PalArch's Journal of Archaeology of Egypt / Egyptology

Assessing the barriers in implementing sustainable supply chain management practices: An ISM approach

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Sanatan Ratna[1*], B Kumar[2,] Assessing the barriers in implementing sustainable supply chain management practices: An ISM approach---- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(9). ISSN 1567-214x

Abstract -Sustainable supply chains are being adopted by the firms throughout the world due to its several advantages over the traditional supply chains. Sustainable supply chains help in tackling the environmental concerns by considering the factors affecting the environment. However detailed studies suggest that lot of medium and small-scale enterprises (SMEs) still overlook the sustainability over the economic aspect. The reason for this neglect is the existence of several barriers. Also, the enablers have not been implemented successfully. The current research work aims at identifying these barriers for a Nickle plating SME and analysing them by using an integrated approach Interpretive Structural Modelling (ISM). Here, nine environmental barriers have been identified with the help of expert opinion and literature review. The nine barriers under consideration are, Lethargy of top management, Unsupportive government policies, Technical inability, improper human resource utilization, Poor IT support, Society Unawareness, Poor environmental steps, Issues within organisation & Fear of risk involved. A Structural framework has been drawn with the use of Interpretive Structural Modelling (ISM) technique, to understand the inter-relationship among the nine identified barriers to find the reliance of one on another. Moreover, the ISM results are further classified based on driving and dependence power. The partitioning of levels for Barriers helps in identifying the most critical barrier among all others.

Keywords: Sustainable supply chains, Barriers and enablers, Interpretive Structural Modelling, Environmental barriers, Driving and dependence power.

Introduction

The past decade has seen a sea change in the approach of the decision makers as the traditional supply chains are largely being replaced by sustainable supply chains. Sustainability refers to utilizing the available resources in a way that it doesn't affect the needs of future generations. It is often noticed that the sustainability aspects are often overlooked by several SMEs due the existence of several barriers. Hence, it is quite important to identify these barriers and their

criticality levels. The current research work through an extensive literature review has been able to identify nine important barriers in implementing sustainability as, Lethargy of top management, Unsupportive government policies, Technical inability, improper human resource utilization, Poor IT support, Society Unawareness, Poor environmental steps, Issues within organisation & Fear of risk involved. There is a need to understand the interrelationships among these barriers as well as to find their dependence & driving power. This is done by using Interpretive Structural Modelling (ISM) technique for a Nickle plating industry. Further the portioning of the of levels for barriers is done to identify the most critical barrier among all.

Literature Review

The paramaeters based on which the business should be optimised for sustanalibility are social and environmental (Ahi & Searcy, 2013; Beske, 2012; Beske & Seuring, 2014; Pagell & Schevchenko, 2014). A lot of factors such as growing population and globalisation have impacted the natural resources which is a downside of the rapoidly growing world economy (Dehghanian & Mansour, 2009). In order to strike a balance, social , economic and environmental factors need to be taken into account (Brito and Laan, 2010). A number of global players such as HP, IBM, Xerox and McDonald's have already incorporated sustainability into their respective supply chains (Maignan et al., 2002; Markley & Davis, 2007). The introduction of sustainability in business results in less energy wastage and low pollution level among several other advantages (Berns et al., 2009; Beske & Seuring, 2014). Developed in 1973 by Warfield, Interpretive Structural Modelling (ISM) is employed by several organisations to find solutions in fuzzy environment (Singh et al., 2003; Luthra et al., 2012; Ansari et al., 2013; Kumar et al., 2013). Information technology (IT) plays a crucial role in the supply chain of any firm as it helps in crucial steps like product design retrieval and recycling (Ravi & Shankar, 2005). The use of IT in any organisation further promotes sustainability as it leads to electronic data transfer (Sarkis and Zhu, 2008). Conciousness of customers towards sustainabilty is also an important factor and hence, the Indian firms spend a lot on advertising for products that are environment friendly. Customer awareness is an important tool in enhancing a firms's sale and reputation (Mudgal et al., 2009, 2010). Another important parameter that affects sustainabilty is governments role and its policies. Yhe government must not look only at the economic aspect of the industries but also try to adress the environmental concerns by pushing for sustainable growth (Scupola, 2003). Environmental stewardship refers to identifying and solving problems such as, ozone layer depletion, deforestation, pollution and decline in biodiversity (Salmona, M.O.A., 2010).

Interpretive structural modelling (ISM)

Interpretive structural modelling (ISM) was adopted in 1973 by J.Warfield to assess the barriers and enablers in sustainable supply chains. ISM is an interactive learning technique in which a set of different and directly related elements are structured into a comprehensive systematic model. The relationship between the identified enabler is represented by hierarchal model i.e. ISM model. This method is employed by several enterprises to find out solutions in complex situations. The judgment and analysis are performed to find out how these enablers are dependent on each other. ISM methodology is used to identify the interrelationships among these identified enablers. It is used to identify, summarize the relationships of variables, which is used to define the problem in graphical form.

The first step is the development of structural self-interaction matrix. Here, the relationships between the barriers are shown by several symbols.

Let, i and j are barriers under consideration,

then symbol 'V refers that i barrier will help to achieve to j barrier;
'A' refers that j barrier will help to achieve to i barrier;
'X' refers that both i and j help each other;
'O' refers that both i and j are not related to each other.
The SSIM for different barriers are shown in Table 1 for Barriers of Environmental dimension.

Table 1- SSIM for Barriers of Environmental dimensions

Sl. No.	**Barriers of Environmental dimension**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
1	Lethargy of top management	V	O	A	O	V	V	V	A	X
2	Unsupportive government policies	V	O	A	O	V	V	V	X	
3	Technical inability	X	V	A	O	X	X	X		
4	improper human resource utilization	X	V	A	O	X	X			
5	Poor IT support	X	V	A	O	X				
6	Society Unawareness	O	A	O	X					
7	Poor environmental steps	V	O	X						
8	Issues within organisation	A	X							
9	Fear of risk involved	X								

SSIM is transformed into Initial reachability Matrix by changing the symbols into binary digits. This binary matrix contains 0 and 1 and follows the rules:

If the value (i, j) occurred in SSIM is V, then reachability matrix will obtain 1 for (i, j) and 0 for (j, i).

If the value (i, j) occurred in SSIM is A, then reachability matrix will obtain 0 for (i, j) and 1 for (j, i).

If the value (i, j) occurred in SSIM is X, then reachability matrix will obtain 1 for (i, j) and 1 for (j, i).

If the value (i, j) occurred in SSIM is O, then reachability matrix will obtain 0 for (i, j) and 0 for (j, i).

Using above rule this, initial reachability matrix (shown in Table 2) is obtained.

Table 2- Initial Reachability matrix for Barriers of Environmental dimension

Sl. No.	**Barriers of Environmental dimension**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Lethargy of top management	1	0	1	1	1	0	0	0	1
2	Unsupportive government policies	1	1	1	1	1	0	0	0	1
3	Technical inability	0	0	1	1	1	0	0	1	1
4	improper human resource utilization	0	0	1	1	1	0	0	1	1
5	Poor IT support	0	0	1	1	1	0	0	1	1
6	Society Unawareness	0	0	0	0	0	1	0	0	0
7	Poor environmental steps	1	1	1	1	1	0	1	0	1
8	Issues within organisation	0	0	0	0	0	1	0	1	0
9	Fear of risk involved	0	0	1	1	1	0	0	1	1

The next step consists of transforming the initial reachability matrix into final reachability matrix by considering the rule of transitivity, which refers that if a variable ‘1’ belongs to ‘2’ and ‘2’ belongs to ‘3’, then ‘1’ is importantly belongs to ‘3’. The final reachability matrix is shown in table 3 below.

Table 3- Final Reachability Matrix for Barriers of Environmental dimension

Sl. No.	**Barriers of Environmental dimension**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Driving power**
1	Lethargy of top management	1	0	1	1	1	0	0	1*	1	6
2	Unsupportive government policies	1	1	1	1	1	0	0	1*	1	7
3	Technical inability	0	0	1	1	1	1*	0	1	1	6

4	improper human resource utilization	0	0	1	1	1	1*	0	1	1	6
5	Poor IT support	0	0	1	1	1	1*	0	1	1	6
6	Society Unawareness	0	0	0	0	0	1	0	0	0	1
7	Poor environmental steps	1	1	1	1	1	0	1	1*	1	8
8	Issues within organisation	0	0	0	0	0	1	0	1	0	2
9	Fear of risk involved	0	0	1	1	1	1*	0	1	1	6
	Dependence power	3	2	7	7	7	6	1	8	7	**48/48**

The final reachability matrix formed in (Table 3) is transformed into distinct levels. The reachability and antecedent set are constructed for all key enablers to SSCM. Six iterations are performed to obtain all levels. In final iteration, we get distinct levels of every enabler as shown in (Table 4).

Table 4- Partitioning of levels for Barriers of Environmental dimension

Sl. No.	Barriers of Environmental dimension	Reachability Set	Antecedent Set	Intersection Set	Level
1	Lethargy of top management	1,3,4,5,8,9	1,2,7	1	IV
2	Unsupportive government policies	1,2,3,4,5,8,9	2,7	2	V
3	Technical inability	3,4,5,6,8,9	1,2,3,4,5,7,9	3,4,5,9	III
4	Improper human resource utilization	3,4,5,6,8,9	1,2,3,4,5,7,9	3,4,5,9	III
5	Poor IT support	3,4,5,6,8,9	1,2,3,4,5,7,9	3,4,5,9	III
6	Society Unawareness	6	3,4,5,6,8,9	6	I
7	Poor environmental steps	1,2,3,4,5,7,8,9	7	7	VI
8	Issues within organisation	6,8	1,2,3,4,5,7,8,9	8	II
9	Fear of risk involved	3,4,5,6,8,9	1,2,3,4,5,7,9	3,4,5,9	III

Development of ISM model-

The partitioning level obtained in table 4 above helps in forming the hierarchical model as shown in figure 1 below.

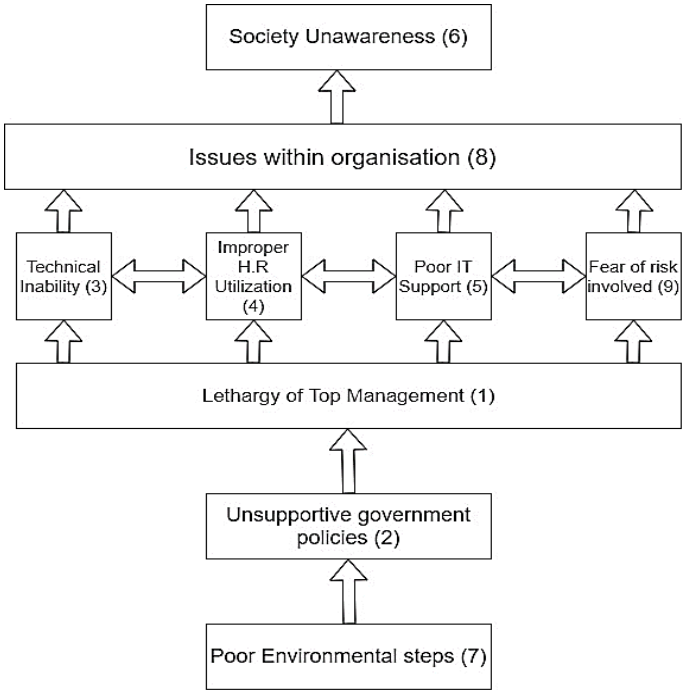

Figure1- ISM of barriers to implement SSCM

The highest level is 'Poor Environmental Steps', which is critical to achieve 'Unsupportive government policies', which further critical in achieving the 'Lethargy of top management' which in turn ,effect 'Technical inability', 'Improper HR utilisation', 'Poor IT support' and 'Fear of risk involved'. All these barriers are critical to achieve 'Issues within organisation' which in turn effect ‘Society unawareness’.

Conclusion

Due to the changing nature of customer expectations and demand, the focus in the market has shifted to the green environment and sustainability. For this, the organisations are trying to embrace environmental aspects of supply chain. The current research work explores the various barriers faced in implementing sustainability in supply chains. The ISM methodology has been used find the interrelations among the identified barriers and conceptualize the relative importance of each barrier. The study reveals that ‘Poor Environmental Steps’ is found to be the foremost barrier and occurred at the lowest level in the ISM hierarchy, whereas ‘Society Unawareness’ is occurring at the highest level of ISM hierarchy and is at lowest priority level. From the evaluation of barriers, it is concluded that ‘Poor Environmental Steps’ followed by ‘Unsupportive

government policies' and 'Lethargy of top management initiative, are the crucial barriers in implementing Sustainable Supply Chain Management (SSCM), which must be removed very first. After removing these barriers, the barriers to be addressed are 'Technical inability', 'Improper HR utilisation', 'Poor IT support' and 'Fear of risk involved'. The removal of these barriers may help to remove, 'Issues within organisation' which in turn would help to remove 'Society unawareness'. The level of awareness among the decision makers in the SMEs need to improve a lot. Environmental barriers need to be focussed at rather than focussing on profitability alone. The study reveals significant results that can be used in imbibing sustainability in the industrial units.

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