Prioritising Barriers towards Adoption of Sustainable Consumption and Production Practices using TOPSIS

Mr Mohd Imran Khan¹, Mr Shahbaz Khan⁎, Dr Abid Haleem², Mr Mohd Javaid³
¹Research Scholar, Department of Mechanical Engineering Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi-110025, India
²Professor of Mechanical Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi-110025, India
³Assistant Professor of Mechanical Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi-110025, India

shahbaz.me12@gmail.com

Abstract: Unsustainable form of consumption and production in current business practices and lifestyle of the consumers seems inviting problems for the planet, such as scarcity of natural resources, environmental issues and increase in waste generation. Therefore, industries and consumers need to focus to integrate Sustainable Consumption and Production (SCP) practices in their daily operations to resolve these emerging problems and ensure sustainable development. However, the adoption of SCP practices faces many challenges due to the presence of various barriers. This paper identifies ten major barriers towards the adoption of SCP practices through extensive literature review and supported by experts. Further, these barriers are prioritised using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The finding of this study suggests that the lack of proper awareness consumers is the most significant barriers among the identified barriers towards the adoption of SCP practices. The prioritising of these barriers can be beneficial for the policy makers, managers and government in developing a framework to mainstream the SCP practices.

Keywords: Sustainable Consumption and Production (SCP); Sustainable Development; TOPSIS; Natural Resources

1. Introduction
During any economic activity, Sustainable Consumption and Production (SCP) aims at reducing the use of resources along the whole lifecycle, increasing the net welfare gains as well as improving the quality of life. This requires a systemic approach and cooperation among the different actors of the supply chain, from producer to final consumer. SCP is one of the ‘2030 Agenda for Sustainable Development’ among its 17 Sustainable Development Goals of United Nations. Oslo symposium in 1994 [1], defines SCP as, "the use of services and related products, which respond to basic needs and bring a better quality of life while minimising the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of further generations". Thus, SCP practices are to develop sustainable infrastructure, efficient use of resources and better quality of life for all.

Due to globalisation, it is expected, in next two decades, the disposable income of masses may increase, this will lead to increase in demand for already constrained natural resources. If consumption and production pattern is not adjusted, irreversible damage to the environment may happen [2]. Making consumption and production sustainable is a pressing challenge to the modern world, and this needs to be addressed in business sector by instigating a responsible business model. Moreover, consumers need to be made aware of sustainable consumption & lifestyles, by providing information through proper labelling/standards and engaging them in sustainable procurement.
The trend of scholarly literature on SCP practices shows overwhelming respond of the researcher to tackle this challenge [3,4]; the area still needs a rigorous ranking of the barriers in making the SCP practices more relevant. This paper has two research objectives:

- to identify the barriers to the adoption of SCP practices in every supply chain operations and
- to prioritise the identified barriers to uncover their relative importance using TOPSIS technique.

Hwang developed TOPSIS, and Yoon [5] and this MCDM technique selects the best alternative to the shortest Euclidean distance from the ideal solution and the farthest from the negative ideal solution [5]. TOPSIS has a minimum rank changes reversal if any alternative is added or removed.

2. Barriers to adopt SCP practices in supply chain

Adoption of SCP practices requires ‘lifecycle thinking’, to extend sustainable development in production as well as consumption phases. The adoption of SCP practices inhibited by several barriers. The mitigation of these barriers may help the policymakers to evaluate their existing practices of SCP practices. Table 1, shows ten barriers to adoption of SCP practices as identified by discussions with the experts and by review of the literature. However, different organisations might have different views regarding barriers to adopting SCP initiatives in supply chains.

| S.No | Barriers                                                                 | References |
|------|--------------------------------------------------------------------------|------------|
| B1.  | Lack of policy for the sustainable consumption                           | [4]        |
| B2.  | Reluctance to change                                                     | [2]        |
| B3.  | Lack of resources                                                         | [6]        |
| B4.  | Lack of government support                                                | [7,8]      |
| B5.  | Lack of regulatory framework                                             | [9]        |
| B6.  | Lack of awareness program to promote the sustainable consumption         | [7,10]     |
| B7.  | Lack of skilled workforce                                                | [11]       |
| B8.  | Lack of knowledge among stakeholder                                      | [3]        |
| B9.  | Lack of effective communication                                          | [12]       |
| B10. | Lack of consumer awareness                                               | [13,14,16,17] |

3. Solution Methodology

The TOPSIS approach is used as a research tool in this work. TOPSIS is purposed by Hwang and Yoon [5] widely used to solve MCDM problems. TOPSIS consists of the following steps [15]:

**Step1:** Construct a decision matrix

The m barriers called $B = \{B1, B2 \ldots Bm\}$ are to be evaluated against n criteria, $C = \{C1, C2 \ldots Cn\}$. The decision matrix is constructed with m row and n column (please see table 3). Table 2 shows the five-point scale (1 to 5) is selected for the rating of the importance. The element of the decision matrix is shown as $x_{ij}$, which represent the importance of each barriers $i$th concerning each criterion $j$th.

| Linguistic scale | Importance intensity |
|------------------|----------------------|
| Very low         | 1                    |
| Low              | 2                    |
| Medium           | 3                    |
| High             | 4                    |
| Very high        | 5                    |

**Step2** Determine the normalised decision matrix

The normalised value of $x_{ij}$ is calculated using equation 1

$$r_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}^2} \quad i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$$

**Step 3:** Calculate the weighted normalised decision matrix.
The weighted normalised decision matrix is calculated as the multiplying the normalised decision matrix by its associated weights:

$$v_{ij} = r_{ij} * w_j$$  \hspace{1cm} (2)

where $w_j$ is the weight of the jth attribute or criterion, and $\sum_{j=1}^{n} w_j = 1$.

**Step 4:** Determine the positive-ideal and negative-ideal solutions

$$A^+ = \{v_{i1}^+, v_{i2}^+, \ldots, v_{in}^+\} \quad i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$$  \hspace{1cm} (3)

$$A^- = \{v_{i1}^-, v_{i2}^-, \ldots, v_{in}^-\} \quad i = 1, 2, \ldots, m; j = 1, 2, \ldots, n$$  \hspace{1cm} (4)

In our case, we are prioritising the importance of the barrier. Thus, positive ideal solution is taken as 5 (highly importance) whereas negative ideal solution is taken as 0.

**Step 5:** Calculate the separation measures through Euclidean distance

$$D^+ = \sqrt{\sum_{j=1}^{n} (v_{ij}^+ - v_{ij})^2} \quad i = 1, 2, \ldots, m;$$  \hspace{1cm} (5)

$$D^- = \sqrt{\sum_{j=1}^{n} (v_{ij}^- - v_{ij})^2} \quad i = 1, 2, \ldots, m;$$  \hspace{1cm} (6)

**Step 6:** Calculate the relative closeness.

The relative closeness of the alternative $i$ is calculated as:

$$CC_i = \frac{D^-}{D^+ + D^-}$$  \hspace{1cm} (7)

Here, $0 \leq CC_i \leq 1$, $i = 1, 2, \ldots, m$.

**Step 7:** Arrange the relative closeness in a descending order to obtain the ranking of the alternative.

4. Result

The barriers to adoption of SCP practices are identified through extensive literature review and expert opinion. These barriers are further discussed with a five members expert's group to obtain a deeper insight these barriers and finalised the barriers (please see Table 1). After finalising, the experts were again asked to rate the importance of the barriers on a 5-point scale (please see Table 3).

| Table 3: Linguistic assessment for Barriers |
|-------------------------------------------|
| **S No** | **Barriers** | **DM1** | **DM2** | **DM3** | **DM4** | **DM5** |
|----------|--------------|---------|---------|---------|---------|---------|
| B1.      | Lack of policy for the sustainable consumption | M       | H       | H       | H       | M       |
| B2.      | Reluctance to change                            | M       | M       | L       | M       | L       |
| B3.      | Lack of resources                                | M       | M       | M       | L       | M       |
| B4.      | Lack of government support                        | H       | M       | H       | M       | M       |
| B5.      | Lack of regulatory framework                      | M       | H       | L       | M       | L       |
| B6.      | Lack of awareness program to promote the sustainable consumption | VH      | H       | H       | H       | H       |
| B7.      | Lack of skilled workforce                         | L       | M       | L       | L       | M       |
| B8.      | Lack of knowledge among stakeholder               | H       | H       | H       | H       | H       |
| B9.      | Lack of effective communication                   | H       | M       | M       | H       | L       |
| B10.     | Lack of consumer awareness                        | VH      | VH      | H       | VH      | H       |

By steps of TOPSIS provided in the previous section, the identified barriers are prioritised and shown in Table 4.

| Table 4: Ranking of Barriers |
|-----------------------------|
| **Barrier** | **D^+** | **D^-** | **CC** | **Ranking** |
| B1.          | 3.896197 | 7.166524 | 0.352192 | 4           |
| B2.          | 2.352759 | 9.041691 | 0.206483 | 9           |
| B3.          | 2.495766 | 8.721722 | 0.222489 | 8           |
| B4.          | 3.43729  | 7.596113 | 0.311535 | 6           |
| B5.          | 2.983431 | 8.683911 | 0.255708 | 7           |
| B6.          | 5.385841 | 5.769811 | 0.48279  | 2           |
Through the analysis, it was found that the ‘Lack of consumer awareness’ is ranked on the top followed by ‘Lack of awareness program to promote the sustainable consumption' and ‘Lack of skilled workforce' is the least prioritised barrier.

5. Discussion based on the Result

The order of relative importance of the barrier obtained is B10-B6-B8-B1-B9-B4-B5-B3-B2-B7. To begin with, ‘Lack of consumer awareness' gains the top rank. In spite of the increasing levels of awareness, it is reported that consumers do not widely practice sustainable consumption. But, consumers are said to consume sustainably for it's symbolic, rather than, economic value. The next barrier in the rank of relative importance is ‘Lack of awareness program to promote the sustainable consumption.' Modern business players adhere to the SCP practices only for using it as a marketing strategy. They usually do not educate the consumers through proper labelling/standards about the advantage of integrating sustainable consumption practices into their lifestyle. A proper marketing strategy for propagating SCP practices may give better results. ‘Lack of knowledge among stakeholder’ is the third barrier in prioritised scale. The possible solution to this barrier is related to the previous strategy. The organisation/individual involved in making SCP practices needs to educate the stakeholder of SCP such as business, researchers, scientists, retailers, media, and development cooperation agencies, among others. ‘Lack of policy for the sustainable consumption' is also a major barrier to the adoption of SCP practices in the supply chain. Due to this barrier business organisation are sceptical about the ways of achieving sustainability in their business operations. The absence of a framework for regulation of SCP practices in case violation is making the supply chain vulnerable to the unsustainable production and consumption. Government support is critical in developing, implementing, monitoring and enforcing strong regulations any strategy regarding SCP practices. Many business organisations are implementing cleaner initiatives in their supply chain to comply with governmental regulations. Lack of sustainable resources is also a significant barrier. Financial constraints have been identified as a challenge for business organisations to make the essential changes required in the production and consumption methods. Reluctance to change and lack skilled labour are prioritised last in the relative importance scale. Capacity building of the workforce should be done to mainstream the SCP practices. The mitigation of these barriers may facilitate the adoption of SCP practices in supply chain and make these practices self-sustaining in future.

6. Managerial Implication

The implication of the research has several implications for the managers and may facilitate the professionals to mitigate the barrier. These identified barriers may help to formulate strategies to coordinate and collaborate to enable SCP practices in SC effectively. The order of relative importance of barrier obtained through TOPSIS may help the policymakers to formulate effective policy. The rank presented may act as a benchmark to mitigate the SCP adoption-related issues.

7. Limitation and Future Scope

The limitation of this study is that it is based on the opinion of the experts, there may be judgmental bias. Also, a wider rating of the 7 or 9-point linguistic scale could be used instead of using a 5-point linguistics scale. The identified barriers can further be evaluated using tools like ANP and DEMATEL under fuzzy environment. A case-based validation will also improve the study.

8. Conclusion

The objective of the SCP practices is reducing the use of resources and provide the less impact on the environment along the whole life cycle to increase the quality of life. This study facilitates the adoption of SCP practices through identifying the major barriers to SCP adoption. Ten major barriers
to adoption of SPC practices were identified through literature review and supported by experts. These barriers are prioritised through TOPSIS method using the expert inputs. The “lack of consumer awareness” having the highest priority among all identified barriers and which implies that it requires the attention of the organisation as well as government bodies. The ranking of the barriers is analysed with the experts, and this provided useful insight as discussed in the above section. Finally, the managerial implication, limitation and future scope of this research are presented.

References
1. Norwegian Ministry of the Environment, 1994. Oslo Roundtable on Sustainable Production and Consumption.
2. Luthra, S., Mangla, S.K., Xu, L., Diabat, A., 2016. Using AHP to evaluate barriers in adopting sustainable consumption and production initiatives in supply chain. *Int. J. Prod. Econ.* 181 (PB), 342–349.
3. Govindan, K., Seuring, S., Zhu, Q., Azevedo, S.G., 2016b. Accelerating the transition towards sustainability dynamics into supply chain relationship management and governance structures. *J. Clean. Prod.* 112, 1813–1823.
4. Tseng, M., Lim, M., Wong, W.P., 2015. Sustainable supply chain management: a closed-loop network hierarchical approach. *Ind. Manag. Data Syst.* 115 (3), 436–461.
5. Hwang C. L. and Yoon K. P. (1981) *Multiple attribute decision making: methods and applications. Business and Economics.* Springer, New York.
6. Luthra, S., Mangla, S.K., Kharb, R.K., 2015. Sustainable assessment in energy planning and management in Indian perspective. *Renew. Sustain. Energy Rev.* 47, 58–73.
7. Blok, V., Long, T.B., Gaziulusoy, A.I., Ciliz, N., Lozano, R., Huisingh, D., Csutora, M., Boks, C., 2015. From best practices to bridges for a more sustainable future: advances and challenges in the transition to global sustainable production and consumption: introduction to the ERSCP stream of the special volume. *J. Clean. Prod.* 108 (A), 19–30.
8. Khan, M. I., Khan, U., & Haleem, A. (2014). Corporate Social Responsibility: Modelling of Critical Factors using an Integrated ISM and Fuzzy-Micmac approach. *International Journal of Global Business and Competitiveness*, 9(1).
9. Mangla, S., Madaan, J., Sarma, P.R.S., Gupta, M.P., (2014) . Multi-objective decision modelling using interpretive structural modelling for green supply chains. *Int. J. Logist. Syst. Manag.* 17 (2), 125–142
10. Khan, S., Haleem, A., Khan, M.I., Abidi, M. H., & Al-Ahmari, A., (2018). Implementing traceability systems in specific SCM through CSFs. *Sustainability* 10 (1)
11. Merli, R., Preziosi, M., Massa, I., 2015. Social values and sustainability: a survey on drivers, barriers and benefits of SA8000 certification in Italian firms. *Sustainability* 7 (4), 4120–4130.
12. Dubey, R., Gunasekaran, A., Ali, S.S., (2015). Exploring the relationship between leadership, operational practices, institutional pressures and environmental performance: a framework for green supply chain. *Int. J. Prod. Econ.* 160, 120–132.
13. Lorek, S., Spangenberg, J.H., (2014). Sustainable consumption within a sustainable economy–beyond green growth and green economies. *J. Clean. Prod.* 63, 33–44.
14. Haleem, A., & Khan, M. I. (2017). Towards successful adoption of Halal Logistics and its’ implications for the stakeholders. *British Food Journal*, 119 (7).
15. Shyur, H. J., & Shih, H. S. (2006). A hybrid MCDM model for strategic vendor selection. *Mathematical and Computer Modeling*, 44, 749–761
16. Khan, M. I. & Haleem, A. (2016). Understanding “Halal” and “Halal Certification & Accreditation System”- A Brief Review”. *Saudi Journal of Business and Management Studies*, 1(1).
17. Saurikhia, A., Ahmed, S., Haleem, A., Gangopadhyay, S., Khan, M. I., (2017). Evaluating technology management factors for fly-ash utilization in the road sector using an ISM approach. *International Journal of Management Science and Engineering Management.*