Plithogenic Sociogram based Plithogenic Cognitive Maps Approach in Sustainable Industries

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Abstract

The theory of Plithogeny is primarily attribute based. Plithogenic Sociogram (PS) and Plithogenic cognitive maps (PCM) are distinct decision-making approaches developed to deal with attributes. This paper proposes an integrated decision-making model combining the approaches of PS with PCM and this sets the beginning of new genre of PCM. The development of this model is applied in investigating the association between the factors pertinent to the promotion of sustainable industries. This work also compares the working of the proposed integrated model of PCM with PS and the independent working of PCM model. The results are more promising to the proposed integrated approach and this paper strongly emphasises the efficacy of this hybrid approach. The blended model of PCM with PS is efficient in handling complex decision circumstances and this approach shall be extended to other kinds of Plithogenic representations.

Keywords: Plithogenic Cognitive Maps; Plithogenic Sociogram; Integrated decision-making approach; Sustainable industries

1. Introduction

Smarandache introduced the theory of Plithogeny as a generalization of crisp, fuzzy, intuitionistic and neutrosophic sets. A Plithogenic set is basically a quintuple of the form (P,a,V,d,c), where P is the set, a is the attribute dealt, V is the set of attribute values pertinent to the attribute ‘a’, d is the degree of appurtenance which expresses the extent of association of the elements of P with the dominant attribute value and c is the contradiction degree indicating the dissociation between the attribute values. Plithogenic sets are more comprehensive in nature and this tendency has influenced the researchers to develop and augment the theory of Plithogeny to decision-making. Abdel et al [15] formulated Plithogenic based decision model to make optimal selection of suppliers, Martin et al [16] applied extended Plithogenic hypersoft sets in framing Covid decision model. Antonio et al [17] employed Plithogenic logic in designing financial model. Singh [18] used Single-Valued Neutrosophic Plithogenic Graph in multi-faceted decision process. Priyadharshini and Irudhayam [19 - 20] developed novel approach in devising plithogenic decision models. Liang et al [21] applied plithogenic based multi-criteria decision approach in simulation. Ahmad and Afzal [22] developed plithogenic based AI decision model. Martin [23] formulated Plithogenic SWARA-TOPSIS in making decisions on Food processing methods. Wang et al [24] proposed an integrated decision model based on plithogenic-neutrosophic rough number. Sudha et al [25] developed integrated Plithogenic decision models based on multi-criteria decision approach. Hema et al [26] formulated novel decision model with Plithogenic Interval Valued

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Neutrosophic Hyper-soft Sets. The theory of Plithogeny is associated with the most commonly applied decision approaches to evolve new genre of Plithogeny based decision models.

Plithogenic Cognitive Maps (PCM) are yet another genre of decision-making models developed by Martin et al [1] as the generalization of fuzzy cognitive maps, intuitionistic cognitive maps and neutrosophic cognitive maps. A cognitive map is basically a directed map comprising nodes and edges representing the factors and the inter associations between them respectively. This relation shall be represented in the form of a connection matrix and by performing iterative computations, the actual extent of inter-influence between the factors shall be investigated. These cognitive maps are extended to Plithogenic cognitive maps by varying the nature of representing the inter associations between the factors in the form of edge weights. As PCM is more generalized in nature the connection matrix has the freedom to assume any kind of representations of crisp values {0,1}, fuzzy values [0,1], intuitionistic values $[0,1]^2$ and neutrosophic values $[0,1]^3$.

Plithogenic Cognitive Maps are widely applied in various arenas of decision-making. To mention a few, Martin et al [2] developed New Plithogenic sub cognitive maps approach to make diagnosis of COVID 19. Priya and Martin [3] coined Induced Plithogenic Cognitive Maps with Combined Connection Matrix to deal with the challenges of online learning system. Sujatha et al [4] applied PCM approach in analyzing the novel corona virus. Priya et al [5] in analysing the spiritual intelligence of the youth. Gomathy et al [6] conceptualized Plıthogeny based Combıned Dısjoınt Block with fuzzy representations. Angel et al [7] introduced PCM with Linguistic Contradiction Degree Representations to explore the factors causing academic stress. The PCM models discussed above primarily deal with the attributes and these models intensely apply the theory of Plithogeny in its designing. Another genre of Plithogenic based decision-making model developed by martin et al [8] is Plithogenic Sociogram (PS). Sociogram is basically a group analysis technique applied to study the interrelationship between the members of the group. The concept of Sociogram is discussed in fuzzy sense and later extended to neutrosophic and Plithogenic environments. PS is also a generalization alike PCM and it also delas predominantly with attributes. The concept of neutrosophic sociogram (NS) is integrated with neutrosophic cognitive maps (NCM) to make investigations on the associations between the factors of the study. This integrated approach applied by Priya et al [9] is used as an alternative to the usual procedure of Neutrosophic Cognitive Maps. The time and energy spent in the computational procedure of cognitive map approach is alleviated by this alternative approach in the case of integrated NS and NCM. This has motivated the authors of this research work to develop an alternative method of PCM by blending the approaches of PCM and PS. The aforementioned PCM models are distinct from one another however all these PCM models follow the iterative computational procedure of Fuzzy Cognitive model. Also, the PCM models investigate the associational impacts between the factors but do not facilitate in identifying the most influential factor. The method of PS is used only as a decision-making tool in ranking the factors not considering the associational impacts. These are the existing research gaps in the PCM and PS literature and this is the vantage point for developing a new genre of PCM model based on PS approach. This research work will be a room for the researchers to explore more on the advantages of this integrated approach in determining the most influential factor considering their associational impacts pertaining to the dominant attribute values.

The contents of this paper are organized as follows. Section 2 sketches out the theoretical developments of the proposed integrated approach of PCM with PS. Section 3 applies the proposed approach to decision-making on the factors contributing to the sustainable industries. Section 4 compares the working efficiency of the integrated approach with that of the independent PCM approach. Section 5 presents the industrial implications of this proposed approach and the final section concludes the work with future directions.

2. Theoretical Development of Integrated PCM & PS Model

This section presents the stepwise procedure involved in developing the integrated decision-making model. To understand the procedure, one has to comprehend the fundamentals of PCM and PS. A PCM is a directed graph that relates the factors of the study in a graphical form. The nodes and edges of the PCM represents the factors and their relationships. The edge weights assigned by the experts indicate the degree of the association between the factors. This graphical representation shall be represented as a connection matrix. The PCM is categorized either as crisp, fuzzy, intuitionistic and neutrosophic based on the respective nature of the values of the matrix. Let us understand the working mechanisms of PCM under two different cases.

Case 1: Contradiction Degree Between the Factors

Let us consider three factors for the study, say P1, P2 and P3. The objective of this case is to investigate the inter association between the factors. Let the connection matrix based on the experts be

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	P1	P2	P3
P1	0	0.4	0.2
P2	0.3	0	0.4
P3	0.5	0.2	0

P1	P2	P3
0	1/3	2/3

Let us find the associational impacts between the factors of the study. Let us consider the factor say P1 to be in ON position. Then the respective contradiction degrees between the other factors are

The associational impacts between the factors are determined using the procedure described by Martin and Smarandache [1]. The associational impacts are represented in Table 1

Table 1: Associational Impacts Between the Factors with Contradiction Degree between the Factors

On Position of the Factors	**Associational Impacts between the other factors with Contradiction Degree between the Factors**
P1 (1 0 0)	(1 0.6 0.46)
P2 (0 1 0)	(0.3 1 0.6)
P3 (0 0 1)	(0.5 0.46 1)

Case 2: Contradiction Degree between the Core Factors and Decisive Factors
This case is the improved version of the case 1. In this case the contradiction degree is considered between the subfactors and factors. Let us consider the same three factors and the respective connection matrix. In addition to the factors, the core factors are also considered, in this case, the core factors are the factors that are considered to be centric for the decisive factors. Let the core factors be C1 and C2.

	P1	P2	P3
C1	0.5	0.6	0.7
C2	0.7	0.8	0.4

The associational impacts between the factors with respect to the core factors are determined using the procedure described by Angel et al [7]. The associational impacts are represented in Table 2
Table 2: Associational Impacts between the other factors with Contradiction Degree between the Core Factors and Decisive Factors

On Position of the Factors	**Associational Impacts between the other factors with Contradiction Degree between the Core Factors and Decisive Factors**	
P1 (1 0 0)	C1	(1 0.76 0.76)
	C2	(1 0.88 0.58)
P2 (0 1 0)	C1	(0.66 1 0.82)
	C2	(0.79 1 0.64)
P3 (0 0 1)	C1	(0.75 0.68 1)
	C2	(0.85 0.84 1)

The objective of the two cases is to find the inter-association between the factors. The two cases have few similarities and differences. The two cases are similar as they both involve the iterative computational procedure to determine the fixed point of this dynamical system which is indeed time consuming. The two cases differ in the assumption of contradiction degrees.

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Let us understand the procedure of Plithogenic Sociogram with the same example. Let us consider the factors, P1,P2 and P3. The inter- association between the factors is presented with respect to the attribute values of the core factors. Let the attribute values of C1 and C2 be represented in set notations of the form{C11,C12,C13} and {C21,C22}. The dominant attribute values are C12 and C21. The preferential associations between the factors with respect to the dominant attribute values are presented in the Table 3 as follows

Table 3: Preferential Associations between the Factors

Factors	Preferential Associations between the Factors
P1	{P2(C12(0.5),C21(0.3)),P3(C12(0.7),C21(0.8))}
P2	{P3(C12(0.7),C21(0.4))}
P3	{P1(C12(0.6),C21(0.5)),P2(C12(0.9),C21(0.6))}

The Evaluation matrix M1 for the dominant attribute value C12 is

	P1	P2	P3
P1	0	0.5	0.7
P2	0	0	0.7
P3	0.6	0.9	0

The Evaluation matrix M2 for the dominant attribute value C21 is

	P1	P2	P3
P1	0	0.3	0.8
P2	0	0	0.4
P3	0.5	0.6	0

The combine evaluation matrix is determined by assuming 0.5 weightage to each of the dominant attribute values is

	P1	P2	P3
P1	0	0.4	0.75
P2	0	0	0.55
P3	0.55	0.75	0

The Plithogenic Fuzzy Amicable degree t_{gh} is calculated using the formula mentioned in [1]

$\frac{2}{t_{gh}} = \frac{1}{f_{gh}} + \frac{1}{f_{hg}}$ ---------- (1)

where f_{gh} presumes the associational impact between the factors g and h and f_{hg} represents the associational impact between the factors h and g. The final scores of the factors are determined by $\frac{\sum_h t_{gh}}{\sum_g \sum_h t_{gh}}$ ---------- (2)

and these values facilitate in identifying the most influential factors.

The fuzzy amicable degree between the factors is

	P1	P2	P3
P1	0	0	0.6346
P2	0	0	0.6346
P3	0.6346	0.6346	0

The score values of the factors determined using (2) are presented in the Table 4

Table 4: Score Values of the Factors

Factors	Score Values
P1	0.25
P2	0.25

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P3	0.5

3. Application of the Proposed Integrated Approach in Determining the Influential factor in establishing sustainable industries

In this section, the proposed PCM integrated PS decision approach is applied to study the factors contributing to the context of creating sustainable industries. This section comprises problem definition, description of the factors of the study and solutions to the problem.

3.1 Problem Definition

Sustainable industries are the need of the hour. All industrial sectors are encouraged to exercise green and sustainable initiatives in their production process. The intricate process of manufacturing comprises sequential steps of transforming raw materials to finished product. However, this process uses maximum of energy and exploitation of resources also takes place. It is the social responsibility of every industrial sector to take immediate actions towards energy conservation and environmental sustainability. These production sectors are bound to few environmental laws and ethical values which constraint them together in adopting sustainable production system. But the question is how do these industrial sectors embrace sustainability in their production mechanisms. What factors or initiatives shall these sectors take to address this problem? What are the sub-factors or the attributes to be considered in investigating the interrelational impacts between the factors? Which of the factors is more influential? The need of determining the most influential factor is very significant for the decision-makers as it directs them to design and devise suitable strategies for implementing. These are some of the questions to be addressed in the context of industrial sectors turning into sustainable industries.

3.2 Factors of the Study

The industrial sectors must possess a clear idea over the concept of sustainability in its transformational journey towards sustainable industries. Sustainability shall be defined as the ability to conserve natural resources for fulfilling the existing demands with more concern on future generations. Researchers have discussed about the characteristics of sustainable industries, to mention a few Korkmaz et al [10], Chalaris et al [11], Rakte et al [12], Oppusunggu et al [13], Verma et al [14] have described in detail about the core attributes of a sustainable industries and also sketched the strategies for transforming the industries more sustainable. It is observed that the notion of sustainability is characterized by the following attributes described below in Table 5.

Table 5: Description of the Characteristics of Sustainability

Characteristics of Sustainability	**Description**
A1: Environmental Responsibility	Minimization of environmental impacts
A2: Social Equity	Equal distribution of resources
A3: Economic Viability	Cost feasible with economic likelihood
A4: Innovation	Implementation of novel ideas in product creation
A5: Stakeholder Engagement	Collaboration and coordinated efforts as a group
A6: Accountability	Transparency and commitment towards environmental conservation

The above tabulated characteristics are considered as the attributes of sustainable industries. The experts in the field of business management are consulted and the following factors are suggested by them as the step towards the creation of sustainable industries pertaining to the attributes presented in Table 5.

The factors are as follows

F1: Magnifying the scale of internal and external collaboration bound to the ethical principles and values

F2: Developing more comprehensive policies with future concerns and conceptualization of sustainability

F3: Delineating the strategical plan and liability with respect to the stakeholders

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F4: Augmenting the research on developing viable products with contemporary features
F5: Appraising the financial constraints and social contributions with transparency
The PCM based PS approach is applied to determine the most persuading factor that influences other factors with respect to the attributes and attribute values presented in Table 6

Table 6: Attributes & Attribute Values

Attributes	**Attribute values**		
Environmental Responsibility (A1)	Initial (A11)	Progressing (A12)	Leading (A13)
Social Equity (A2)	Base (A21)	Developing (A22)	Advanced (A23)
Economic Viability (A3)	Foundational (A31)	Growth (A32)	Thriving (A33)
Innovation (A4)	Baseline (A41)	Advanced (A42)	Cutting-edge (A43)
Stakeholder Engagement (A5)	Primary (A51)	Collaborative (A52)	Transformative (A53)
Accountability (A6)	Initial (A61)	Progressive (A62)	Exemplary (A63)

The dominant attribute values considered for sustainability are Leading Environmental responsibility (A13), Advanced social equity (A23), Thriving Economic viability (A33), Cutting-edge in Innovation (A43), Transformative Stakeholder engagement (A53), Exemplary in Accountability (A63). The expert's opinion representing the relational impacts between the factors with respect to the dominant attribute values are presented in Table 7.

Table 7: Expert's Opinion on the Proximity between the Factors over Sustainability

Strategies	**Proximity between the Factors over Sustainability based on Dominant Attribute Values**	
	Expert-I	**Expert-II**
F1	F2 (A13(0.5), A23(0.7), A33(0.5), A43(0.7), A53(0.3), A63(0.5)), F5 (A13(0.3), A23(0.8), A33(0.8), A43(0.5), A53(0.2), A63(0.5))	F2 (A13(0.7), A23(0.5), A33(0.8), A43(0.3), A53(0.5), A63(0.7)), F4 (A13(0.5), A23(0.3), A33(0.8), A43(0.7), A53(0.3), A63(0.5))
F2	F4 (A13(0.8), A23(0.5), A33(0.8), A43(0.5), A53(0.3), A63(0.5)), F5 (A13(0.3), A23(0.5), A33(0.7), A43(0.3), A53(0.8), A63(0.5))	F3 (A13(0.5), A23(0.8), A33(0.7), A43(0.5), A53(0.2), A63(0.3)), F4 (A13(0.7), A23(0.8), A33(0.5), A43(0.3), A53(0.2), A63(0.3))
F3	F1(A13(0.2), A23(0.7), A33(0.8), A43(0.7), A53(0.2), A63(0.8)), F4(A13(0.3), A23(0.8), A33(0.7), A43(0.3), A53(0.5), A63(0.5))	F1(A13(0.5), A23(0.8), A33(0.7), A43(0.3), A53(0.2), A63(0.5)), F2(A13(0.5), A23(0.3), A33(0.7), A43(0.3), A53(0.7), A63(0.7))
F4	F3 (A13(0.8), A23(0.5), A33(0.8), A43(0.2), A53(0.5), A63(0.2)), F5 (A13(0.2), A23(0.8), A33(0.7), A43(0.3), A53(0.2), A63(0.5))	F2 (A13(0.5), A23(0.3), A33(0.7), A43(0.5), A53(0.3), A63(0.3)), F5 (A13(0.3), A23(0.8), A33(0.3), A43(0.8), A53(0.5), A63(0.5))
F5	F1(A13(0.7), A23(0.8), A33(0.5), A43(0.3), A53(0.3), A63(0.5)), F3 (A13(0.3), A23(0.5), A33(0.5), A43(0.5), A53(0.5), A63(0.8))	F1 (A13(0.5), A23(0.3), A33(0.8), A43(0.7), A53(0.3), A63(0.8)), F4 (A13(0.3), A23(0.5), A33(0.7), A43(0.5), A53(0.8), A63(0.5))

The Evaluation matrix for the dominant attribute value A13 is given by

	F1	F2	F3	F4	F5

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F1	0	0.6	0	0.25	0.15
F2	0	0	0.25	0.75	0.15
F3	0.35	0.25	0	0.15	0
F4	0	0.25	0.4	0	0.15
F5	0.6	0	0.15	0.15	0

The Evaluation matrix for the dominant attribute value A23 is given by

	F1	F2	F3	F4	F5
F1	0	0.6	0	0.15	0.4
F2	0	0	0.4	0.65	0.25
F3	0.75	0.15	0	0.4	0
F4	0	0.15	0.25	0	0.8
F5	0.55	0	0.25	0.25	0

The Evaluation matrix for the dominant attribute value A33 is given by

	F1	F2	F3	F4	F5
F1	0	0.65	0	0.4	0.4
F2	0	0	0.35	0.65	0.35
F3	0.75	0.35	0	0.35	0
F4	0	0.35	0.4	0	0.5
F5	0.65	0	0.25	0.35	0

The Evaluation matrix for the dominant attribute value A43 is given by

	F1	F2	F3	F4	F5
F1	0	0.5	0	0.35	0.25
F2	0	0	0.25	0.4	0.15
F3	0.5	0.15	0	0.15	0
F4	0	0.25	0.1	0	0.55
F5	0.5	0	0.25	0.25	0

The Evaluation matrix for the dominant attribute value A53 is given by

	F1	F2	F3	F4	F5
F1	0	0.4	0	0.15	0.1
F2	0	0	0.1	0.25	0.4
F3	0.2	0.35	0	0.25	0
F4	0	0.15	0.25	0	0.1

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F5	0.3	0	0.25	0.4	0

The Evaluation matrix for the dominant attribute value A63 is given by

	F1	F2	F3	F4	F5
F1	0	0.6	0	0.25	0.25
F2	0	0	0.15	0.4	0.25
F3	0.65	0.35	0	0.25	0
F4	0	0.15	0.1	0	0.5
F5	0.65	0	0.4	0.25	0

The evaluation matrices are obtained by taking average values of the Expert's opinion. For example, if both the experts prefer factor F2 with respect to factor F1 with a dominant attribute value of 0.5 and 0.7 then we take average of those values as 0.6 but if expert 1 alone prefers factor F2 with respect to factor F1 with a dominant attribute value of 0.5 the we take average of 0.5 as 0.25.

The procedure of finding the significant factors is discussed under two cases as follows

Case (1) Dominant Attribute Values with Equal Weightage

The combined evaluation matrix with equal weightage of 0.17 to each dominant attribute values is given by

	F1	F2	F3	F4	F5
F1	0	0.5695	0	0.2635	0.2635
F2	0	0	0.255	0.527	0.2635
F3	0.544	0.272	0	0.2635	0
F4	0	0.221	0.255	0	0.442
F5	0.5525	0	0.2635	0.2805	0

The plithogenic amicability degree is given as

	F1	F2	F3	F4	F5
F1	0	0	0	0	0.3568
F2	0	0	0.2632	0.3114	0
F3	0	0.2632	0	0.2592	0
F4	0	0.3114	0.2592	0	0.3432
F5	0.3568	0	0	0.3432	0

The score values and the ranking of factors are presented in the following table 8

Table 8: Ranking of the Factors based on Equal Weightages

Factors	**Score Value**	**Ranking of Factors**
F1	0.116317	5
F2	0.187319	3
F3	0.170294	4
F4	0.297877	1

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F5	0.228193	2

Case (2) Dominant Attribute Values with Unequal Weightage
The combined evaluation matrix with unequal weightage (A13=0.1, A23=0.1, A33=0.3, A43=0.15, A53=0.2, A63=0.15) are presented as follows

	F1	F2	F3	F4	F5
F1	0	0.56	0	0.28	0.27
F2	0	0	0.25	0.505	0.285
F3	0.5475	0.29	0	0.27	0
F4	0	0.235	0.265	0	0.4225
F5	0.5425	0	0.2625	0.3	0

The plithogenic amicability degree with unequal weightage is given by

	F1	F2	F3	F4	F5
F1	0	0	0	0	0.3606
F2	0	0	0.2685	0.3207	0
F3	0	0.2685	0	0.2675	0
F4	0	0.3207	0.2675	0	0.3509
F5	0.3606	0	0	0.3509	0

The score values and the ranking of factors with unequal weightages are presented in the following table 9.

Table 9: Ranking of the Factors based on Unequal Weightages

Factors	**Score Value**	**Ranking of Factors**
F1	0.114961	5
F2	0.187883	3
F3	0.1709	4
F4	0.299423	1
F5	0.226833	2

4. Discussions

From the above table, it is very evident that the factor F4 appears to be more influential in comparison with other factors. On identifying F4: Augmenting the research on developing viable products with contemporary features as the most persuading factor, the decision makers shall make provisions to implement so as to make the industries turn more sustainable. The Plithogenic cognitive maps are primarily applied to determine the causal impact between the factors with respect to certain attributes values subjected to the concerned attributes. The impact between the factors are presented in Table 10 by following the procedure mentioned in [7].

Table 10: Associational Impacts Between the Factors using Plithogenic Cognitive Maps

On Position of the	**Initial Vector stating the**	**Final Vector stating the Impacts between the other Factors with respect to the Contradiction Degree**

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Factors	ON Position of the Factors	Between the Factors	Between the Factors & the Decisive Factors	
F1	(10000)	(1 0.65 0.9 0.92 0.88)	A1	(1 0.6 0.94 0.77 0.85)
			A2	(1 0.75 0.94 0.87 0.71)
			A3	(1 0.85 0.84 0.85 0.9)
			A4	(1 0.65 0.9 0.7 0.6)
			A5	(1 0.75 0.94 0.71 0.75)
			A6	(1 0.9 0.86 0.86 0.78)
F2	(01000)	(0.83 1 0.79 0.85 0.67)	A1	(0.81 1 0.91 0.74 0.81)
			A2	(0.77 1 0.91 0.9 0.73)
			A3	(0.76 1 0.76 0.84 0.88)
			A4	(0.85 1 0.85 0.75 0.61)
			A5	(0.91 1 0.91 0.68 0.71)
			A6	(0.89 1 0.79 0.86 0.78)
F3	(00100)	(0.94 0.62 1 0.78 0.75)	A1	(0.85 0.53 1 0.77 0.85)
			A2	(0.77 0.65 1 0.9 0.73)
			A3	(0.79 0.79 1 0.85 0.9)
			A4	(0.91 0.61 1 0.75 0.61)
			A5	(0.94 0.72 1 0.71 0.75)
			A6	(0.91 0.86 1 0.86 0.78)
F4	(00010)	(0.94 0.87 0.8 1 0.85)	A1	(0.9 0.55 0.9 1 0.91)
			A2	(0.84 0.67 0.88 1 0.79)
			A3	(0.86 0.79 0.75 1 0.94)
			A4	(0.94 0.62 0.87 1 0.76)
			A5	(0.96 0.73 0.93 1 0.85)
			A6	(0.94 0.87 0.82 1 0.85)
F5	(00001)	(0.88 0.54 0.84 0.96 1)	A1	(0.85 0.53 0.88 0.86 1)
			A2	(0.81 0.66 0.87 0.96 1)
			A3	(0.8 0.76 0.7 0.9 1)
			A4	(0.91 0.61 0.86 0.9 1)
			A5	(0.94 0.72 0.92 0.86 1)
			A6	(0.92 0.86 0.81 0.94 1)

From the above table the following interpretations shall be made. The vector (10000) states that the factor F1 is kept in ON position, the iterative procedure described in [7] is applied to find the consequential impacts between the other factors with respect to the Contradiction Degree Between the Factors. The resultant vector values (1 0.65 0.9 0.92 0.88) state the consequential impacts of the factor

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F1 over the other factors say F2, F3, F4 and F5. In the similar fashion the other resultant vectors shall be interpretated based on the ON position of the other factors.

On other hand, the final vector values namely A1(1 0.6 0.94 0.77 0.85), A2 (1 0.75 0.94 0.87 0.71), A3(1 0.85 0.84 0.85 0.9), A4(1 0.65 0.9 0.7 0.6), A5(1 0.75 0.94 0.71 0.75) and A6(1 0.9 0.86 0.86 0.78) obtained with respect to the Contradiction Degree Between the between the Core Factors and Decisive Factors clearly states the influence of F1 over the other factors

However, on intense analysis, it is found that the Plithogenic Cognitive Maps facilitates only in determining the relational impacts or the consequential impacts between the factors. This solution procedure does not assist in finding the influential or the dominant factor that persuades other factors. On other hand the factors cannot be ranked based on their significance or on their rate of influence. This drawback is tackled by applying the integrated PCM & PS approach. This blended approach helps in ranking the factors based on their influence and relational impacts. This proposed approach appears to be an alternative to the iterative procedure followed in PCM method.

5. Conclusion

This paper proposes an integrated approach based on Plithogenic Cognitive Maps and the Plithogenic Sociogram approach. The proposed approach is more efficient compared to the PCM method. The efficacy of the integrated approach is demonstrated in an illustration concerning sustainable industries. Significant factors are determined using the approach proposed in this research work. The decision-making procedure described in this work will be further extended and discussed with an extended Plithogenic Sociogram approach considering the recessive attribute values. Additionally, the hypersoft approach will also be integrated with Plithogenic cognitive maps to evolve more integrated and novel decision-making approaches.

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