mcdm from a

Business, Decision Making

Selection of materials in engineering design have vital role.

Choice of relevant material for particularproduct is major task for designers. In this paper we are using Multi Criteria Decision Making (MCDM)TOPSIS tool for selecting the material for the designing of powered hand truck. The suitable fivematerials (SS 304, AISI 1010, AISI 1020, Al 6061-T6, Al 5052-O) are taken into consideration and withattributes as 5 material properties as well as characteristics (tensile strength, modulus of elasticity, density, affordability, machinability) are considered for analysis purpose. The attribute weights are computedusing entropy method. As per the analysis AISI 1020 is more suitable material and hence chosen fordesigning and fabrication of powered hand truck.

 1. IntroductionPowered Hand Truck is a material handling equipment, a solution thatwill provide enormous leverage for a more efficient and responsivemanual material handling. The unique design enables one-personoperation to lift and load small equipment or bulky goods weighing up to60kg (133lbs). To achieve this, powered hand truck has an optionalattribute called Electric linear actuator.

Electric battery provides thesource of energy. C-sections and square sections need to be designed aswell as fabricated for the completion of powered hand truck. Since it is amaterial handling equipment, a perfect material should be selected on thebasis of design considerations. Material selection is one of the mostchallenging tasks. This material selection will ensure that design will notbe conflicted.

There are number of materials in market having its ownproperties, characteristics, advantages, limitations and applications makesthe selection process more complex and time consuming. The criteria andobjectives for selecting the appropriate material are observed to be oftenin conflict and it involves judgement amongst the devise factors such asrequired mechanical properties, cost, machinability, performance etc. thusthe material selection process can be observed as MCDM. Among manymulti-criteria techniques, MAXMIN, MAXMAX, SAW, AHP, TOPSIS, SMART, ELECTRE are the most frequently used methods (Chen, Hwang, 1992). Abrishamchi et al. (2005) in his research study state thatselection of appropriate MCDM from a long list of available MCDMmethods is a multi-criteria problem itself. There is no single MCDMmethod which can be suitable for all decision-making problems.

Differentresearchers have different views on this issue. Guitouni and Martel (1998) 2 ARAB ECONOMIC AND BUSINESS JOURNAL 00 (2014) 000–000argue that different MCDM methods will yield different recommendationswhile Hajkowicz and Higgins (2008) argue that the ranking of decisionalternatives is unlikely to change noticeably by using a different MCDMmethod provided ordinal and cardinal data are handled correctly. However, Guitouni and Martel (1998) have developed some guidelineswhich can still be helpful in selecting an appropriate MCDM method. AliJahan et al(2013) discussed about Selection of Engineering Materials inProduct Design in their research. Entropy method is a measure of uncertainty in the information formulatedusing probability theory.

It indicates that a broad distribution representsmore uncertainty then the sharply peaked one (Deng et al. 2000). Entropymethod can computes fair relative criteria weights, entropy approachenables measuring the source and determining the relative weights ofcriteria (B1, B2, …, Bm) in rather simple and straightforward manner. Entropy approach has been proved as sufficiently reliable in identifyingboth contrast intensity and conflict of criteria and computing their weightsappropriately (Srdjevic et al. 2004). The Entropy method produces moredivergent coefficient values for all the criteria. We regard thisphenomenon as favorable to the Entropy method as it can better resolvethe inherent conflict between the criteria embedded in Multi attributedecision problems (Diakoulaki et al. 1995).

TOPSIS was first represented by Yoon (1980) and Hwang and Yoon(1981), for solving MCDM based problems. According to this technique, the best alternative would be the one that is nearest to the positive idealsolution and farthest from the negative ideal solution (Benitez et al., 2007).

Positive Ideal Solution minimizes the cost criteria and maximizesthe benefit criteria, whereas the Negative Ideal Solution maximizes thecost criteria and minimizes the benefit criteria (Wang & Chang, 2007). Itassumes that each criterion requires to be maximized or minimized. TOPSIS is a simple and useful method for ranking alternatives accordingto closeness to the ideal solution.

The TOPSIS procedure is based on asimple idea that the optimal ideal solution, having the maximum benefit, is obtained by selecting the best alternative which is far from the mostunsuitable alternative, having less benefits. The ideal solution should havea rank of 1 and the non-ideal or worst alternative should have a rank 0. Asideal materials are not probable and each alternative would have some inbetweenranking between the ideal solution extremes. Regardless ofabsolute accuracy of rankings, comparing number of different materialsunder the same set of selection criteria allows accurate weighting ofrelative materials and hence selecting best material amongst manyalternatives.