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BLENDED NAHP AND NCM DECISION MAKING ON LEADERSHIP 4.0 ATTRIBUTES

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Abstract

The advent of industry 4.0 has laid a greater extent of transitions in the context of leadership and every company is taking tiresome efforts in fostering the leadership skills of their employees. These companies also face many decision-making challenges in determining the prime leadership attributes to focus on, as they make huge investments in organizing various leadership training programmes at all levels. This paper put forth an integrated decision-making model that blends the approaches of neutrosophic analytic hierarchy process (NAHP) and neutrosophic cognitive maps (NCM) to handle an indeterminate decision-making environment. The newly developed blended decision-making model is time efficient and will certainly facilitate making optimal decisions in various decision-making environments. The efficacy of the blended model is estimated by applying it to make decisions on leadership attributes.

Introduction

Neutrosophic Cognitive Maps developed by Vasantha and Smarandache [1] are the extensions of Fuzzy Cognitive Maps (FCM). Kosko [2] introduced FCM, which are excellent decision-making tools widely applied in various decision-making fields. NCMs are directed graphical structures comprising

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nodes and edges which depict causal effects between the factors of decision-making problems. The edge weight of NCM consists of $\{-1, 0, 1, I\}$. The algorithmic approach of NCM encompasses the steps to find the inter influence of one factor over another. NCMs are extensively used to make optimal decisions in fields of situational analysis [3], education [4], medical diagnosis [5], knowledge-based institutions [6], industrial management [7], and also in the arenas of other managerial decision-making. NCMs are predominantly applied to determine the causal impacts between the factors of decision-making. One of the shortcomings of this NCM decision-making model is its inefficiency in handling any number of decision-making factors. To overcome this limitation, the significant factors shall be determined by integrating other ranking decision models.

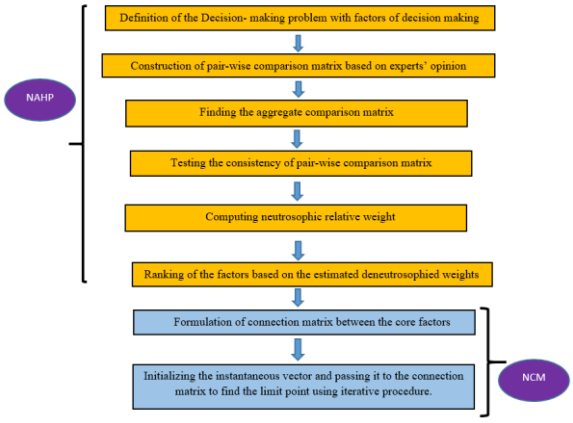
Nivetha et al. [8] integrated NCM with a concentric hypergraphic approach to find the factors of significance and the hypergraphic integration was also applied to FCM models. In these integrated models, the factors are first ranked and then their inter-relational impacts are determined. Based on these integrated model developments, a blended model integrating neutrosophic analytic hierarchy process and neutrosophic cognitive model is proposed in this paper. Analytic hierarchy process (AHP) is developed by Saaty [9] and it is applied in various decision-making environments of quality evaluation, optimal selection of weapons, 3D printers alternatives [10]. AHP was discussed in a fuzzy environment by Van Laarhoven and Pedrycz [11]. Fuzzy AHP is characterized by fuzzy representations of information and this was later extended to intuitionistic AHP by Xu and Liao [12] in which the data representations have both membership and non-membership values. Based on the theory of neutrosophy introduced by Smarandache [13], the AHP was discussed in a neutrosophic setting. In general, neutrosophic representations are characterized by truth, indeterminate and falsity values. Neutrosophic AHP has been extensively applied in many decision-making situations such as selection of learning management systems [14], prioritization of legal services [15], location of safe cities [16], models of transportation [17].

In all the above mentioned Neutrosophic AHP decision-making models, the core factors of decision-making are ranked. As this ranking method is efficient and competent this is blended with the neutrosophic cognitive map

model. This newly proposed model will alleviate the decision-making challenges and facilitates in finding the significant factors of decision-making and their inter-relational impacts, The contents of the paper is organized into four sections; section 2 presents the methodology; section 3 applies to decision-making on attributes of leadership 4.0; section 4 discusses the results and the last section concludes the work.

2. Methodology of Blended Decision Models

This section presents the steps involved in the blended NAH and NCM method, for further study the readers shall refer [1][14].



The usual procedures of NCM and NAH as discussed in [1, 14] are followed to determine the significant factors of decision making and their causal relationship. 3. Decision making on the attributes of leadership 4.0. In this section the blended decision making model is applied to determine the core leadership 4.0 attributes. The method of NAHP is applied to find the core attributes and the method of NCM is used to find the interrelational impacts between the core attributes. On determining the interrelational impacts between the attributes the company decision-makers shall organize training programmes in accordance to it. The NAHP is employed to choose the significant attributes of leadership 4.0 under four major domains such as Cognitive skills, Managerial skills, Interpersonal skills and Strategic skills. [18]

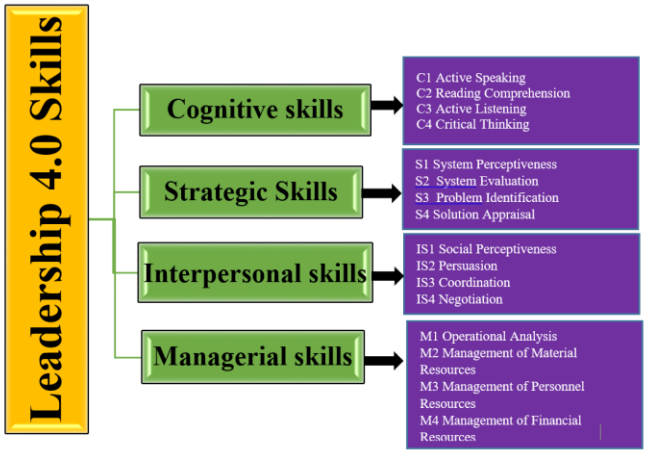


Figure 3.1. Attributes of Decision-Making.

The pairwise comparison matrices between the attributes of leadership 4.0 under each domain of skills is presented below.

	C1	C2	C3	C4
C1	EP	MP	MP	MP
C2	SP	EP	MP	MP
C3	SP	SP	EP	SP
C4	SP	SP	SP	EP

	M1	M2	M3	M4
M1	EP	MP	MP	MP
M2	SP	EP	SP	SP
M3	MP	MP	EP	MP
M4	SP	MP	SP	EP

	IS 1	IS 2	IS 3	IS 4
IS 1	EP	SP	MP	MP

IS 2	MP	EP	SP	SP
IS 3	SP	MP	EP	MP
IS 4	SP	MP	SP	EP

	S1	S2	S3	S4
S1	EP	SP	SP	MP
S2	MP	EP	MP	SP
S3	MP	MP	EP	MP
S4	SP	MP	SP	EP

The neutrosophic linguistic representation and its respective quantification is presented in Table 3.1.

Table 3.1. Neutrosophic Quantification of Linguistic Variable.

Linguistic scale of preference	Neutrosophic representation	Deneutrosophied value
Equally preferred (EP)	(0.5,0.5,0.5)	0.5
Lowly preferred (LP)	(0.3,0.7,0.7)	0.26
Moderately preferred (MP)	(0.60,0.35,0.4)	0.6
Strongly preferred (SP)	(0.75,0.2,0.2)	0.7
Extremely preferred (ExP)	(0.9,0.1,0.1)	0.8

By using the decision making software for NAHP the score values of the attributes considered for decision making are obtained.

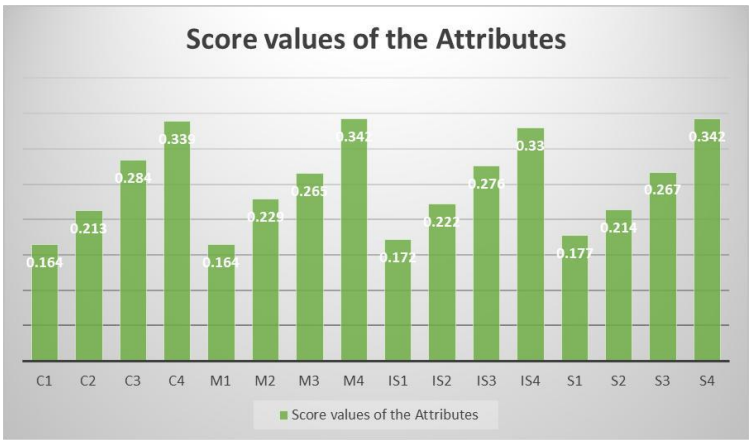


Figure 3.2. Score values of the Attributes of Decision-Making.

From the above fig, the attributes C3, C4, M4, M3, IS3, IS4, S3, S4 appears to be significant. These attributes are taken as the core factors of decision making under NCM approach.

C1 Active Listening,

C2 Critical thinking

C3 Management of Personnel resources

C4 Management of Financial resources

C5 Coordination

C6 Negotiation

C7 Problem Identification

C8 Solution Appraisal

By using CM Expert software the NCM directed graph and the convergence plotter is obtained. It is very evident that each of the factors have high interrelational impacts on all other factors.

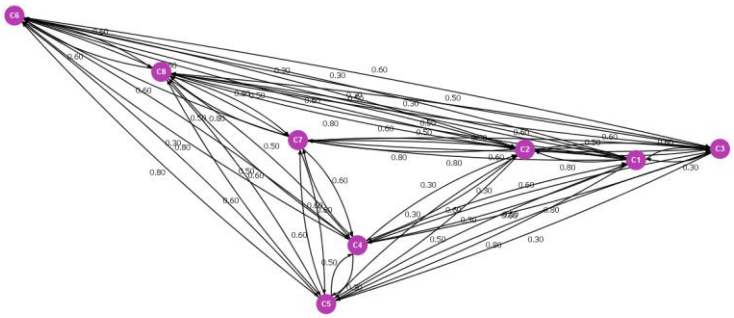


Figure 3.3. NCM Directed Graph.

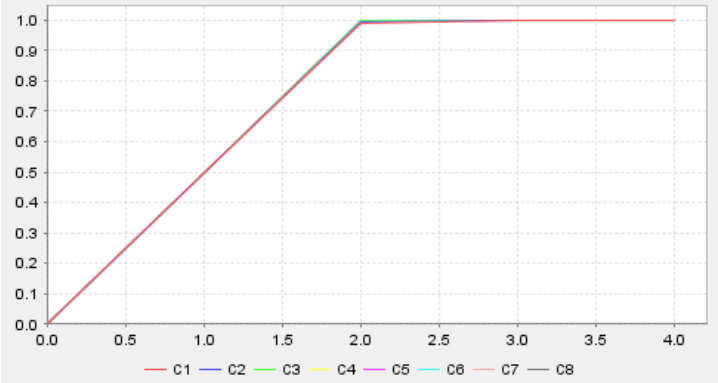


Figure 3.4. Convergence Plotter.

4. Discussion

From Figure 3.4 it is very clear that each of the factors influences positively over all other factors of decision making and one shall make inferences that if one of the attributes is initiated then all other factors get stimulated and accelerated. It is also inferred that the blended NAHP and NCM have reduced the risks of making optimal decisions by reducing the number of significant criteria. This integrated model with neutrosophic representations is efficient in making optimal decisions.

Conclusions

The proposed blended model under a neutrosophic environment is the

novel feature of this research work. The integrated model reduces the challenges in determining the interrelational impacts of the NCM decision-making model. The efficacy of this model shall be found by comparing this proposed model with other integrated NCM and ranking decision methods.

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