Supplier selection criteria for sustainable supply chain management in thermal power plant

Faisal Firoz¹, Jitendra Narayan Biswal², Suchismita Satapathy³*
¹, ², ³ SME, KIIT UNIVERSITY, BHUBANESWAR
² C V RAMAN COLLEGE OF ENGINEERING, BHUBANESWAR
Email: suchismitasatapathy9@gmail.com

Abstract. Supplies are always in great demand when it comes to industrial operations. The quality of raw material their price accompanied by sustainability and environmental effects are a major concern for industrial operators these days. Supply Chain Management is the subject which is focused on how the supply of different products is carried out. The motive is that each operation performed can be optimized and inherently the efficiency of the whole chain is integrated. In this paper we will be dealing with all the criteria that are required to be evaluated before selecting a supplier, in particular, focusing on Thermal Power Plant. The most suppliers of the thermal power plant are the coal suppliers. The quality of coal directly determines the efficiency of the whole plant. And when there are matters concerning coal environmental pollution plays a very crucial role. ANP method has been used here to select suppliers of thermal power sectors in Indian context. After applying ANP to prioritize the sustainable supplier selection criteria, it is found that for thermal power industries best suppliers are Nationalized/State owned suppliers then 2nd ranked suppliers are imported supplier. Private owned suppliers are ranked least. So private owned suppliers must be more concerned about their performance. Among these suppliers it is found that to compete in the global market privatized suppliers have to give more emphasize on most important criteria like sustainability, then fuel cost and quality. Still some sub-criteria like a clean program, environmental issues, quality, reliability, service rate, investment in high technology, green transportation channel, waste management etc needs for continuous improvement as per their priority.

1. Introduction

In world arena due to increasing awareness of environmental sustainability among stake holders, local community, employees as well as government huge pressure is surmounting on the organizations to adopt sustainability effectively by the government stringent rules and regulations (Luthra et al., 2017; Govindan et al., 2016). Decision regarding effective supplier selection plays a key role to improve organizational performance and competitive advantage keeping in view of sustainable supply chain management (Mangla et al., 2014; Grimm et al., 2014; Rostamzadeh et al., 2015; Govindan et al., 2014). In recent years the organizations incorporating environmental, societal and economic facets to enable achieving sustainable development (Benn et al., 2014). Achieving improvement in socio, economic and environmental phases, the supplier selection criteria and tactical decision play vital role in sustainable supply chain management (Grimm et al., 2016; Amindoust et al., 2012; Shen et al., 2013). Supplier selection is the practice by which firms
classify, assess and deal with suppliers. The supplier selection process deploys a great amount of a firm’s financial income. In return, firms also look forward to large profit from contracting with suppliers offering a high price (Yan et al., 2016; Amindoust, A. & Saghafinia, A., 2014). The above-mentioned challenges create supplier selection an important topic for operations and management science disciplines. To endure in the current global economy, one needs to discover new suppliers and at the same time widen the scope of the existing suppliers. This section we will be dealing with many processes which may help us in finding new suppliers. But when we critically focus on suppliers of thermal power sectors, sustainability is the main issue for consideration. In present era, Environment and Sustainability are the most important subject for all types of farms and industries. As coal is the raw material essential for generating thermal power, so coal suppliers are in high demand in power sector. Usually, in India coals are supplied by coal mines (may be privatized, state/national owned or imported from outside countries). But every supplier has to consider all dimensions of supplier selection criteria including sustainability (Luthra et al., 2017; Shahryari et al., 2016). Whenever industrial financial accounts are studied there are two types of costs that one focus on, there are the fixed and the variable cost. Now, as the name suggests fixed costs are the one which remains fixed for an operational span while the variable one varies in very small time intervals. Variable costs deal with the cost of raw materials and other such elements. The major components are generation fuel related cost and environmental cost. To reduce power generation variation costs of generation companies and ensure stable power generation earnings in the next period of time, generation companies need to evaluate coal-fired supplier from fuel quality, fuel costs, reputation, long-term development capacity, and other factors, choose the best coal-fired supplier, sign long-term cooperation agreement, and maintain the stability of the fuel cost. Therefore, choosing reasonable coal suppliers for thermal power generation companies has great significance on reducing revenue uncertainty, improving market competitiveness, and achieving sustainable development. Many researchers have implemented different Multicriteria decision making methods for supplier evaluation technique. In this paper ANP (Analytic Network Process) is applied to select suppliers for thermal power sectors. ANP uses the technique of comparisons to measure the weights of the components of the structure, and then ranking system is adopted to rank the alternatives (Chung et al., 2016; Mohaghar et al., 2014).

To achieve Sustainability in Supply chain management supplier selection for thermal power industries is one of the most important issues. Many authors have implemented many methods to find supplier selection criteria for different industries. Xia (2006) and Tang (2004) have evaluated coal-fired supplier of thermal power companies. They use a set seven evaluation indicators to perform the task. Tan et.al.(2014) have Selected Ideal Coal Suppliers of Thermal Power Plants using the Matter-Element Extension Model with Integrated Empowerment Method for Sustainability.

Rising awareness about environmental and societal issues has created one of the greatest revolutions in human attention, uniting the entire world in a fight against the emissions which are produced during industrial activities (Dubey et al., 2015). Particularly the last decade has seen an increased pressure to broaden the accountability of the industries beyond economic performance, for shareholders to sustainability performance, for all stakeholders (Labuschagne et al., 2005). Consequently, an increased interest was exhibited by organizations in addressing sustainability in their supply chains, which has been described as Sustainable Supply Chains Management (SSCM) that incorporates the triple bottom line of sustainability (Walker and Jones, 2012). SSCM is the management of raw materials and services from suppliers to manufacturers/ service providers to customers and back with the improvement of the social and environmental impacts explicitly considered (Grzybowska, 2012).

A green or environmental aspect of SSCM focuses on minimization of the adverse environmental consequences of various activities of supply chains whereas the second one, the social aspect of SSCM ensures ethical as well as decent working conditions of various stakeholders including the suppliers.
The third component of the SSCM, the economic aspects ensures local economic generation through purchasing from local suppliers (Walker and Jones, 2012).

SSCM implementation in industries is influenced by a number of factors and there is no exception for the thermal power industries. These influential factors broadly can be divided into two categories:

- Enablers the factors that encourage SSCM adoption
- Barriers that hinder SSCM adoption.

Enabler as defined in layman’s term is “an entity that makes it possible or easy”. Therefore enablers for sustainable supply chains are processes that can drive a supply chain to be sustainable (Hussain, 2011).

Scanning of contemporary literature reveals that there exists a number of studies that focused exclusively either on the enablers (Grzybowska, 2012; Faisal, 2010; Walker and Jones, 2012; Muduli and Barve, 2013; Diabat et al., 2014) or barriers (Bhattacharyya, 2010; Walker and Jones, 2012; Ageron et al., 2010). However, this study provides a framework to study both the categories factors simultaneously, so that it will be easy to identify the relative importance of an enabler with respect to a barrier. This, in turn, will enable the organizations to identify their degree of strength in handling a particular barrier.

SSCM is at its nascent stage in India; moreover, its adoption amongst Indian thermal power sector is limited to only a few big companies. Hence, an analytical approach such as AHP has been proposed in this study to analyze various influential factors of SSCM instead of the statistical approach that depends upon bigger sample sizes. AHP developed by Saaty (1970), is a simple mathematical method based on elementary operations with matrices and relies on decomposition of the problem into objective, criteria, sub-criteria and alternatives, pair-wise comparison of elements of each level with respect to its immediate upper level factor using a nine-point scale and generation of priority vector (Muduli and Barve, 2015). It has the ability to accommodate qualitative attributes in an organized manner and can be used to structure a system and its environment into mutually interacting elements and then to synthesize them by measuring and ranking the impact of these elements on the entire system (Sambasivan and Fei, 2008) with the objective or goal (SSCM implementation) occupying position at the top level of the hierarchy, various criteria and sub-criteria occupy positions in the subsequent level.

2. Research Methodology

A standard questionnaire consisting of 26 questions was designed to find the supplier selection criteria in Thermal power Industries. Then 150 questionnaire was sent to different Indian Thermal industries by post, mail and personal contact. The respondents are asked to respond each item on a five point likert scale (1 = totally disagree, 2 = partially disagree, 3 = No opinion, 4 = Partially agree, 5 = totally agree). The details of items in the questionnaire are given in Appendix1. We received 106 responses and the response rate was found to be more than 70%. Then statistical analysis was done on the requisite data. Then ANP method is implemented to rate supplier selection criteria by Super decision modelling.
Appendix-1 Questionnaire on Supplier's selection criteria

| Supplier’s selection criteria                        | 1 | 2 | 3 | 4 | 5 |
|-----------------------------------------------------|---|---|---|---|---|
| 1. Associated services                              |   |   |   |   |   |
| 2. Clean programs                                   |   |   |   |   |   |
| 3. Delivery                                          |   |   |   |   |   |
| 4. Personal relationships                           |   |   |   |   |   |
| 5. Waste Management                                 |   |   |   |   |   |
| 6. Quality                                           |   |   |   |   |   |
| 7. Reliability                                       |   |   |   |   |   |
| 8. Reverse logistics                                |   |   |   |   |   |
| 9. Geography proximity                              |   |   |   |   |   |
| 10. Reducing carbon footprint                       |   |   |   |   |   |
| 11. Green Transportation channels                   |   |   |   |   |   |
| 12. Environmental issues                            |   |   |   |   |   |
| 13. Eco-design                                       |   |   |   |   |   |
| 14. Information technology and systems              |   |   |   |   |   |
| 15. Confidence                                       |   |   |   |   |   |
| 16. Source of competition among suppliers            |   |   |   |   |   |
| 17. Investment in high end technology                |   |   |   |   |   |
| 18. Economic dependency                              |   |   |   |   |   |
| 19. Service rate                                     |   |   |   |   |   |
| 20. Price                                            |   |   |   |   |   |
| 21. Long term relationships                         |   |   |   |   |   |
| 22. Savings from packaging                          |   |   |   |   |   |
| 23. Size                                             |   |   |   |   |   |
| 24. Certification ISO 14001                         |   |   |   |   |   |
| 25. Company’s future plan                            |   |   |   |   |   |
| 26. Lean management                                 |   |   |   |   |   |
| 27. Flexibility                                     |   |   |   |   |   |
| 28. Production resources system                     |   |   |   |   |   |

3. Result and Discussion

The collected data for supplier selection criteria in Indian thermal industries were subjected to various statistical analyses such as factor analysis and Kaiser–Meyer–Olkin (KMO) test. Factor analysis of 106 useful responses has been conducted using principal component method followed by varimax rotation via SPSS17.0. After analysis, it is found that only 22 items are coming under 4Dimensions. Percentage of total variance explained was found to be 72 %, which is an acceptable value for the principal component varimax rotated factor loading procedure (Johnson and Wichern, 2002). The internal consistency of the actual survey data was tested by computing the Cronbach’s alpha (α). The value of alpha for each dimension is shown in Tables 2 and 3. The value of KMO, which is a measure of sampling adequacy, was found to be 0.67 indicating that the factor analysis test has proceeded correctly and the sample used is adequate as the minimum acceptable value of KMO is 0.5 (Othman and Owen, 2001). Therefore, it can be concluded that the matrix did not suffer from multicollinearity or singularity. The result of Bartlett test of sphericity shows that it is highly significant (significance = 0.000) which indicates that the factor analysis processes are correct and suitable for testing multidimensionality (Othman and Owen, 2001). The factors coming after factor analysis are Fuel Quality, Fuel cost, Credibility of supplier and Sustainability.
Table 1. Factor Analysis for Thermal power plant supplier selection criteria

| Item       | Factor1 | Factor2 | Factor3 | Factor4 | Cronbach's alpha |
|------------|---------|---------|---------|---------|------------------|
| Credibility| 1       | 0.631   |         |         | 0.669            |
|            | 3       | 0.579   |         |         | 0.743            |
|            | 15      | 0.618   |         |         | 0.557            |
|            | 16      | 0.615   |         |         | 0.532            |
|            | 25      | 0.593   |         |         | 0.579            |
|            | 26      | 0.712   |         |         | 0.515            |
| Sustainability | 2   | 0.766   |         |         | 0.590            |
|            | 5       | 0.600   |         |         | 0.616            |
|            | 8       | 0.536   |         |         | 0.590            |
|            | 10      | 0.576   |         |         | 0.699            |
|            | 11      | 0.667   |         |         | 0.573            |
|            | 12      | 0.632   |         |         | 0.586            |
|            | 13      | 0.635   |         |         | 0.712            |
| Fuel Quality | 6     | 0.639   |         |         | 0.523            |
|            | 7       | 0.592   |         |         | 0.546            |
|            | 9       | 0.651   |         |         | 0.613            |
|            | 23      | 0.630   |         |         | 0.623            |
|            | 24      | 0.517   |         |         | 0.556            |
| Fuel cost | 17      |         |         |         | 0.553            |
|            | 18      |         |         |         | 0.579            |
|            | 19      |         |         |         | 0.599            |
|            | 20      |         |         |         | 0.612            |

The factors or dimensions of Table 1 are as follows.
Fuel Quality: Evaluate coal-fired supplier from fuel quality is required in order to reduce power generation variation costs of generation companies. This technique also ensures stable power generation earnings in the next period of time.

Fuel cost: Fuel costs are the major affecting factor, generally accounting for more than 75% of total variable costs.

Credibility: The quality of suppliers being convincing or believable by the consumer.

Sustainability: It is the property of biological systems to remain diverse and productive indefinitely.

The bar diagrams of factors Credibility, Sustainability, Fuel quality and Fuel cost of table 1 are shown in figure 1, figure 2, figure 3 and figure 4 respectively.

Figure 5 shows the subcriteria or sub-factors coming under four above mentioned factors like fuel quality, cost, credibility and sustainability and alternative suppliers for thermal power industries for Indian Thermal power generative industries are Privately owned companies, state or nationalized companies and imported fuels from outside India
Figure 1. Bar Diagram of the Credibility

Figure 2. Bar Diagram of the factor Sustainability

Figure 3. Bar Diagram of the factor Fuel quality

Figure 4. Bar Diagram of the factor Fuel cost
Figure 5. Supplier selection model for thermal power industries

After creating the above model it is analyzed by super decision modeling for applying ANP. ANP is a method of selecting or prioritizing with respect to multiple criteria. It is often referred to as Multi-Criteria Decision Making (MCDM). Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) are the common methods by which to solve Multi-Criteria Decision Making problems.

- Step 1: Analyse the problem, and determine the main goal.
- Step 2: Determine the criteria and sub-criteria that affect the main goal.
- Step 3: Determine alternatives for the problem.
- Step 4: Determine the interactions between criteria, sub-criteria, and alternatives respect to the main goal.
- Step 5: Construct super matrix according to the network, and then construct weighted super matrix and limit super matrix. In a super matrix, each element is represented by one row and one respective column. If the column sum of any column in the composed super matrix is greater than 1, that column will be normalized. Such a super matrix is called as weighted super matrix. The weighted super matrix is then raised to a significantly large power in order to have the converged or stable values. The values of this limit matrix are the desired priorities of the elements with respect to the goal.
- Step 6: Choose the best alternative with the highest priority.
A Model is created by Super decision modelling in which goal is supplier selection criteria and it is connected to cluster criteria (i.e., fuel quality, cost, credibility, sustainability), clusters like subcriteria that contains the sub-elements coming under individual dimensions and alternatives(privatized, nationalized and imported. Then this model is analyzed to prioritize alternatives by creating a unweighted and weighted matrix. A flow Diagram of Multi Criteria Decision Making problem using ANM and AHP for sustainable supplier selection criteria as shown in figure 6.

**Figure 6.** Flow Diagram of Multi Criteria Decision Making problem using ANM and AHP

**Table 2.** Rating of Criteria of selecting suppliers for Thermal power plant

| Name           | Normalized By Cluster | Limiting    |
|----------------|-----------------------|-------------|
| 1. Fuel cost   | 0.15219               | 0.038047    |
| 2. Fuel Quality| 0.09389               | 0.023473    |
| 3. Credibility | 0.05595               | 0.013987    |
| 4. Sustainability | 0.69797           | 0.174492    |
Figure 7. Bar Diagram of the Rating of Criteria of selecting suppliers for Thermal power plant

Table 3. Pairwise comparison of sub-criteria of selecting suppliers for Thermal power plant

| Name                              | Normalized | Idealized |
|-----------------------------------|------------|-----------|
| 1. Reliability                     | 0.15651148171860277 | 0.81599543876407155 |
| 2. Size                            | 0.040437299791909166 | 0.21082576066501627 |
| 3. Quality                         | 0.19180435855825276 | 1.0 |
| 4. Geographic proximity            | 0.014615034123829416 | 0.0761976121590099 |
| 5. Certification ISO 14001         | 0.019178631476708587 | 0.099990592606287718 |
| 6. Price                           | 0.038847718191916014 | 0.20253824513647639 |
| 7. Service rate                    | 0.077053279212149953 | 0.4012851019309946 |
| 8. Economic dependencies           | 0.052484176210624213 | 0.273639083595466 |
| 9. Investment in high technology   | 0.094240234459751646 | 0.491352082722876 |
| 10. Assorted services              | 0.03382170163274012 | 0.17633437470852964 |
| 11. Confidence                     | 6.7629316216575965E-11 | 3.5259530453285453E-10 |
| 12. Lean Management                | 6.7629316216575965E-11 | 3.5259530453285453E-10 |
| 13. Company's future plan          | 0.064417106398556717 | 0.3358479801124678 |
| 14. Delivery                       | 0.026924967158430124 | 0.14037724356640605 |
| 15. Source of competition among suppliers | 0.053568235445723818 | 0.27928508979438 |
| 16. Environmental Issue            | 0.051324566347622648 | 0.2675881128740612 |
| 17. Reverselogistics               | 0.039133383729421846 | 0.20402736946948308 |
| 18. Waste Management               | 0.022625701062491867 | 0.11796239268264715 |
| 19. Greentransportation chanels     | 0.015177229505023067 | 0.079128699780894721 |
| 20. Clean program                  | 0.0064381480254890322 | 0.0336622380160202 |
| 21. Eco-design                      | 6.7629316216575965E-11 | 3.5259530453285453E-10 |
| 22. Carbon footprint reduction     | 0.0013967917478681239 | 0.0072823775140850363 |
Table 2 and Table 3 shows the normalized values of criteria and sub-criteria after analysis by super decision modeling. In Table 2 highest normalized value is found for Sustainability, then fuel cost and Quality and in Table 3 shows subcriteria like clean program got the first rank, Environmental issues 2nd, Quality 3rd, Reliability 4th, service rate, investment in high technology, Green Transportation channel, Waste Management, etc got rest ranks respectively. The criteria and sub-criteria are ranked as per their importance in supplier selection criteria in the Thermal power plant. Inconsistency value lies between 0 to 1. It shows the analysis is done correctly. The bar diagrams of table 2, table 3 and table 4 are shown in figure 7, figure 8, and figure 9 respectively.

Table 4. Ranking of Alternatives for selecting suppliers for Thermal power plant

| Name   | Ideals | Normals  | Raw     | Rank |
|--------|--------|----------|---------|------|
| 1.Private | 0.984595 | 0.330753 | 0.082688 | 3    |
| 2.State  | 1.000000 | 0.335928 | 0.083982 | 1    |
| 3.Imported | 0.992238 | 0.333320 | 0.083330 | 2    |

Table 4 shows that for Thermal power industries best suppliers are Nationalized/State owned suppliers then 2nd ranked suppliers are imported supplier. Private owned suppliers are ranked least. So private owned suppliers must be more concerned about their performance.
Supplying coal for Thermal power plants is a challenge for suppliers now a days. They have to take care of price and Quality of coal supplied in a sustainable manner. Sustainability and Environmental issues are focused issues for all types of industries in all over the world. Basically mining and coal industries are in the picture for spreading maximum pollution. But the Coal Industries are the backbone of thermal power industries and in India maximum power is generated by thermal power plants. So care must be taken when suppliers are selected for Thermal power plants. In this paper factor analysis shows the basic dimensions of supplier selection criteria for thermal power industries like Fuel Quality, Fuel cost, the credibility of suppliers and sustainability. After finding the criteria and sub-criteria of supplier selection to prioritize the alternatives ANP is applied on various alternatives of Indian thermal power plants like privatized coal suppliers, State or Nationalized suppliers and Imported Coal Suppliers. Among these suppliers it is found that the State/Nationalized suppliers are ranked first and imported suppliers are second. It means the state/nationalized suppliers and imported suppliers are following rules of environmental protection more compared to privatized suppliers. So to stick to the competitive market privatized suppliers have to give more emphasize on most important criteria like Sustainability, then fuel cost and Quality. Still some sub-criteria like a clean program, Environmental issues, Quality, Reliability, service rate, investment in high technology, Green Transportation channel, Waste Management etc needs for continuous improvement as per their priority. So all types of suppliers must take care of these issues to improve their services and power sectors must select suppliers as per these important criteria. In future more power sectors must be involved to check the certainty of the result. Some other types of decision making methods can be implemented in this paper to justify the content.
5. References

[1] Luthra, S., Govindan, K., Kannan, D., Mangla, S.K. and Garg, C.P., 2017. An integrated framework for sustainable supplier selection and evaluation in supply chains. Journal of Cleaner Production, 140, pp.1686-1698.

[2] Govindan, K., Seuring, S., Zhu, Q., & Azevedo, S. G. (2016). Accelerating the transition towards sustainability dynamics into supply chain relationship management and governance structures. Journal of Cleaner Production, 112, 1813-1823.

[3] Mangla, S. K., Kumar, P., & Barna, M. K. (2014). Flexible decision approach for analyzing performance of sustainable supply chains under risks/uncertainty. Global Journal of Flexible Systems Management, 15(2), 113-130.

[4] Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2014). Critical factors for sub-supplier management: A sustainable food supply chains perspective. International Journal of Production Economics, 152, 159-173.

[5] Rostamzadeh, R., Govindan, K., Esmaeili, A., & Sabaghi, M. (2015). Application of fuzzy VIKOR for evaluation of green supply chain management practices. Ecological Indicators, 49, 188-203.

[6] Govindan, K., Kaliyan, M., Kannan, D., & Haq AN. (2014). Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process. International Journal of Production Economics, 147, 555-568.

[7] Benn, S., Dunphy, D., & Griffiths, A (2014). Organizational change for corporate sustainability. Routledge Publication.

[8] Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2016). Exploring sub-suppliers' compliance with corporate sustainability standards. Journal of Cleaner Production, 112, 1971-1984.

[9] Aminidoust, A, Ahmed, S., Saghafinia, A, & Bahreininejad, A (2012). Sustainable supplier selection: A ranking model based on fuzzy inference system. Applied Soft Computing, 12(6), 1668-1677.

[10] Shen, L., Olfat, L., Govindan, K., Khodaverdi, R., & Diabat, A. (2013). A fuzzy multi criteria approach for evaluating green supplier's performance in green supply chain with linguistic preferences. Resources, Conservation and Recycling, 74, 170-179.

[11] Aminidoust, A. and Saghafinia, A., 2014. Supplier evaluation using fuzzy inference systems. In Supply chain management under fuzziness (pp. 3-19). Springer Berlin Heidelberg.

[12] Shahryari Nia, A., Olfat, L., Esmaeili, A., Rostamzadeh, R. and Antuchevičienė, J., 2016. Using fuzzy Choquet Integral operator for supplier selection with environmental considerations. Journal of Business Economics and Management, 17(4), pp.503-526.

[13] Chung, C.C., Chao, L.C. and Lou, S.J., 2016. The establishment of a green supplier selection and guidance mechanism with the ANP and IPA. Sustainability, 8(3), p.259.

[14] Mohaghar, A., Kashef, M.O.J.T.A.B.A. and Khanmohammadi, E.H.S.A.N., 2014. A Novel Technique to Solve the Supplier Selection Problems: Combination of Decision Making Trial & Evaluation Laboratory, Graph Theory and Matrix Approach Methods. International Journal of Industrial Engineering, 25(2), pp.103-113.

[15] Xia H Study of the Coal Management of Power Plant, Shandong University of Science and Technology, Qingdao, China, 2006, (Chinese).

[16] Tang L. Research on the Fuel Management of Huaneng Yueyang Power Plant in the New Circumstance, Tsinghua University, Beijing, China, 2004, (Chinese).

[17] Tan Z., Ju L., Yu X., Zhang H.,and Yu C., (2014),” Selection Ideal Coal Suppliers of Thermal Power Plants Using the Matter-Element Extension Model with Integrated Empowerment Method for Sustainability Hindawi publication Volume 2014, Article ID 302748, pp. 1-12.
[18] Lewis WG, Pun KF, Lalla TRM. Empirical investigation of the hard and soft criteria of TQM in ISO 9001 certified small and medium-sized enterprises. International Journal of Quality & Reliability Management 2006;23(8):964 985.

[19] Kamalakanta Muduli and Akhilesh Barve, Developing a Framework for Study of GSCM Criteria in Indian Mining Industries APCBEE Procedia 5 ( 2013 ) 22 – 26.

[20] Hussain Mohammed, 2011, Modelling the enablers and alternatives for sustainable supply chain management, Concordia Institute for Information Systems Engineering, Canada, PhD Thesis.

[21] Carter C R and Rogers D S A framework of sustainable supply chain management: moving toward new theory International Journal of Physical Distribution & Logistics Management, vol. 38 ED-5, pp. 360-387, 2008.

[22] Dubey R, Gunasekaran A., Wamba, S.F., Bag, S., 2015, Building Theory of Green Supply Chain Management using Total Interpretive Structural Modeling, IFAC-Papers Online, 48-3, pp-1688-1694.

[23] Labuschagne C, Brent, A.C., van Erck, R.P.G., 2005, Assessing the sustainability performances of industries, Journal of Cleaner Production, 13, 373-385.

[24] Walker H and Jones N, 2012, Sustainable supply chain management across the UK private sector, Supply Chain Management: An International Journal, 17/1, 15-28.

[25] Grzybowska Katarzyna, 2012, Sustainability in the supply chain: Analysing the enablers, P. Golinska and C.A. Romano(eds.), Environmental Issues in Supply Chain Management, Eco Production, Springer-Verlag, Berlin Heidelberg, 25-40.

[26] Faisal M N 2010, Sustainable supply chains: a study of interaction among the enablers, Business Process Management Journal, Vol. 16, No. 3, pp.508-529.

[27] Muduli, K. and Barve, A. (2013) ‘Sustainable development practices in mining sector: a GSCM approach’, Int. J. Environment and Sustainable Development, Vol. 12, No. 3, pp.222–243.

[28] Diabat A, Kannan D, Mathiyazhagan K, Analysis of Enablers for implementation of sustainable supply chain management – A textile case, Journal of Cleaner Production(2014).

[29] Bhattacharyya S C Shaping a sustainable energy future for India: Management challenges, Energy Policy 38 (2010) 4173–4185.

[30] Ageron B, Gunasekaran A Spalanzani A. Sustainable supply management: An empirical study, Int. J. Production Economics 140 (2012) 168–182.