



Evaluating the human resource related soft dimensions in green supply chain management implementation

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Abstract: Due to increased carbon emissions, environmental protection initiatives have gained significant attention at global level. One of the major initiatives taken by the industrial sector to minimise the negative environmental effect of the value chain activities is Green Supply Chain Management (GSCM). In industry, soft (human resource-related) dimensions influence the implementation of GSCM process greatly. In the literature, relatively less discussion is provided on assessing the significance of soft dimensions in efficient GSCM acceptance in industry. The present work is an attempt to construct a structural framework for assessing the significance of the soft dimensions in adopting GSCM concepts by taking a case of automotive company in India. A hybrid approach of Best Worst Method (BWM) and Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach is employed in this work. BWM is used to prioritize the GSCM oriented soft dimensions, and DEMATEL is employed to extract interrelationships among them. The result shows that 'Top management commitment', 'Employee involvement', 'Organizational culture' and 'Teamwork' are the highly prioritized causal soft dimensions in efficient GSCM adoption. This research work would help industry managers and practitioners to decide where to concentrate for GSCM concepts in context of soft dimensions for sustainable business development.

Keywords: Green Supply Chain Management; Soft Dimensions; Best Worst Method; DEMATEL; Automotive Sector; India'

1. Introduction

In the current scenario, companies and investors are seeking to improve their financial performance together with adding more value to their supply chain activities (Walker and Jones, 2012; Shi and Yu, 2013). Business owners understood the importance of sustainability in their business, thus, considering the supply chain as one of the enabler leveraging business strategic capability with environmental friendly dimensions (Jabbour et al, 2017). The core functioning areas of supply chain are planning, sourcing and procurement, operations and logistics & distributions (Yang et al., 2013). These areas provide functional knowledge and framework to managers to make strategic trade-offs (Shi and Yu, 2013; Colangelo et al., 2018). The rapid manufacturing and industrialization growth leads to higher natural resources consumption and environmental degradation problems, all this evolve the concept of integrating environment with traditional SCM called as Green Supply Chain Management (GSCM) (Mangla et al., 2015; Luthra et al., 2015). The integration of environment dimensions into business corporate policies further results to high competitive advantages (Govindan et al., 2016). The companies are competing with each other in adopting leading edge practices *i.e.* competitive benchmarking, supplier quality evaluation, customer satisfaction evaluation, supplier partnerships and continuous improvement (Tokar, 2010; Muduli et al., 2013). The competitive advantage of industrial green value chains is enhanced by integrating human resource with systems and practices, so as to leveraging the superior human resource with advance systems and practices in GSCM adoption (Longoni et al., 2016). GSCM concepts helps industrial sector in terms of reduced costs, better working condition, better information flow and transparency across value chain, higher quality and delivery, sustainable business development etc. (Mangla et al., 2014; Govindan et al., 2016). To help further industries in GSCM implementation, Dubey et al., (2017) established a conceptual model combining hard as well as soft dimensions. In industries, the aspect of GSCM is important from many dimensions like human relationships, training and learning, and management development. Therefore, it is significant to address the soft dimensions (human related dimensions) rather than just focusing on the hard dimensions (strategy technology, and policy) in GSCM adoption (Sweeney, 2013; Luthra et al., 2016). There is, however, very few research focused on evaluating the soft dimension implications in GSCM adoption (Muduli et al., 2013; Dubey et al., 2017). In line with this, human related dimensions are generally neglected in supply chain context (Tokar, 2010). The major enhancement steps by experts have been primarily focused with technology structure and process issues (Dubey and Ali, 2015). All this led difficulties and encountered in GSCM due

to lack of poor integration of human related dimensions in its implementation (Gavronski et al., 2011; Gandhi et al., 2016; Longoni et al., 2016; Dubey et al., 2017; Jabbour et al., 2017).

In this contribution, this study is focused on developing a framework of evaluating the soft (human resource-related) dimension in implementing GSCM and set the following objectives:

- i) To identify the key soft dimensions in the implementation of GSCM;
- ii) To assess the listed GSCM oriented soft dimensions by knowing their priority rank and interrelationships in GSCM adoption.

In this work, an extensive review of literature and expert's inputs are used to list the key soft dimensions in GSCM adoption in an industry. Further, this work uses a hybrid approach of BWM and DEMATEL. BWM (Yadav et al. 2018) is used to prioritize the GSCM oriented soft dimensions, and DEMATEL (Saleem et al. 2016) is employed to extract interrelationships among the dimensions. The study is focused on developing a framework for assessing the soft dimensions implications in GSCM implementation using an Indian automotive case company. The automobile industry is one of the most promising and contributing industry in India (Gopal and Thakkar, 2016a). The role of SCM in this industry is significant for higher competitive advantages (Gopal and Thakkar, 2016b). The automobile industry in the recent times has been criticized for its increased hazardous effect on the environment (Luthra et al., 2018). Thus, it is important to consider the green concepts in automotive sector, and therefore we conducted a case of automotive company in this research.

The whole study is organized into six parts. The literature review is outlined in part two. The methodology is given in part three. Part four provides the case study results. Discussion and implications are provided in part five. The concluding remarks and further research recommendations are given in part six.

2. Literature Review

This section includes relevant literature review, proposed soft dimensions in GSCM adoption and used MCDM methods in GSCM adoption and research gaps for this work.

2.1 Green Supply Chain Management

Supply chains are becoming indispensable for the completion of the transaction cycle between manufacturer and customer (Hsu et al., 2013; Petrillo et al., 2017). Therefore,

preventive action needs to be taken to include the eco-friendly aspects in the business line (Agi and Nishant, 2017). To protect the environment and control pollution, companies are trying hard to adopt prevention strategy. Therefore, to achieve an appropriate prevention strategy, a large number of companies have started to switch themselves from traditional concepts of SCM to a new framework of supply chain called as the GSCM (Hsu et al., 2013; Malviya and Kant, 2016; Mumtaz et al., 2018b). To understand and explain the GSCM concept, various definitions are available in the literature. Lin (2013); Mangla et al. (2014); Agi and Nishant, (2017) described GSCM as the practice of improving environment performance of our existing supply chain. The concluding remarks of all the definitions is that GSCM is the consideration of protection of the planet in our supply chain system which start from product design to the end-of-life management of green products (Dubey et al., 2015; Luthra et al., 2016). GSCM can mitigate the negative effect that the various steps involved in the supply chain causes to the environment in which they operate (Buyukozkan and Ciftci, 2012). GSCM takes into consideration all the facets related to the business such as purchasing, manufacturing and finally delivering the product to the end user. GSCM pertains to the trap the value from the exhausted products as well (Tyagi et al., 2015; Dubey et al., 2015; Gandhi et al., 2016; Malviya and Kant, 2016).

In today competitive business environment, the performance of the organisation is not only based on finance but also environmental performance, therefore the implementation of GSCM is not only the results in an improved organizational competitive position, but also it also essential in having an enhanced environmental image (Gandhi et al., 2015; Luthra et al., 2015). The appropriate implementation of the GSCM requires the fulfilment of the four basic activities *i.e.* green inbound operation, green production operation, reverse logistic, green outbound operations (Hsu and Hu, 2008; Mudgal et al., 2010). GSCM has been built upon two fundamental primary advents. First, the environmental impact of the product is gauged to make sure the externalities do not affect the surroundings. Once the managers receive satiating results from it, the future course of action is initiated. Second, the practices in the industry are now focusing on converging to maintain a balance between environment issues and the supply chain management (Hsu and Hu, 2008; Mumtaz et al., 2018a). This approach has been largely observed due to the pertinent need of keeping a check on the environmental activates practiced by the corporate. Also, the GSCM helps in extending and maintaining a bare minimum equilibrium between the legal and regulatory standards for the permissible pollution level. Hence, all of this results in the reduction in the wasteful usage of the natural

resources (Dubey and Ali, 2015). It well justified the need of GSCM execution in any organization.

2.2 Proposed Soft Dimensions in GSCM

Dubey et al. (2017) proposed a conceptual dimensions framework for effective implementation of GSCM and divided all the dimensions into soft (human-related) and hard (strategy, technology and policy) with support references (p.14, Dubey et al., 2017). They suggested that for effective implementations of GSCM, the separate evaluation of these dimensions is required in future research studies. Therefore, take this motivation and after discussion with case company experts, it was decided to conduct this study only for the measurement of soft dimensions. The previous literature supported that in the implementation of GSCM, soft dimensions play an important role for an organization (Gavronski et al., 2011; Dües et al. 2013; Dangelico, 2016; Govindan et al., 2016; Longoni et al., 2016; Dubey et al., 2017; Jabbour et al, 2017). For identifying GSCM related soft dimensions, the Systematic Literature Review (SLR) approach was used in this study (Gunasekaran et al., 2015; Mangla et al., 2018; Yadav et al., 2018). Based on the following criteria the relevant papers are selected:

- (1) Papers should include relevant soft dimensions in implementations of GSCM. The following keywords were used for searching articles for the data bases like ‘soft dimension’, ‘behaviour factors’, ‘human related factors’, ‘critical human success factors’, ‘enablers’ and their combinations including: (1) human success critical factors and green supply chain management, (2) influencing behaviour factors and green supply chain management, (3) human success critical factors and automobile industry (4) human drivers and green supply chain management.
- (2) The following databases were used to collect the papers: Google Scholar, Science Direct, Scopus, Taylor and Francis, Springer, and Emerald. All collected articles further were refined as per the set criteria: the language of article must be English, journals from which a particular article has been take must be peer-reviewed and book chapters.
- (3) After identification of relevant articles and finding the dimensions, the brain storming sessions were conducted with experts from industry and academic. These sessions helped us a lot not only to remove the overlapping problem among dimensions but also regrouped if the authors used same dimensions with different names and phrases.

After following above steps, the final selected GSCM oriented soft dimensions are described as below and more details about their validation are provided in Section 5.1.

2.2.1 Top management commitment

The commitment from the top management is important for strategic planning at corporate level and then cascade it to bottom in root of business internal as well as external processes (Govindan et al., 2016). Top management in GSCM is the dominant driver of corporate endeavours (Dües et al. 2013) and it has significant power and ability to support and influence the actual integration of environment in supply chains (Muduli et al., 2013). Top management is an integral part of the main policy in implementation of green initiatives (Dües et al., 2013). Top management understands mutual influence and working among the barriers for internal as well external processes, so that they able to provide their counter ideas with continuous support for GSCM (Buyukozkan and Ciftci, 2012).

2.2.2 Employee involvement

The companies are responsible to create value for their business through competitive advantage *i.e.* the best quality of product, service provided to customer or affordability of product or service (Luthra et al., 2011; Tyagi et al., 2015; Gandhi et al., 2016). A company with a high quality of employees provides a higher company performance and results better value creation in different processes (Shi and Yu, 2013). A higher employee involvement provides new and innovative ideas, learning and therefore, the implementation of new technologies is easier in this collaborative approach (Muduli et al., 2013). An employee involvement environment of organization not only helps the organization to empower their employee for learning but also motivate them to think about new and innovative ideas (Jabbour et al., 2014; Tyagi et al., 2015; Gandhi et al., 2016; Malviya et al., 2018). Hence, employee involvement and creativity is a crucial environment problem solving resources for organizations (Govindan et al., 2016).

2.2.3 Customer relationship management

CRM is an important factor for managing a company internal as well external interaction with current and future customers. It enhances value creation and smoothen the information flow among players. It involves using new technology and initiatives to organize, standardize, automate, and synchronize company sales, marketing with technical support and customer service (Baines et al., 2012; Diabat et al., 2014). In today competitive environment, the GSCM is focusing on creating value to the customers and the companies through customer relationship management strategically. When customers value the customer service that they receive from a company through green distribution and marketing in GSCM, these customers are less likely to switch to competitor's alternatives for their needs. Literature suggests that the companies are strengthening their customer relationship management and growing their significance understating of customer's critical dimensions. Soft skills

(communication) trainings are part of this dimension because effective CRM is not only help the organization to create good relationship with customer but also help to maintain good interrelationship with each stakeholder (Diabat et al., 2014; Shibin et al., 2016). These learning and relationship enables companies to gain competitive advantage (Baines et al., 2012).

2.2.4 *Corporate green social responsibility*

A corporate green social responsibility (CGSR) activity involves taking care of environment and spending by corporate in green initiatives (Orlitzky, et al., 2011). Practically, there are very few corporate, which spend a huge amount in green initiative as a part of their corporate green social responsibility. These initiatives are rather used as a form of advertisement. Variety of work has been conducted related to corporate social responsibility and most of them taken it as a factor for researching customer satisfaction (Green et al., 2011; Shibin et al., 2016). Besides, corporate green social responsibility is a major factor which enhances value of brand/corporate for customers, similar finding are claimed by Orlitzky, et al. (2011), while researching impact of corporate green social responsibility in customer buying behaviour for any brand. Through initiatives of CGSR, all businesses have started showing their commitment towards environment and society. Now they understand that CGSR practices are not only advocates the relevance of sustainable development but also ensures an improvement in the overall performance of the business (Jabbour et al., 2015; Singla et al., 2018). Under CGSR, organizations are providing the training to their suppliers about green practices in supply chain etc.

2.2.5 *Mutual understanding*

In respect of launching new product/service and implementations of new idea, the mutual understanding between various members of supply chain is very important (Kumar et al., 2017). This will increase the trust and understanding among employee and results in enhanced teamwork. The strong mutual understanding not only improves communications and dialogue, but also creates common strategic vision for the organization in implementing GSCM concept (Barve et al., 2008). This will further improve relations of management with employees that can endure green focused changes in the business (Jabbour et al., 2014).

2.2.6 *Organisational culture*

It is a system of shared beliefs, value and assumptions, which governs how people's behave in different setting in organizations (Lee and Klassen, 2008; Jabbour et al., 2014). The most effective driver for implementing green supply chain is organization internal drivers (Jabbour and Santos, 2008; Shibin et al., 2016). Culture of any organization depends on leadership

team as well as employees. The effective information flow is the key to implement any initiative, which is only possible if we take care of organizational culture and use it as a positive driving force for implementing green initiatives (Irajpour et al., 2012; Patil and Kant, 2014). Internal as well as external factors need to be examined for efficient GSCM adoption (Muduli et al., 2013). Organization culture is one of the internal factors of the organization which plays important role for environment commitment of employees as well as management of the organization (Dubey et al., 2017; Malviya et al., 2018). Eco-friendly organization culture of the business helps the organization many ways; for instance increase the trust of employee and customer, empowering both employee and customer come-up with new and innovate idea, green initiatives training to their employee and customer etc. (Rosario and René, 2017; Kim et al., 2019).

2.2.7 Teamwork

In today's context, teamwork has become a key to success for any organization, without teamwork it is almost impossible for any organization to achieve its vision, mission and goals (Jabbour and Santos, 2008; Walker and Jones, 2012). GSCM integrates environmental concepts, which include minimization of utilization of harmful material, process, and any type of activities which adversely affects environment, therefore behavioural factors plays a vital role in implementing green initiative across the value chain (Pinjani and Palvia, 2013). Hence, the behavioural factors, such as teamwork, and understanding their influence in GSCM becomes very significant. There is a direct link between implementation of greener initiatives in supply chain and collective behaviour of organization (Nissen et al., 2014; Fruchter and Medlock, 2015).

2.2.8 Green motivation

Motivation has always being a key driver for the success of an organization (Liou et al., 2016). When the motivation is about the betterment of environment and green sustainability then this driving force is called green motivation. The concept of GSCM has now become the key to achieve sustainable holistic growth for any organization (Mangla et al., 2014; Luthra et al., 2016). Without ensuring green processes at every step of supply chain, it is not possible to achieve green supply chain. There is a potential linkage between employee motivation and green SC initiatives (Sharma et al., 2017). Vanpoucke et al. (2016) determined that motivation of stakeholder plays a vital role in initial stages of GSCM concept.

2.2.9 Social green innovation

The companies need to design its value chain and internal processes to enable their employees to involve in creative and innovative work or assignments that are focused towards business growth and sustainability (Dangelico, 2016). The companies having incorporated environment in their corporate strategies are investing in research and development and promoting green innovation in organisation. These innovative ideas must support optimum usage of natural resources with social and environmental consideration (Muduli et al., 2013)

2.3 Multi Criteria Decision Analysis and GSCM

In literature, many studies have been conducted by researchers where they used Multi Criteria Decision Making (MCDM) methods in the context of GSCM. MCDM methods allow managers to manage many dimensions at time and to select the best one (Liou et al., 2016; Kumar et al., 2017; Ishizaka and Siraj, 2017; Yadav et al., 2018). With the help of MCDM technique, more inconsistent dimensions which have different unit of measurement can be handled easily (Ishizaka and Nemery, 2013). The various contributions using different MCDM methods in the context of GSCM are given in Table 1.

Table 1. Contributions and applied MCDM methods in GSCM

| Authors | Contribution | Applied MCDM methods |
|-----------------------------|--|---------------------------------|
| Hsu and Hu (2008) | GSCM Implementation | Fuzzy AHP |
| Irajpour et al. (2012) | Evaluated the GSCM practices | Fuzzy DEMATEL |
| Chen et al. (2012) | Evaluated the business strategy and GSCM adoption | ANP |
| Hsu et al. (2013) | Carbon based supplier selection model | DEMATEL |
| Lin (2013) | Evaluated the GSCM practices | Fuzzy DEMATEL |
| Mangla et al. (2014) | GSCM performance enhancement | DEMATEL |
| Mirhedayatian et al. (2014) | Evaluated the GSCM practices | Novel Data Envelopment Analysis |
| Wu et al. (2015) | Explored the decisive factors in GSCM | Fuzzy DEMATEL |
| Wu and Chang (2015) | Identified the critical factors in GSCM implementation | DEMATEL |
| Rostamzadeh et al. (2015) | Evaluated the GSCM practices | Fuzzy VIKOR |
| Gandhi et al. (2015) | Evaluated the factors in GSCM implementation | DEMATEL |
| Liou et al. (2016) | Selected the suppliers in GSC context | Hybrid COPRAS-G |
| Govindan et al. (2016) | Evaluated the GSCM adoption | DEMATEL |
| Gandhi et al. (2016) | Evaluated the success factors of implementing GSCM | AHP and DEMATEL |

Table 1 showed that in previous studies used many MCDM techniques to analyse the GSCM concepts. However, no application is available where a hybrid approach of BWM-DEMATEL is employed for measuring soft dimensions related to GSCM. A hybrid approach of BWM-DEMATEL technique is new and provides superior outcomes.

2.4 Research Gaps

From the perspectives of decision makers and practitioners in the context of GSCM, following research gaps are identified:

- Tokar (2010) examined that human resource and employee behaviour have been largely neglected in GSCM. The organizations primarily consider the hard dimensions (system and technology) in minimizing their ecological impacts and soft (people) dimensions and human behaviour, who is primarily responsible to execute these hard dimensions are ignored (Sweeney, 2013). This leads to poor integration of human related dimensions with GSCM adoption in industry (Muduli et al., 2013; Govindan et al., 2016).
- For sustainable business development, the commitment of an organization to implement GSCM is required. However, without proper understanding the role of soft dimensions in GSCM, it is difficult to enhance organizational environment performance. The soft dimensions refer to human resource-related dimensions, are playing a significant role in implementing GSCM. Little attention has been paid by researchers to find the key soft dimensions in implementing GSCM in an industry (Dangelico, 2016; Longoni et al., 2016; Dubey et al., 2017). In addition to this, hardly there has been any study reported, which deals with both the qualitative or quantitative aspects for assessing the soft dimensions implications in GSCM adoption.
- GSCM literature has evolved with human resource being incorporated in theoretical frameworks in different aspects (Dües et al., 2013; Jabbour et al., 2017). This study is focused on developing a structural framework to address the concept of soft or people dimensions, in efficient GSCM adoption in an industry. This work seeks to know the priority rank and interrelationships among the soft dimensions identified from literature and inputs received from the experts in GSCM implementation.

3. Solution Methodology

Three phase approach used as a solution methodology (see Fig.1). In the first phase, identification of the soft dimensions is done. In the second phase, BWM method is used to know the priority rank of identified GSCM focused soft dimensions and to analyse the cause interrelationships among dimensions, DEMATEL method is employed. This will further help managers in assessing the implications of soft dimensions in efficient GSCM concepts and sustainable business development.

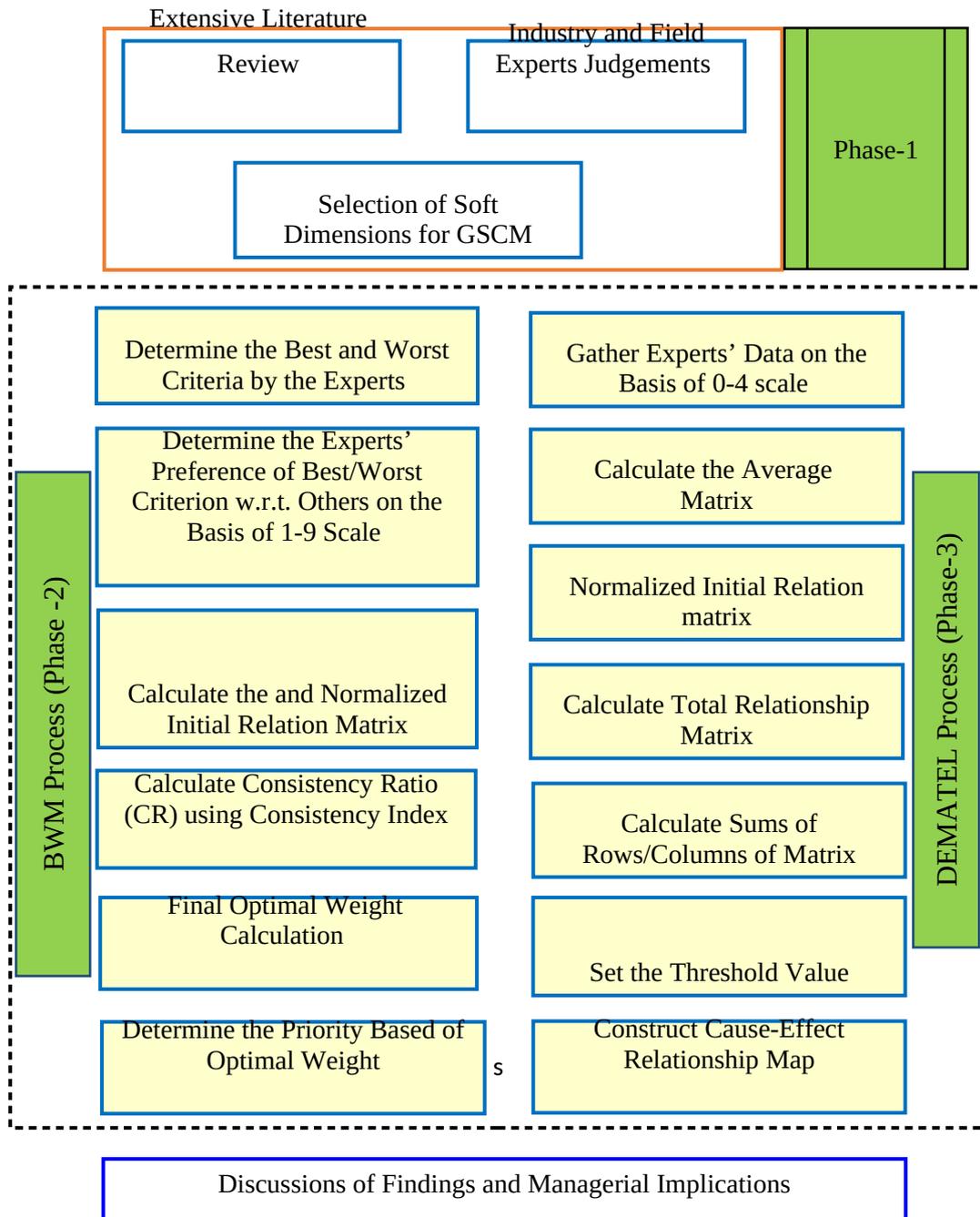


Fig. 1. Methodology of the study

The methodology of this work consists of three phases - in first phase, identification of the important dimension related to soft dimension for in GSCM by industrial and field expert inputs along with literature resources. In the second and third phase, priority rank of the soft dimensions is determined by BWM, and the causal interrelationships among the dimensions are analysed using DEMATEL method.

A brief details of these methods are provided in the below subsections.

3.1 Best Worst Method (BWM)

BWM was developed by [Rezaei \(2015\)](#). BWM allows making the pair wise comparisons of the selected best dimension to the other dimension and all the other dimensions to the selected worst dimension. BWM technique has been widely used by researchers in different decision making situation, such as segmentation of suppliers ([Rezaei et al., 2016](#)), measurement of risk ([Torabi et al., 2016](#)), supply chain management ([Ahmadi et al., 2017](#)), medical tourism development ([Abadi et al., 2018](#)), outsourcing and offshoring decision making ([Yadav et al., 2018](#)) etc. The various steps used in BWM are given as follows:

Step 1. Identify the decision dimensions. The potential soft dimensions (D_1, D_2, \dots, D_n) needs to be recognized.

Step 2. Identify the best and the worst dimension. The best dimension is the most preferred, the most important or the most desirable while the worst is the opposite of it, the least preferred, the least important or the least desirable.

Step 3. Identify the preference of the best dimension over others based on 1-9 scale (1 for the equal important to the best dimension, 9 shows the best dimension is most preferred over the other) the resultant of best-to-others vector would be:

$$A_B = [a_{Bj}], \quad (1)$$

Where, a_{Bj} indicates the preference of the best dimension B over dimension j .

Step 4. Identify the preference of each of the other dimension over the worst dimension, where, 1 for the worst dimension and 9 for the most important, the others-to-worst vector would be:

$$A_w = [a_{jw}], \quad (2)$$

Where, a_{jw} indicates the preference of the dimension j over the worst dimension W .

Step 5. Calculate the weight of each dimension. The details of further essential calculations as given by [Rezaei \(2015\)](#) are provided in an Appendix A. The optimal weights

$(w_1^i, w_2^i, \dots, w_n^i)$ and the optimal value of ξ , called ξ^* are obtained. Taking the help from Consistency Index (CI) Table 2, we can estimate the consistency ratio (CR), using ξ^* and the corresponding consistency index, as below:

$$CR = \frac{\xi^i}{CI} \quad (3)$$

Value of the CR, closer to zero means the high consistent.

Table 2. Consistency Index (CI)

| | | | | | | | | | |
|--------------------------------|---|------|---|------|-----|---|------|------|------|
| a_{BW} | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Consistency index (max ξ) | 0 | 0.44 | 1 | 1.63 | 2.3 | 3 | 3.73 | 4.47 | 5.32 |

3.2 DEMATEL

DEMATEL is a useful tool to develop the cause-effect model of the selected variables (Wu and Chang, 2015; Saleem et al., 2016). This method is originally developed by Fontela and Gabus (1972). DEMATEL technique has been widely used by researchers in different decision making situation, such as knowledge management (Wu, 2008), e-marketplace (Kumar and Dash, 2016), supplier selection (Liou et al., 2016), emergency management (Zhou et al., 2017), job satisfaction (Tsai, 2018) etc. The steps involved in the DEMATEL process are mentioned below.

Step 1: To define the criteria (dimensions) for the research. The potential soft dimensions needs to be recognized.

Step 2: To frame the direct relation matrix, the average direct relation matrix (A) is formed using Eq.(4) for all experts' (p) opinions

$$A = a_{ij} = \frac{1}{p} \sum_{k=1}^p X_{ij}^k \quad i, j=1, \dots, n \quad (4)$$

Step 3: The matrix normalization is obtained applying Eqs.(5-6):

$$U = k \times V, \quad (5)$$

$$k = \min \left(\frac{1}{\max_i \left(\sum_{i=1}^n a_{ij} \right)}, \frac{1}{\max_j \left(\sum_{j=1}^n a_{ij} \right)} \right), i, j = 1, 2, \dots, n.$$

(6)

Step 4: Compute the total relation matrix (T) using Eq.(7):

$$T = U(I - U)^{-1} \quad (7)$$

The sum of rows and columns of matrix (T) are obtained by Eqs.(8-9) as below:

$$r = [r_i]_{n \times 1} = \left[\sum_{j=1}^n t_{ij} \right]_{n \times 1}$$

(8)

$$c = [c_i]_{1 \times n} = \left[\sum_{i=1}^n t_{ij} \right]_{1 \times n}$$

(9)

Where t_{ij} is total relation matrix, for $i, j = 1, 2, \dots, n$.

Step 5: In order to obtain the digraph and to eliminate minor effects Eq.(10) is used.

$$\alpha = \frac{\sum_{i=1}^n \sum_{j=1}^n [t_{ij}]}{N} \quad (10)$$

Where, N represents all elements in matrix T . The values greater than (α) are considered and plotted on the digraph.

4. Case Study

The case company is the largest two wheeler automotive manufacturer in India. With a rich and dynamic network of dealers and service outlets across the country, the company vision is to extend the best in class automobile products to the society and expands its own horizons to create new and meaningful products for its customers. The company have four major manufacturing plants, which have a huge production capacity of deploying more than 72 lakhs two wheelers in the market annually. The company has a total of 17 products that it provides to its customers across geographical boundaries. The company with 108th spot rank in Forbes list holds 46 per cent market in the country, is thorough with its grip on the market, and retains its top spot of being the most trusted and selling automobile brand in India. The annual turnover of company is INR 5800 Crores and currently has 11,000 employees. The case company is engaged with manufacturing of four stroke, electric motorcycle and scooters of varied engine specifications. Having established itself in the conventional automobile segment in and off the country, the company is now trying to diversify its portfolio towards electric vehicle segment in the country. The company is very much involved in setting new environmental friendly and contributing activities in motion. There are many green initiatives taken by the company i.e. energy conservation, rain water harvesting, waste recycling, zero liquid discharge, paint conservation, maintaining green roofs and consideration of sustainability issues etc.

The role of maintaining a robust and efficient supply chain for an automobile company is indispensable. The case company has realized it and hence, managers launched the ‘Green Supply Chain Management initiative’. The GSCM initiative is a dedicated approach towards making the stakeholders understand the importance of maintaining a green and sustainable environment while being a market player. The company is continuously looking to improve its performance through GSCM initiatives. Management of the case company intends to identify and analyse the soft (human resource related) dimensions for efficient green concepts in the supply chain. A group comprising of 9 experts was formed whose expertise detail is provided in Table 3. The data collection for this research was carried out in the months of November and December, 2017.

Table 3. Expertise detail of the experts

| Expert | Education | Experience in years | Major Role and Responsibilities |
|---------------|------------------|----------------------------|---|
| 1 | B. Tech, MBA | 15 | Head strategy supply chain planning, responsible for creating supply chain strategies for increasing efficiency and speed. |
| 2 | B. Tech | 15 | Strategic planning and purchasing, sourcing and supply chain, inventory management. |
| 3 | B. Tech, PGDBM | 15 | Senior supply chain managers, monitoring supply chain planning and operations. |
| 4 | B.E, MBA | 12 | Supply chain planning and operations, collaborate with other departments to identify vulnerabilities and close operational gaps |
| 5 | B. Tech | 15 | Head of supply chain department in plant two, inventory management and optimize warehouse functions. |
| 6 | B.E. | 14 | Head strategic sourcing and vendor selection, supply chain planning and operations. |
| 7 | B. Tech, | 12 | Vendor selection, supply chain planning and operations. |
| 8 | B. Tech, MBA | 12 | Outsourcing, supply chain and logistics management. |
| 9 | B. Tech, MBA | 15 | Supply chain planning and reviewing supply chain practices, update to top management. |

4.1 Phase 1- Finalization of Soft Dimensions

For finalizing the soft dimensions, the selected experts were contacted individually. The literature based nine GSCM focused soft dimensions were presented to experts for their feedback. For this, a survey questionnaire was designed as shown in Appendix B. The experts were asked to specify which of the soft dimensions are relevant in implementing GSCM by selecting “1” for relevant and “0” for irrelevant. The experts were also asked to ‘please add any other soft dimensions’ to the list. Later, based on a discussion with all experts, they all agreed on 9 dimensions found in the literature (section 2.2). However, they strongly recommended that the dimension ‘Mutual Understanding’ is part of ‘Teamwork’. The experts suggested that mutual understanding certainly enriches the business green initiatives. However, mutual understanding and team working complements each other in developing nations, such as India so as to the very initial level of green initiatives in supply chain context (Pinjani and Palvia, 2013; Nissen et al., 2014; Fruchter and Medlock, 2015). In view of this, we studied these two dimensions together. In this way, a total of 8 human resource related soft dimensions to GSCM adoption are finalized, given as Top Management Commitment (SD1), Employee Involvement (SD2), Customer Relationship Management (SD3), Corporate Green Social Responsibilities (SD4), Organizational Culture (SD5), Teamwork (SD6), Green Motivation (SD7), and Social Green Innovation (SD8).

4.2 Phase 2- Priority Rank of Soft Dimensions using BWM

After identification of soft dimensions, we recorded the expert’s inputs for determining of the best and the worst dimensions. The best and worst dimension were identified as the most desirable and less desirable dimension in implementing GSCM through expert’s inputs as shown in Table 4.

Table 4. Identified best and worst soft dimension in GSCM adoption

| Dimensions | Identified as ‘Best’ by the experts | Identified as ‘Worst’ by the experts |
|-------------------|--|---|
| SD1 | E1, E2, E6, E7, E9 | |
| SD2 | | |
| SD3 | E8 | |
| SD4 | | E3, E4 |
| SD5 | E3, E4, E5 | |
| SD6 | | |
| SD7 | | E1, E6, E7 |
| SD8 | | E2, E5, E8, E9 |

In the next step, we identified the preferences of the identified best dimension over the others dimension. Comparison of the selected best dimension to all others dimension is performed by using scale nine-point scale (Rezaei et al., 2016) and is provided in Table 5.

Table 5. Best to other dimensions in GSCM adoption for nine experts

| Experts | Best | SD1 | SD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
|---------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | SD1 | 1 | 3 | 4 | 7 | 2 | 5 | 6 | 7 |
| 2 | SD2 | 1 | 3 | 6 | 4 | 2 | 4 | 3 | 6 |
| 3 | SD5 | 4 | 2 | 2 | 8 | 1 | 3 | 3 | 4 |
| 4 | SD5 | 2 | 2 | 6 | 8 | 1 | 3 | 4 | 5 |
| 5 | SD5 | 2 | 3 | 7 | 6 | 1 | 4 | 5 | 8 |
| 6 | SD1 | 1 | 3 | 6 | 8 | 4 | 5 | 7 | 4 |
| 7 | SD1 | 1 | 5 | 7 | 8 | 2 | 4 | 7 | 4 |
| 8 | SD3 | 2 | 3 | 1 | 2 | 4 | 7 | 6 | 8 |
| 9 | SD2 | 1 | 3 | 6 | 7 | 2 | 4 | 5 | 8 |

Next, we asked the experts to select their preferences of all soft dimensions over the least important dimension with details as provided in Table 6.

Table 6. Others-to-worst dimensions in GSCM adoption for nine experts

| Experts | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Worst | DS7 | SD8 | SD4 | SD4 | SD8 | SD7 | SD7 | SD8 | SD8 |
| SD1 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 7 | 9 |
| SD2 | 5 | 5 | 5 | 7 | 6 | 5 | 4 | 8 | 7 |
| SD3 | 5 | 2 | 3 | 2 | 2 | 4 | 2 | 6 | 4 |
| SD4 | 4 | 2 | 1 | 1 | 3 | 2 | 7 | 4 | 2 |
| SD5 | 4 | 6 | 6 | 8 | 8 | 2 | 3 | 5 | 8 |
| SD6 | 3 | 3 | 6 | 5 | 5 | 6 | 5 | 2 | 7 |
| SD7 | 1 | 2 | 2 | 3 | 4 | 1 | 1 | 3 | 3 |
| SD8 | 2 | 1 | 2 | 2 | 1 | 5 | 6 | 1 | 1 |

Consistency ratio (CR) for each respondent is close to zero, which means comparisons made were consistent (Rezaei, 2015; Rezaei et al., 2016). The consistency ratio of each response is given in Table 7.

Table 7. Consistency Ratio & ξ^* for all nine respondents

| Experts | A_{BW} | ξ^* | CR |
|---------|----------|---------|-------|
| 1 | 7 | 0.092 | 0.025 |
| 2 | 6 | 0.068 | 0.023 |
| 3 | 8 | 0.106 | 0.024 |
| 4 | 8 | 0.113 | 0.025 |
| 5 | 8 | 0.124 | 0.028 |
| 6 | 8 | 0.112 | 0.025 |
| 7 | 8 | 0.132 | 0.030 |
| 8 | 8 | 0.101 | 0.023 |
| 9 | 9 | 0.093 | 0.018 |

Next, the final optimal weight are calculated for all nine experts by following the calculation steps as mentioned in Appendix A and then do the mean of all nine expert's weights for every dimension. The final weight for each soft dimension is presented in Table 8.

Table 8. Final weights for each soft dimension for the decision makers

| Dimension | Weight | Rankin g |
|---|--------|-------------|
| Top Management Commitment (SD1) | 0.259 | 1 |
| Employee Involvement (SD2) | 0.102 | 5 |
| Customer Relationship Management (SD3) | 0.108 | 3 |
| Corporate Green Social Responsibilities (SD4) | 0.071 | 7 |
| Mutual Understanding (SD5) | 0.216 | 2 |
| Organisational Culture (SD6) | 0.102 | 4 |
| Teamwork (SD7) | 0.077 | 6 |
| Green Motivation (SD8) | 0.066 | 8 |

From Table 8, the most important dimension top management commitment (SD1) with 25.9% relative weight obtained the topmost rank, while organizational culture (SD5) with relative 21.6% and customer relationship management (SD3) with 10.8% relative weight are ranked to second and third place respectively. The priority rank of all eight dimensions is given above in Table 8.

4.3 Phase 3 – Causal Interrelationships among Soft Dimensions using DEMATEL

Based on procedural steps of DEMATEL, the average direct relation matrix of GSCM focused soft dimensions is formed using expert's inputs as depicted in Table 9.

Table 9. Average matrix of soft dimensions in GSCM adoption

| | SD1 | SD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|
| SD1 | 0.000 | 2.333 | 3.000 | 2.083 | 2.000 | 2.917 | 3.000 | 3.917 |
| SD2 | 3.000 | 0.000 | 3.833 | 2.000 | 2.417 | 1.500 | 2.250 | 0.083 |
| SD3 | 2.167 | 2.000 | 0.000 | 2.000 | 2.333 | 2.667 | 2.917 | 2.333 |
| SD4 | 2.667 | 3.000 | 2.000 | 0.000 | 2.417 | 2.833 | 2.000 | 2.083 |
| SD5 | 2.750 | 2.583 | 2.667 | 2.333 | 0.000 | 2.083 | 1.167 | 2.250 |
| SD6 | 2.000 | 2.917 | 2.917 | 1.000 | 1.167 | 0.000 | 1.333 | 2.167 |
| SD7 | 2.000 | 3.000 | 2.500 | 2.000 | 3.000 | 2.250 | 0.000 | 1.250 |
| SD8 | 1.500 | 2.917 | 2.000 | 1.000 | 1.167 | 2.000 | 3.917 | 0.000 |

The average direct matrix is converted into normalized matrix (U) using Eqs. (5-6) and result is given in Table 10.

Table 10. Normalized initial direct-relation matrix

| | SD1 | SD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
|--|-----|-----|-----|-----|-----|-----|-----|-----|

| | | | | | | | | |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| SD1 | 0.000 | 0.155 | 0.197 | 0.103 | 0.124 | 0.077 | 0.116 | 0.004 |
| SD2 | 0.064 | 0.000 | 0.103 | 0.155 | 0.129 | 0.103 | 0.155 | 0.116 |
| SD3 | 0.112 | 0.103 | 0.000 | 0.103 | 0.120 | 0.137 | 0.150 | 0.120 |
| SD4 | 0.137 | 0.155 | 0.103 | 0.000 | 0.124 | 0.146 | 0.103 | 0.107 |
| SD5 | 0.142 | 0.133 | 0.137 | 0.120 | 0.000 | 0.107 | 0.060 | 0.116 |
| SD6 | 0.103 | 0.150 | 0.150 | 0.052 | 0.060 | 0.000 | 0.069 | 0.112 |
| SD7 | 0.120 | 0.155 | 0.107 | 0.103 | 0.150 | 0.115 | 0.000 | 0.197 |
| SD8 | 0.077 | 0.150 | 0.103 | 0.052 | 0.060 | 0.103 | 0.202 | 0.000 |

Next, the total relation matrix (T) is commuted Using Eqs.(7-8) as shown in Table 11.

Table 11. Total relation matrix

| | | | | | | | | |
|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | SD1 | SD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
| SD1 | <i>0.623</i> | <i>0.806</i> | <i>0.707</i> | <i>0.578</i> | <i>0.663</i> | <i>0.704</i> | <i>0.595</i> | <i>0.713</i> |
| SD2 | 0.430 | <i>0.684</i> | <i>0.674</i> | 0.502 | 0.559 | 0.545 | <i>0.589</i> | 0.462 |
| SD3 | 0.556 | <i>0.684</i> | 0.537 | 0.520 | <i>0.577</i> | <i>0.623</i> | <i>0.650</i> | <i>0.587</i> |
| SD4 | 0.469 | <i>0.620</i> | <i>0.578</i> | 0.408 | 0.449 | 0.416 | 0.503 | 0.496 |
| SD5 | 0.561 | <i>0.682</i> | <i>0.638</i> | 0.519 | 0.451 | <i>0.576</i> | 0.559 | 0.557 |
| SD6 | <i>0.587</i> | <i>0.739</i> | <i>0.645</i> | 0.440 | <i>0.592</i> | <i>0.640</i> | <i>0.625</i> | <i>0.583</i> |
| SD7 | 0.513 | <i>0.582</i> | <i>0.619</i> | 0.558 | <i>0.579</i> | <i>0.591</i> | <i>0.647</i> | <i>0.580</i> |
| SD8 | 0.483 | <i>0.666</i> | <i>0.577</i> | 0.440 | 0.487 | 0.550 | <i>0.649</i> | 0.442 |

The sum total of rows and columns of total relation matrix (T) are compiled by Eqs.(9-10) as mentioned in Table 12.

Table 12. Impact results of soft dimensions in GSCM adoption

| Dimensions | r_i | c_j | $r_i + c_j$ | $r_i - c_j$ | Impact |
|-------------------|-------|-------|-------------|-------------|---------------|
| SD1 | 5.389 | 4.815 | 10.204 | 0.573 | Cause |
| SD2 | 4.445 | 4.222 | 8.667 | 0.223 | Cause |
| SD3 | 4.734 | 4.974 | 9.708 | -0.240 | Effect |
| SD4 | 3.938 | 4.646 | 8.583 | -0.708 | Effect |
| SD5 | 4.543 | 4.356 | 8.899 | 0.187 | Cause |
| SD6 | 4.851 | 3.964 | 8.815 | 0.886 | Cause |
| SD7 | 4.668 | 5.463 | 10.131 | -0.795 | Effect |
| SD8 | 4.294 | 4.421 | 8.715 | -0.126 | Effect |

To avoid minor impact, the threshold value (α) is computed by using Eq.(10).

$$\alpha = \frac{\sum_{i=1}^n \sum_{j=1}^n [t_{ij}]}{N} = 0.576$$

Only values $> \alpha$ were taken and used to build the influence network relationship map and these values have been made in 'italic' in matrix T (Table 11). The graphical cause-effect

representation of soft dimensions is figured in Fig.2 and the corresponding digraph is presented in Fig.3.

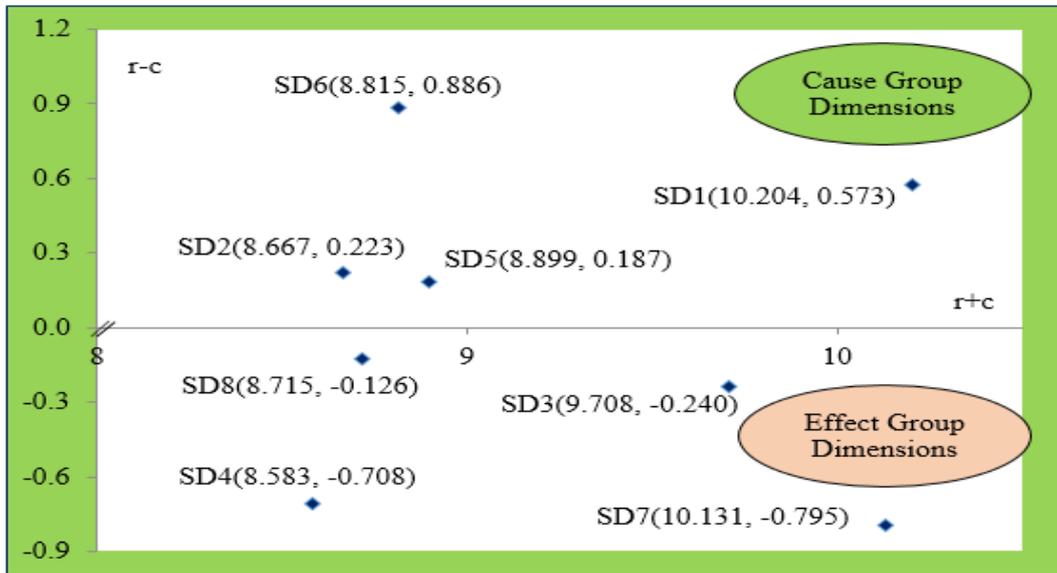


Fig.2 Graphical cause-effect representation of soft dimensions in GSCM adoption

The relationship digraph is built with values greater than the threshold of 0.576. For example, the element $oft_{12}(0.806) > \alpha(0.576)$; this relationship in the digraph is shown using arrow form SD₁ to SD₂ i.e. SD₁ effects on SD₂. In the same manner, all relationships among soft dimensions are constructed as shown in Fig.3.

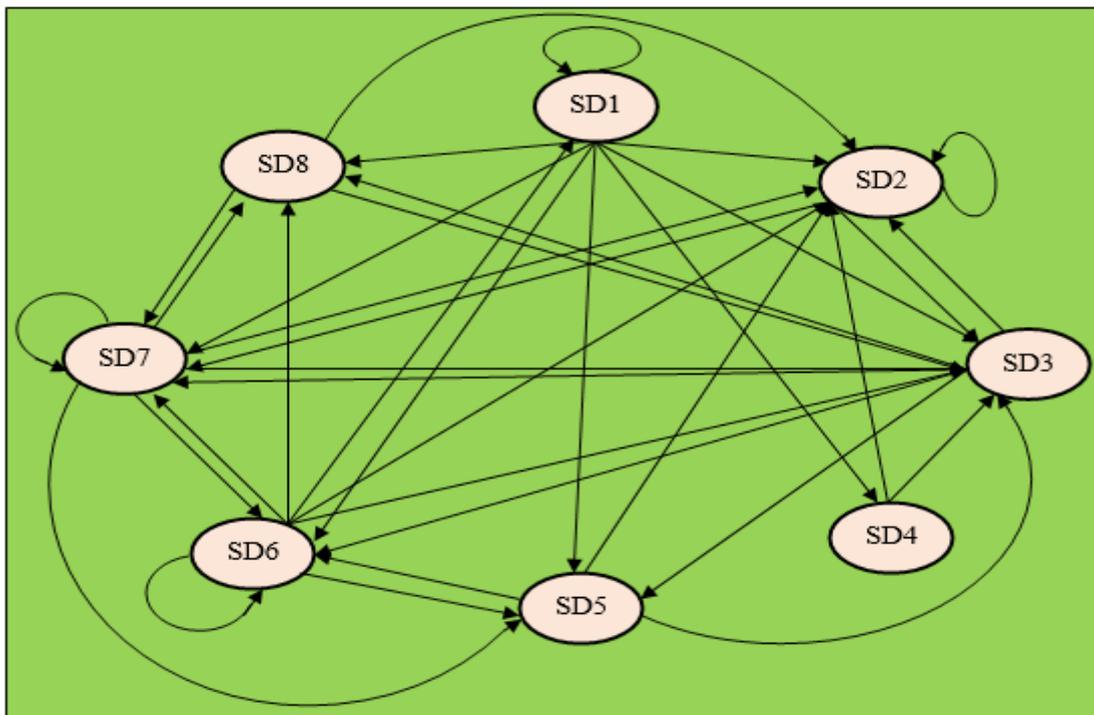


Fig.3 Relationship digraph of the GSCM oriented soft dimensions

The DEMATEL analysis divided all soft dimensions into cause and effect groups. Cause group dimensions have positive value of (r-c) and directly affect the other dimensions. Based on Table 12, the dimensions Top Management Commitment (SD1), Employee Involvement (SD2), Organizational Culture (SD5) and Teamwork (SD6) are cause group dimensions. The effect group dimensions have negative value of (r-c) and are affected by the others. The dimensions, Customer Relationship Management (SD3), Corporate Green Social Responsibilities (SD4), Green Motivation (SD7), and Social Green Innovation (SD8) belong to effect group.

5. Discussion of Findings

According to the findings, the soft dimension 'Top management commitment (SD1)' holds the first rank and is placed in cause group. This dimension is interrelated with all soft dimensions, which means all others soft dimensions are influenced by this dimension. To extend the global footprint and environment performance, the commitment of top management is crucial. Top management can effectively understand mutual interaction among the barriers for internal as well external processes, so as that they are able to provide counter solutions with continuous support for GSCM (Dües et al. 2013). Poor top management commitment supports GSCM barriers in aggregate form and results in decreased performance. Thus, top management allows developing mature integration within these value chain partners or players. Therefore, effective top management commitment and leadership is needed to integrate environmental and social components in business (Dubey et al., 2017). The case company managers should involve motivating their stakeholder to prefer sustainable procurement and consumption concepts.

The dimension 'Organizational culture (SD5)' acquires the second rank in the priority list and is placed in the group of cause dimensions. Most of the green initiatives adopted by industries are either due to statutory requirement of the state or due to visionary environment committed leadership and employees involvement. Organizational culture and the management techniques must be compatible with supply chain planning (Gandhi et al., 2015). The GSCM implementation is the resultant of variety of pressure that an organization feels. These pressures may be internal or external forces responsible for strategic transformations, such as adoption of green concepts in supply chain environment. The management of case company should support and develop the sustainable organizational culture environment in GSCM

implementation. The case company managers are suggested to motivate stakeholders for their responsibility in implementing GSCM in the value chain.

The dimension 'Employee involvement (SD2)' holds the fifth rank in priority list and belongs to the cause group dimensions. In the implementation of GSCM, employee involvement is very important and a critical dimension, therefore, the management of case company must empower their employee about their environment commitment (Liou et al., 2016; Shibin et al., 2016). In order to enhance value chain effectiveness in GSCM adoption, the case automotive company or related industries should support employee actions. Therefore, sustainable businesses must focus on ways how to encourage employees' involvement in environmental initiatives to improve competitive gains (Gandhi et al., 2016). The case company managers have suggested conducting training and development sessions to improve employee capabilities. A short term employee encouragement program can be initiated for more environmental consciousness among employee. As a resultant, the case company can motivate their employee about long term economic benefits significant to both the organizational level and the individual level.

The 'Teamwork (SD6)' dimension holds fourth rank in priority list and belongs to cause group dimension. Management support plays critical role in managing green initiatives and organizations green innovation might remain stuck in planning phase if it is not taken by management as top priority (Fruchter and Medlock, 2015). Management priority and interest triggers teamwork for implementation of GSCM. To this support, Dubey et al. (2017) stated that teamwork is very significant in accomplishing successful GSCM concepts in an industrial sector. The managers of the case company can improve the required teamwork for the implementation of GSCM in many ways. For example, the case company can run some educational programs to develop teamwork skills among employees. The project managers may recognize the best team effort and appreciate it by distributing small gestures of credit.

'Customer relationship management (SD3)', 'Corporate green social responsibilities (SD4)', 'Green motivation (SD7)' and 'Social green innovation (SD8)' are effect group dimensions and ranked at third, seventh, sixth and eighth positions respectively. The concept of GSCM has now become the key to sustainable holistic growth for any organization. If the management is motivated to implement GSCM definitely they have competitive advantages. In addition, it is concluded that employee motivation is key to successful GSCM. The industries are pushed to adopt GSCM concepts by its stakeholders and the motivation of stakeholders' is crucial in this. The managers should develop good relationships with their customers for greening their supply chains. They should develop their value chains to

motivate employees for creativity and innovations for business growth and sustainability (Rostamzadeh et al., 2015). The case company managers are suggested to invest in research and development and promote innovations, such as green, lean, six sigma, waste management etc. The case company managers are also suggested to be responsible to society through green concept. To be socially responsible, the managers are suggested to envisage initiatives, such as energy conservation, use of LED's, rain water harvesting, waste food recycling etc. These initiatives would assist case company and related industries to achieve green sustainability in a supply chain context.

5.1 Implications of the Research

The finding of the study can help managers and practitioners of the case company and related industries in efficient initiation and implementation of GSCM. With the increasing pressure from the stakeholders and government, the companies are now taking sufficient steps to execute the framework for having a successful GSCM concept (Luthra et al., 2011; Rostamzadeh et al., 2015; Dubey et al., 2017; Ahmadi et al., 2017). The case company is fully committed and using various strategies, technology and policy as well for adoption of GSCM. For instance, the case company started many green initiatives such as a green vendor development programme and under it the case company recently launched new motor bike which is a revolutionary green technology. In their green initiatives programme they are giving the priority of green efficiency in supply chain etc. In our study, survey made us for understand and role of soft dimensions for adoption of these programmes/green technologies in the case company in their supply chain process. There are many human related soft dimensions associated with structural implementation of GSCM (Gavronski et al., 2011; Govindan et al., 2016; Longoni et al., 2016; Dubey et al., 2017; Jabbour et al., 2017). After discussion with the case company area experts; among human related soft dimensions - top management commitment, employee involvement, customer relationship management, corporate green social responsibilities, organizational culture, teamwork, green motivation, social green innovation are identified for this work. Managers should focus on these human related dimensions for effective greening of the supply chain.

With rising environmental issues posing threat to the surrounding in which human beings are living, it becomes imperative that green supply chain is rolled out with best of the firms' efficiency. Overall by maintaining a proper equilibrium between the various facets of the value chain of the case company, it would enhance its green performance. To help industries, this work develops a decision framework for assessing the soft dimensions implications in

GSCM implementation. This framework also assists managers in upgrading knowledge among stakeholders on long term benefits of GSCM implementation. This will increase the business sustainability of the case company and strengthen their relationships with stakeholder too. In respect of GSCM implementation, there are many problematic issues available, such as high level of market uncertainty, stakeholder's behavior, employee participation etc. In this sense, the present work facilitates management of case company to enhance its environment commitment by improving their human related resource skills, talents and interrelationships. The findings of this study provide the direction to the case company about among all selected soft dimensions that is the most important and cause group (influence to others) dimension so that the management can focus on that particular dimension first. In this way, the case company is going to benefited in two way; 1) minimize their cost and 2) able to give more focus and attention on the most important dimension.

The recognized cause group human resource related dimensions provide an opportunity for the managers in improving the surroundings and its approach in implementing GSCM by maintaining a long-term relationship with their suppliers and the stakeholders. Further, the listed effect group human resource related dimensions assist managers to improve their image and goodwill, when they are gradually showing commitment towards the GSCM. The finding will help the case company to understand the significance of human resources based soft dimensions to develop green sustainability in business.

6. Conclusions and Further Research Directions

In recent years, the environmental protection initiatives have considered attentions at global level. One of key initiative taken by industries to minimise the effect of the supply chain activities on environment, is GSCM. The present work seeks to develop a structural framework for assessing the significance of the soft dimensions in adopting GSCM concepts in an industrial context. BWM and DEMATEL method are employed to reach the desired objectives. BWM is used to prioritize the GSCM oriented soft dimensions, and DEMATEL is employed to extract interrelationships among soft dimensions. In this study, eight key soft dimensions (human resource related) are finalized using literature and inputs of experts collected through questionnaire set. The data from an Indian automotive case company is used in this work. The result shows that 'Top management commitment', 'Employee involvement', 'Organizational culture' and 'Teamwork' are the highly prioritized causal dimensions in efficient GSCM in automotive company of India. The outcomes of this research work would help industry managers and practitioners to decide where to concentrate

their effort to obtain GSCM in context of soft dimensions for sustainable business development. The major contributions of this piece of work as mentioned below.

- 1) This research work, first identified the main soft (human related) dimensions which are playing a significant role for a case company for implementation of GSCM effectively. For finalization of the dimensions, both literature review and experts' inputs are used.
- 2) This study used BWM and DEMATEL approaches to find the priority and cause-effect relationship among the soft dimensions.
- 3) The findings of this study are not only contributing to existing literature but also will help the case company managers for implementation of GSCM concept properly and get benefited to minimize their implementation cost.
- 4) The findings of the study help the managers to know which dimension is the most important and influencing one; accordingly they can make their action plan for effective implementation of GSCM.

There are some limitations of the study which could be addressed in future studies. The identification of soft dimensions was quite challenging. In this study, a single case automotive company in India is considered for the data collection. Studies with multiple companies could be conducted in future. An interrelationship (cause-effect) diagram among identified soft dimensions is developed in this work. In future, relevant hypothesis can be tested among human resources dimensions and GSCM performance. The proposed BWM-DEMATEL based framework is applied to automotive industry context in India. This framework may be adopted in several other sectors, such as Construction, Manufacturing, and the findings may be compared with this work. The study may also be adopted with minor adjustments in other developing countries context based on expert's feedback and industry priorities.

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Appendix A

The details of essential calculation of BWM method

Based on the study of [Rezaei \(2015\)](#), to determine the optimal weights of the dimension, the maximum absolute differences $\{|w_B - a_{Bj} w_j|, |w_j - a_{jw} w_w|\}$, for all j should be minimized. The problem statement is written as:

$$\begin{aligned}
& \min \max_j \left(|w_B - a_{Bj} w_j|, |w_j - a_{jw} w_w| \right) \\
& \text{subject to} \\
& \sum_j w_j = 1, \\
& w_j \geq 0 \text{ for all } j
\end{aligned} \tag{A.1}$$

We can solve this by converting it linear programming formulation as under:

$$\begin{aligned}
& \text{Min } \xi^* \\
& \text{Subjected to} \\
& |w_B - a_{Bj} w_j| \leq \xi, \text{ for all } j \\
& |w_j - a_{jw} w_w| \leq \xi, \text{ for all } j \\
& \sum_j w_j = 1 \\
& w_j \geq 0 \text{ for all } j
\end{aligned} \tag{A.2}$$

The Eq. A.2 is a linear programming problem and must have a unique solution.

Appendix B
Sample Questionnaire

Phase 1 - Finalization of Soft Dimensions Questionnaire

Greetings!!!!

Dear respondent, this research is about evaluating the implications of soft (people/human resource-related) dimensions in GSCM implementation. We identified 9 GSCM focused soft dimensions in industry through literature. Please respond to confirm the relevancy of the following literature based human resource related soft dimensions in GSCM implementation using values 1 and 0 (1 for relevant and 0 for irrelevant). You are also free to add/delete/reword/merge the dimensions, which you think should be do in context of automotive sector in company in question or related industries in India.

| Soft Dimensions to GSCM adoption | Response |
|---|-----------------|
| Top Management Commitment | |
| Employee Involvement | |
| Customer Relationship Management | |
| Corporate Green Social Responsibilities | |
| Mutual Understanding | |
| Organisational Culture | |
| Teamwork | |
| Green Motivation | |
| Social Green Innovation | |
| Please add any other specific dimension | |
| Please add any other specific dimension | |

Phase 2 - Priority rank of the soft dimensions

Greetings!!!!

Dear respondent, this research seeks to know the significance of soft dimensions by knowing their priority in GSCM implementation. In this sense, please select the most important dimension from the eight dimensions (first line), and evaluate others based on 1-9 scale.

| | | | | | | | | |
|-------------------------------------|---------------------------|----------------------|----------------------------------|---|------------------------|----------|------------------|-------------------------|
| The Most Important Dimension | Top Management Commitment | Employee Involvement | Customer Relationship Management | Corporate Green Social Responsibilities | Organizational Culture | Teamwork | Green Motivation | Social Green Innovation |
| | | | | | | | | |

Next to this, please select the least important dimension from the eight dimensions (first column), and evaluate others based on 1-9 scale.

| | |
|---|--|
| The Least Important Dimension | |
| Top Management Commitment | |
| Employee Involvement | |
| Customer Relationship Management | |
| Corporate Green Social Responsibilities | |
| Organizational Culture | |
| Teamwork | |
| Green Motivation | |
| Social Green Innovation | |

Phase 3 - Causal interrelationships among soft dimensions

Dear respondent, this research also seeks to determine the causal interrelationships among soft dimensions in GSCM implementation. In this sense, the questionnaire is planned to measure the interrelationship among the dimensions on the basis of the following scale:

4 = Very high influence, 3 = High influence, 2 = Low influence, 1 = Very low influence, 0 = No influence.

Please tick (✓) in appropriate box

| With respect to: The Overall Goal | Compare the influence of one dimension over another | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|---|---|---|---|----------------------|---|---|---|---|----------------------------------|---|---|---|---|---|---|---|---|---|------------------------|---|---|---|---|----------|---|---|---|---|------------------|---|---|---|---|-------------------------|---|---|---|---|
| <i>Main dimensions</i> | Top Management Commitment | | | | | Employee Involvement | | | | | Customer Relationship Management | | | | | Corporate Green Social Responsibilities | | | | | Organisational Culture | | | | | Teamwork | | | | | Green Motivation | | | | | Social Green Innovation | | | | |
| <i>Main dimensions</i> | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 | 4 | 3 | 2 | 1 | 0 |
| Top Management Commitment | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Employee Involvement | | | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Customer Relationship Management | | | | | | | | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Corporate Green Social Responsibilities | | | | | | | | | | | | | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | |
| Organisational Culture | | | | | | | | | | | | | | | | | | | | | 0 | | | | | | | | | | | | | | | | | | | |
| Teamwork | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | | | | | | | | | | | | | |
| Green Motivation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | | | | | | | | |
| Social Green Innovation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | | | |