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Evaluating Human Resource to Implement SCP Using Grey Relational Analysis

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Abstract
In order to overcome the situation of misuse of earth and society, a large pressure is building around all the factors of the humankind to successfully adopt and implement sustainable manufacturing at various stages of the supply chains. In the present study six factors of human resources are identified and categorized in the Indian automobile industry context. The Grey relational analysis (GRA) technique is utilized to evaluate the success factors. The Grey relational analysis (GRA) is a qualitative and quantitative approach that is used widely as a multi-criterion decision making (MCDM) method to solve the complicated relationship problems having uncertainties. The factor 'Commitment and transparency of stakeholders towards standardization of products' achieves the first position whereas factor 'Trust among the members of the supply chain' stays behind at last position. This work is helpful for managers and practitioners to create a coordinated and focused system within the supply chain.

Keywords- Sustainable Consumption and Production, Human Resource, Success Factors, Grey Relational Analysis.

1. Introduction

The exponential development of human financial extension has devastatingly affected the earth and natural resources of the world. As per the WWF, "the Earth's regenerative limit can never stay up to the demand – individuals are transforming resources into waste quicker than nature can transform waste into resources". "By 2050 we will require multiple planets because of continuous pattern of consumption and production" (Bentley, 2008). Around 35% of absolute power delivered on the planet is utilized for production activities and production activities are accountable for almost 20% of worldwide carbon emanations (Graedel et al., 2011).

As the present age employees are progressively mindful and worried about environment degradation, global warming, and environmental change (Pandey et al., 2016), we can unmistakably recognize the double responsibility of the individual component as originator and recipient of the usage of Sustainable Development (Chams and García-Blandón, 2019). The discipline that is advancing sustainability in industries is Sustainable Human Resource. HR

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assumes to be an indispensable job in the board of individuals that is viewed as an asset of the association (Das and Singh, 2016). The HR is the key driver for the organization to implement environmental policy to achieve the environmental sustainability goal (Govindarajulu and Daily, 2004).

Current studies have drawn awareness of the impact of human factors on resource conservation and sustainable development (Pfeffer, 2010). People, organizations and government, somewhat, are altogether engaged with integration practices (Labuschagne et al., 2005). During the past decade, considerable deliberation and research efforts have been conducted by business strategists, civic body policymakers, environmentalists and government towards SCP practices (Shibin et al., 2016).

Current paper listed the following research objectives –
(1) To recognize the human resource factors relevant to SCP in an industrial context.
(2) To model the factors to establish their priority.

To accomplish the above objectives, the factors are identified with the help of intense literature survey and expert's input which are then ranked based on a priority basis.

The remainder of the paper is sorted out as - Relevant literature is described in Section 2. The methodology of the research is described in Section 3. Data analysis and results are given in Section 4. A discussion of findings is explained in Section 5. Conclusions, research implications, and future work are explained in Section 6.

2. Literature Review

To accomplish SCP, HR based factors are essential for automotive industries. The HR factors are presented in Table 1.

Table 1. HR factors to adopt SCP in an automobile supply chain context

No.	HR Factors	References
1	Attitude and awareness of human towards SCP (HRF1)	Dahl (2012); Grunert et al. (2014)
2	Participation of stakeholders in decision making (HRF2)	Benn and Bolton (2011), Hesselbarth and Schaltegger (2014)
3	Commitment and transparency of stakeholders towards standardization of products (HRF3)	Rettab et al. (2009), Reuter et. al. (2010)
4	Understanding customer's need about sustainability (HRF4)	Schafer et al. (2012), Spaargaren and Van Vliet (2000)
5	Expertise of workforce (HRF5)	Callenbach et al. (1993), Arulrajah and Opatha (2016)
6	Trust among the members of supply chain (HRF6)	Kausar et al. (2017)

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3. Solution Methodology

The factors of human resources in the implementation of SCP in automobile industries are identified and analyzed with the help of the GRA technique. The GRA technique is a qualitative and quantitative approach that is used globally as an MCDM method to solve the complicated relationship problems having uncertainties. GRA is a productive estimation method that is comprehensively utilized for MCDM problems, particularly where there is uncertainty in decision-making (Ju-Long, 1982, 1989, Wen, 2016). It evaluates the association of each factor by measuring the correct solution (Song et al., 2014; Hashmi et al., 2015,). Following are the steps of GRA.

Step 1: In the first step, the values for the assessment of HR factors are collected from experts to form a decision matrix. The decision matrix is constructed as:

$$B = \begin{pmatrix} w_{11} & w_{12} & \cdots & w_{1l} \\ w_{21} & w_{22} & \cdots & w_{2l} \\ \vdots & \vdots & \ddots & \vdots \\ w_{k1} & w_{k2} & \cdots & w_{kl} \end{pmatrix} \tag{1}$$

where, ($1 \leq x < m$, $1 \leq y \leq n$) signifies the assessment rate of the x^{th} data sequence concerning criterion y.

Step 2: In this step, the data is normalized for all individual decision matrices. For loss, "Smaller-the better" criterion is used and for gain "Larger-the better" is utilized.

$$s_{xy} = \frac{w_{xy} - \min_x \left(w_{xy}\right)}{\max_x \left(w_{xy}\right) - \min_x \left(w_{xy}\right)} \tag{2}$$

Step 3: After step 2, using equation (2), the group of "larger-the-better" is achieved for all the criteria. Now the normalization matrix can be formed.

$$S = \begin{pmatrix} s_{11} & s_{12} & \cdots & s_{1l} \\ s_{21} & s_{22} & \cdots & s_{2l} \\ \vdots & \vdots & \ddots & \vdots \\ s_{k1} & s_{k2} & \cdots & s_{kl} \end{pmatrix} \tag{3}$$

Additionally, the reference sequence is explained

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$$\Delta_{xy} = \left| S_{xy} - S_{xy_{\max}} \right| \tag{4}$$

The difference matrix is created as

$$\Delta = \begin{pmatrix} \Delta_{11} & \Delta_{12} & \cdots & \Delta_{1l} \\ \Delta_{21} & \Delta_{22} & \cdots & \Delta_{2l} \\ \vdots & \vdots & \ddots & \vdots \\ \Delta_{k1} & \Delta_{k2} & \cdots & \Delta_{kl} \end{pmatrix} \tag{5}$$

Step 4: The grey relational coefficient is determined as

$$\gamma_{xy} = \frac{\Delta_{\min_{xy}} + \xi.\Delta_{\max_{xy}}}{\Delta_{xy} + \xi.\Delta_{\max_{xy}}} \tag{6}$$

Where, y ξ ($0 \leq \xi \leq 1$) indicates the distinguishing coefficient which is utilized to direct the range of the grey relational coefficient, generally y $\xi = 0.5$ (Rajesh and Ravi, 2015).

Step 5: In this step, the rank and grey relational degree of the factors are determined using the given equation.

$$\Gamma_x = \sum_{y=1}^{l} \left[z_y \times \gamma_{xy} \right], \quad \sum_{y=1}^{l} z_y = 1 \tag{7}$$

where, z_y represents the weight of the y^{th} criterion.

Grey relational degree represents the correlation among reference sequences and compared sequence. Priority rankings can be estimated based on gray relational degrees. The grade having the lowest relation is identified as the best solution.

4. Data Analysis and Results

In the current study, 6 human resource factors (HRF1, HRF2, HRF3, HRF4, HRF5, HRF6) were identified through literature study and analyzed with the help of expert's judgment from industry to ascertain the factors related to HR for SCP adoption in automobile supply chain. The experts were asked to rank the factors on the basis of priority using a scale of 1 – 6 (where, 1- most

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significant and 6- least significant). Table 1 shows these factors. HR factors were analyzed using GRA to determine their precedence rank.

The data collected after expert's judgment is shown in Table 2.

Table 2. Determination of data of HR factors in SCP

S.No.	Factors of HR for SCP	Expert 1	Expert 2	Expert 3
1	HRF1	2	3	2
2	HRF2	3	4	3
3	HRF3	5	6	6
4	HRF4	6	5	4
5	HRF5	4	1	5
6	HRF6	1	2	1

The decision matrix is then constructed using equation (1),

$$B = \begin{pmatrix} 2 & 3 & 2 \\ 3 & 4 & 3 \\ 5 & 6 & 6 \\ 6 & 5 & 4 \\ 4 & 1 & 5 \\ 1 & 2 & 1 \end{pmatrix}$$

After the formation of the decision matrix, by using equation (2), the normalization and reference sequence are calculated and are given in Table 3.

Table 3. Normalization and reference sequence for HR factors in SCP

Factors of HR for SCP	Expert 1	Expert 2	Expert 3
HRF1	0.20	0.40	0.20
HRF2	0.40	0.60	0.40
HRF3	0.80	1.00	1.00
HRF4	1.00	0.80	0.60
HRF5	0.60	0.00	0.80
HRF6	0.00	0.20	0.00

The normalization matrix is then constructed using equation (3),

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$$S = \begin{bmatrix} 0.20 & 0.40 & 0.20 \\ 0.40 & 0.60 & 0.40 \\ 0.80 & 1.00 & 1.00 \\ 1.00 & 0.80 & 0.60 \\ 0.60 & 0.00 & 0.80 \\ 0.00 & 0.20 & 0.00 \end{bmatrix}$$

Then the deviation sequence of the reference sequence is calculated with the help of equation (4) shown in Table 4.

As, $\Delta_{min} = 0.00$ and $\Delta_{max} = 1.00$.

The deviation sequence matrix is formed by using equation (5)

Table 4. Deviation sequence of HR factors in SCP

Factors of HR for SCP	Deviation sequence		
	Δxy (1)	Δxy (2)	Δxy (3)
HRF1	0.00	0.00	0.00
HRF2	0.00	0.00	0.00
HRF3	0.00	0.00	0.00
HRF4	0.00	0.00	0.00
HRF5	0.00	0.00	0.00
HRF6	0.00	0.00	0.00

Finally, the calculation of grey relational grade and coefficient is done by employing equations (6) and (7) presented in Table 5.

Table 5. Grey relational coefficient and grey relational grade of HR factors in SCP

Factors of HR for SCP	Deviation sequence			γxy = 1/3(γxy (1)+γxy (2)+γxy (3))	Rank
	γxy (1)	γxy (2)	γxy (3)		
HRF1	0.38	0.45	0.38	0.408	5
HRF2	0.45	0.56	0.45	0.488	4
HRF3	0.71	1.00	1.00	0.905	1
HRF4	1.00	0.71	0.56	0.757	2
HRF5	0.56	0.33	0.71	0.534	3
HRF6	0.33	0.38	0.33	0.350	6

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5. Discussion of Findings

According to the findings of this study and calculations based on the GRA technique the factors are ranked as HRF3 > HRF4 > HRF5 > HRF2 > HRF1 > HRF6. The HR factor 'Commitment and transparency of stakeholders towards the standardization of products (HRF3)' acquire the first rank. Stakeholders and employees have a commitment towards their organization to ensure sustainability practices to advance the organization's performance and status (Rettab et al., 2009). The HR factor 'Understanding customer's need about sustainability (HRF4)' holds the second rank. They are implanted in relatively stable functioning networks of social and physical circumstances and each day practices that are part of the customer's daily activities (Spaargaren and Van Vliet, 2000; Schafer et al., 2012). The HR factor 'Expertise of workforce (HRF5)' holds the third rank. As per Callenbach et al. (1993), for the organization to be sustainable, managing and technical skills of employees are having high priority. The HR factor 'Participation of stakeholders in decision making (HRF2)' holds the fourth rank. Sustainability professionals and stakeholders act as transformational operators (Visser and Crane, 2010; Hesselbarth and Schaltegger, 2014). The HR factor 'Attitude and awareness of human towards SCP (HRF1)' holds the fifth rank. Customers have brought issues to light that increasingly sustainable purchasing conduct could be accomplished with the assistance of SCP related data. As per the studies, an expanding number of customers are taking moral, environmental, and social influences in their purchases (Grunert et al., 2014). The HR factor 'Trust among the members of supply chain (HRF6)' holds the sixth rank. Trust among members of the supply chain has been instrumental in the execution of SCP in an organization (Kausar et al., 2017).

6. Conclusion and Future Work

Employees are believed to be the leading assets for any business, where top performers are considered as the engine and drivers of advancement for the organization. In this study, 11 HR factors to establish SCP in an automobile industry were identified based on literature survey and expert's input. These factors were then analyzed using GRA (Grey Relational Analysis) with the help of expert's feedback. The factors are arranged on the basis of their preference order as HRF10 > HRF9 > HRF5 > HRF8 > HRF11 > HRF3 > HRF7 > HRF4 > HRF2 > HRF1 > HRF6. The HR factor 'Organizational culture and vision (HRF10)' stands first whereas HR factor 'Trust among the members of supply chain (HRF6)' stands last.

In this research, GRA is utilized to investigate the SCP based HR factors for the automobile industry. This analysis can be elaborated for other sectors such as power, medicine, etc. Also, in further studies GRA can be combined with other techniques such as Grey DEMATEL, AHP, Graph theory, etc to get more precise outcomes.

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