



The 3 Cs', Innovative Green Procurement Practices and Contextual Relationship

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Abstract

Green procurement is gaining popularity because organizations derive multiple benefits from such practices. However, these green practices require certain resources for desired outcome. Now procurement managers may wonder what exactly these resources are and how critical are they with respect to the corporate objectives? Secondly, which resources are available in-house and what need to be sourced? Finally, how the linkages may impact organization's access to these resources? The integration of all sub activities is dependent on the manipulation of three dimensions-collaboration, coordination and cooperation. The underlying mechanisms for collaboration, coordination and cooperation generally build complexity in the system. Therefore, it is imperative to understand the interplay of these forces. Drawing on a Resource Dependence Theory (RDT), the current study develops a conceptual framework to identify the contextual relationships between collaboration, coordination and cooperation (3 Cs) and development of innovative green procurement practices. Employing interpretive structural modeling (ISM), it is shown that strong associations exist between 3Cs and innovative green procurement practices. The ISM model is finally validated using MICMAC analysis. The results indicate better customer retention is the top level element whereas internal integration, information sharing, governance, organizational autonomy, mutuality, problem solving and willingness to adapt to changes are the bottom level elements. Finally, managerial implications are discussed, and future research directions are also suggested.

Keywords: RDT, Green Procurement, Innovation, Collaboration, Coordination, Cooperation ISM, MICMAC

JEL Classification: C6, M1, O3

Paper Classification: Research Paper

Introduction

Resource Dependence Theory (RDT) advocates that member firms within the supply chain should coordinate and collaborate to achieve superior performance. Under RDT theory, the most important assumption is that firms cannot be fully independent with regards to strategically critical resources for survival (Sarkis, Zhu & Lai, 2011).

In Green procurement, eco-design of products and materials recovery is outstanding organizational resources requiring partnership with suppliers to extract performance benefits (Zhu, Sarkis & Geng, 2005). From the RDT viewpoint, customer and supplier relationships are important links for firms to reduce the uncertainty surrounding their operating environment (Carter & Rogers, 2008).

While establishing theoretical foundations for three Cs and innovative green procurement practices, the following research questions are proposed. Do collaboration, coordination and cooperation create value in improving innovative green procurement practices of firms?

The manuscript has been organized as follows. First, theoretical background and research framework are presented. Then, research objectives and methodology are discussed, and subsequently analysis and findings are explained. Finally, the manuscript concludes with a discussion of managerial implications and suggested future research.

Literature Review

Literature review is an important part of the any research study. Traditional review approach mostly lacks thoroughness, quality and information which ultimately do not make sense to practitioners. Here, the author attempts to use the process of systematic review for exploring and understanding the links. The systematic literature review (SLR) process creates transparency and assists in developing the research questions which will further enhance the knowledge base. Earlier SLR was mainly used by researchers in the area of medical sciences but recently SLR has gained popularity in the area of management sciences. Some of the recent published papers have adopted SLR techniques (Chakrabarty, De & Dubey, 2014; Bag & Anand, 2014a, b; Dubey & Ali, 2014; Dubey & Gunasekaran, 2014; Srivastava & Dubey, 2014). The steps of systematic review of literature followed in the present study have been adopted based on the guidelines of Tranfield, Denyer, and Smart (2003).

Stage 1: Planning the review

In this stage researcher conduct studies to assess the relevance and size of the literature and to draw up the boundaries of the topic. The review basically focuses on articles published in reputed peer reviewed journals. To set up a time span, a starting position was set at 1990. Library database (EBSCO) was used through a keyword search using keywords "Resource Dependence theory", "Green Procurement", "Collaboration," "Cooperation" and "Coordination". As the literature is interlinked, when the author picked up one thread, the rest was easily identified. Finally, only the important papers relevant for the present study were selected. The list of cited references is presented at the end of the study.

Phase 0: Identifying the Need for a Review. The objective of conducting the review is to identify the research gaps from published literature and further develop the problem statement, research questions and research objectives for the present research. There are studies available in the area of supplier relationship, supplier integration and collaboration but none of the studies address the importance of 3Cs in influencing innovative green procurement practices. The importance of particularly using the term "innovative green procurement practices" for the study is that any firm practicing green practices involves thinking, i.e., innovation. Firms are innovating in many new ways to come out with eco-friendly designs, reduce wastage, reclaim, add value and also save costs. Firms use different tools and techniques to measure performance under green practices which differ from the traditional/standard practices. Although sustainable

practices of top companies such as Apple, Nokia, Ford, Honda, differ from each other, the ultimate objective is to save natural resources and reduce carbon footprint. Innovation and green practices is intertwined and no common or standard practice can yield the same result to every firm. The central concept is to innovate and come out with better ideas for sustainability. In this study Resource Dependence Theory is used as a theoretical lens to further disseminate and enhance the existing knowledge base. It is interesting to note that resource scarcity can generate huge risks both internally and externally. Therefore, author felt the need to identify the interrelationships among innovative green practices and the internal (internal cooperation, internal coordination) and external (supplier collaboration) dimensions. The present study will generate rich insight mainly for the procurement professionals practicing green practices or thinking to commence such practices. The findings will help in developing practical tools for real performance measurement.

Phase 1: Preparation of a proposal for review. Researchers have carried out detailed review of research articles published in top supply chain and operations journals to understand the links for the present study.

Phase 2: Development of a research protocol. In this step the conceptual discussion of the research problem and a statement of the problems significance are presented.

The starting point is the innovative green procurement practices. Since natural resources are widely used, there are chances of resources becoming scarce and expensive to acquire. In that scenario, firms need to innovate so that they can source alternate resources. Here firms depart from the standard practices and adopt the best practices which enhance their prestige in the business world. As per RDT theory scarcity can occur internally or externally (Leblebici, Salancik, Copay & King, 1991). The scenario where firms have unskilled manpower with low level of cooperation and lacks coordination leads to resource scarcity. Externally, if the firm does not collaborate with customers and suppliers, then the firm might run out of resources which later become costlier to acquire. Also the growth in demand for the eco designed products increase the demand of the resources. In case of scarcity, the firm cannot produce the products. On the other hand, competitive pressures also restrict firms in raising the prices of final products. The internal and external forces compound together and act on the firm. This is a burning problem for the firm and often results in unsuccessful green procurement practices. As per National Science Foundation (2010) study, existing green initiatives have mainly focused on investment in new technology and developing energy saving equipment and facilities. Such initiatives are valuable but they tend to ignore the green production economics, interaction and coordination where the flow of products to final customers engages multiple firms in long and complex supply chains. Therefore, the present study is necessary to bring out the richness of 3 Cs and its importance in enhancing innovating green procurement practices in today's complex supply chain structure under uncertainty.

Stage 2: Conducting a review

In this turbulent business scenario, every supply chain practitioner is struggling to mitigate the risks. The level of uncertainty is more due to long and complex supply chains (Applequist, Pekny & Reklaitis, 2000; Juttner, Peck & Christopher, 2003 and Kleindorfer & Saad, 2005). In this scenario, every supply chain practitioner spends their time majorly in aligning supply chain strategies with product uncertainties (Lee, 2002). The problem has aggravated with tight competition in the market and strict government regulations which raised the question of firm's sustainability and difficulty to stay in the business (Walker, Sisto & McBain, 2008; Wagner & Bode, 2008). To change the game and remain in business, supply chain practitioners innovated

and shifted the focus towards triple bottom line concept while focusing simultaneously on environmental, social and economic aspects of business. Carter and Rogers (2008); Dubey and Bag (2014); and Dubey, Gunasekaran, Sushil, and Singh (2015) further evolved the concept of green procurement practices where firms emphasize on reduction of waste produced; material substitution through environmental sourcing of raw materials and reduction of usage of hazardous materials. Basically green procurement focuses on life cycle thinking whereas the traditional procurement system focused only on costs (Kaiser, Eagan & Shaner, 2001). In response to the internal and external changes firms have instituted socially responsible buying process (Cater, Ellram & Ready, 1998). Currently green procurement is considered as a noble approach to improve the performance of firms (Hamner & del Rosario 1998; Dubey, Bag, Ali, & Venkatesh., 2013; Dubey, Bag & Ali., 2014a). Green procurement is controlled by the internal and external forces and the balance between the two forces is necessary for successful green procurement practices. The internal forces are the forces within the firm and the external forces are basically supplier and customer pressures. From the internal viewpoint, the team coordination and cross functional cooperation among members are necessary for running any projects successfully (Pinto & Pinto, 1990). The tasks and roles embedded in driving innovative green practices as well as rules and procedures to coordinate the project needs attention of members (Tjosvold, 1988; Hoegl, Weinkauff & Gemuenden, 2004). It is the responsibility of top management to cultivate effective communication, cooperation and trust to achieve rapid milestones in green procurement (Kerzner, 2013).

Also it is essential to understand the external forces such as supplier pressures and customer pressures. The strict regulations drive firms to form alliance with suppliers and integrating suppliers into environmental management practices. Green procurement demands environmentally conscious suppliers who have implemented ISO 14000. This necessitates firms in developing environmental policy and environmental supplier evaluation criteria (Green, Morton & New, 1996, 1998; Chen, 2005; Zhu, Sarkis & Geng, 2005; Zhu & Sarkis, 2006, 2007). Khidir ElTayeb, Zailani & Jayaraman., 2010; Dubey et al., 2013). Supplier collaboration is an important part of green procurement. Such collaborative strategies facilitate closer cooperation between buyer and supplier firms and provide flexibility in handling projects (Bowen, Cousins, Lamming & Farukt, 2001). It was found that firms achieved greatest success in innovative green practices where suppliers were physically involved in buyer's plant and where the buyer is present for maximum time in the supplier's plant (Simpson & Power, 2005). In some of the earlier studies, researchers have used the term innovative practices under green procurement practices such as innovative packaging based on customers' willingness to buy biodegradable packages; innovative environmental practices; and innovative approaches in managing waste at source. Several studies have also discussed on ways to bring innovative green products in the market (Green et al., 1996; Min & Galle, 1997, 2001).

Research Gaps

The research gaps which evolved from the extensive review of literature are presented to further develop the research objectives for the present study.

First gap is that the existing studies mainly focused on identifying green procurement drivers and barriers. There is a lack of studies dealing with leading soft dimensions of green procurement such as collaboration, coordination and cooperation. Secondly, although existing studies discussed about innovative approaches important for environmental practices, no study argued that innovation and green procurement is intertwined. Thirdly, no study exists which can interpret the contextual interrelationships existing between innovative green practices and the 3Cs. There are

studies showing links between RBT and green practices (Cooper & Ellram, 1993; Carter & Carter, 1998; Buvik, 2001; Carter & Rogers, 2008; Zhu, Sarkis, Lai & Geng., 2008; Sarkis et al., 2011; Sarkis, 2012; Lee, Kim, Tae & Cho, 2012). But there is a huge scope for further intensifying the theory and enhance the knowledge base.

Research Objectives

The research objectives for the present study are as follows:

1. To identify the leading soft dimensions influencing innovative green procurement practices.
2. To identify the contextual interrelationships between innovative green procurement practices and the leading soft dimensions.

Research Methodology

Several papers are available in the area of qualitative research design under management sciences (Eisenhardt, 1989; Mays & Pope, 1995; Eisenhardt & Graebner, 2007; Suering, 2008; Stock & Boyer, 2009). The present study adopted ISM methodology for identifying the contextual interrelationships between identified variables. The reason for adopting ISM methodology is basically to generate a transparent model from the complex links for which ISM is the perfect tool and has gained popularity in the branch of supply chain management (Mandal & Deshmukh, 1994; Singh, Shankar, Narain & Agarwal, 2003; Luthra, Kumar, Kumar & Haleem, 2011; Shahabadkar, 2012; Sushil, 2012; Attri, Dev & Sharma, 2013; Dubey & Ali, 2014; Srivastava & Dubey, 2014; Bag & Anand 2015; Bag & Anand, 2014a, b; Bag, 2014; Dubey, Singh, Ali & Tiwari, 2014b; Dubey & Singh, 2015).

The steps of Interpretive Structural Modeling (ISM) are presented in Figure 1.

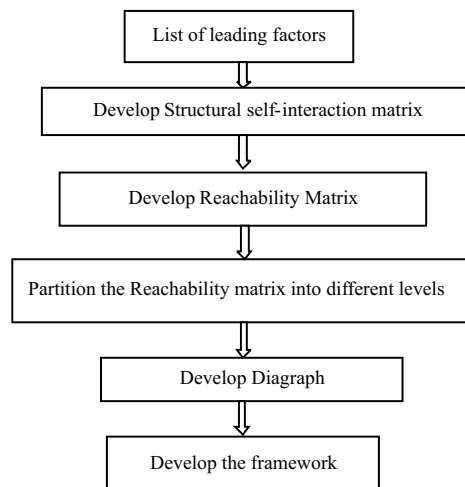


Figure 1. Flowchart for the ISM Methodology

Finding variables from literature review

From the systematic literature review, 30 variables were found to be influencing innovative procurement practices.

Table 1: Final list of variables

<i>Construct</i>	<i>Variables</i>	<i>Source</i>
Innovative Green Procurement Practices	Innovative capability	Min & Galle, (2001); Zhu and Sarkis, (2007)
	Wastage Reduction	Dubey et al., 2013
	Materials recovery	Min & Galle, (1997); Zhu et al., (2008)
	Create Value for customers	Hartmann & Ibáñez (2006); Bag, (2014)
	Better customer retention	www.ic.gc.ca/logistics
	Successful compliance	www.ic.gc.ca/logistics
	Enhanced risk management	www.ic.gc.ca/logistics
	Differentiate services	www.ic.gc.ca/logistics
Coordination	Internal integration	Pinto & Slevin (1987); Ford (1995)
	Information sharing	Gonzalez & Bharosa, (2009); Andersen, Carstensen & Nielsen (2000)
Collaboration	Governance	Thomson & Perry (2006)
	Organizational Autonomy	Thomson & Perry (2006)
	Mutuality	Thomson & Perry (2006)
Cooperation	Problem solving	Mahama (2006)
	Willingness to adapt to changes	Mahama (2006)

Sample and Method of data collection

For the purpose of study, the responses of seven procurement managers from manufacturing sector were collected for evaluation of interrelationship among selected variables. These experts are well experienced with the green procurement practices. They have more than 20 years of industry experience in electronics, steel, rubber and automobile industries. A joint meeting was organized with these experts and the research problem and methodology was presented and explained to them for duration of 45 minutes. Further, they were requested to fill up the VAXO matrix. The entire process of filling up the data in VAXO matrix took almost 25 minutes. The details are presented in Table 2 under data analysis section.

Data Analysis

In this step the detailed analysis of ISM has been presented.

Developing the structural self-interaction matrix (SSIM)

For developing SSIM in Table 2, the below symbols have been used to denote the direction of relationships between variables (i and j). V indicates that variable i lead to variable j but variable j does not lead to variable i; A indicates that variable i does not lead to variable j but variable j lead to variable i; X indicates that variable i lead to variable j and j lead to variable I and O indicates that variable i and variable j are unrelated to each other.

Table 2: Structural self-interaction matrix

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	A	A	A	A	A	A	A	V	V	V	V	V	V	V	
2	A	A	A	A	A	A	A	V	V	V	V	V	A		
3	A	A	A	A	A	A	A	V	V	O	V	V			
4	A	A	A	A	A	A	A	A	A	A	V				
5	A	A	A	A	A	A	A	A	A	A					
6	A	A	A	A	A	A	A	O	V						
7	A	A	A	A	A	A	A	O							
8	A	A	A	A	A	O	O								
9	A	V	V	V	V	V									
10	V	V	V	V	V										
11	V	V	V	V											
12	V	V	V												
13	V	V													
14	V														
15															

Develop Reachability Matrix

The SSIM has been converted into a binary matrix i.e., the reachability matrix (Table 3) by substituting V, A, X and O by 1 and 0. The substitutions of '1' and '0' is done as per below logic.

- I. If the (i, j) entry in the SSIM is V, then the (i, j) entry in the reachability matrix becomes '1' and (j, i) entry becomes '0'
- II. If the (i, j) entry in the SSIM is A, then the (i, j) entry in the reachability matrix becomes '0' and (j, i) entry becomes '1'
- III. If the (i, j) entry in the SSIM is X, then the (i, j) entry in the reachability matrix becomes '1' and (j, i) entry also becomes '1'
- IV. If the (i, j) entry in the SSIM is O, then the (i, j) entry in the reachability matrix becomes '0' and (j, i) entry also becomes '0'

Table 3: Initial Reachability Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driving power(Y)
1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	8
2	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	6
3	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	6
4	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
6	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	4
7	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	3
8	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	3

(Continued)

9	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	13
10	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	14
11	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	14
12	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	13
13	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	12
14	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	11
15	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	10
Dependence power(X)	8	10	9	14	15	10	12	9	7	2	3	4	5	6	6	

Transitivity Principle

In this step the concept of transitivity is introduced and the final reachability matrix is obtained in Table 4.

Table 4: Final Reachability Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driving power(Y)
1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	8
2	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	6
3	0	1	1	1	1	1*	1	1	0	0	0	0	0	0	0	7
4	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
6	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	4
7	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	3
8	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	3
9	1	1	1	1	1	1	1	1*	1	1	1	1	1	1	1*	15
10	1	1	1	1	1	1	1	1*	1	1	1	1	1	1	1	15
11	1	1	1	1	1	1	1	1	1	1*	1	1	1	1	1	15
12	1	1	1	1	1	1	1	1	1	1*	1*	1	1	1	1	15
13	1	1	1	1	1	1	1	1	1	1*	1*	1*	1	1	1	15
14	1	1	1	1	1	1	1	1	1	1*	1*	1*	1*	1	1	15
15	1	1	1	1	1	1	1	1	1	1*	1*	1*	1*	1*	1	15
Dependence power(X)	8	10	9	14	15	11	12	11	7	7	7	7	7	7	7	

Level Partitioning

The final reachability matrix obtained above in Table 4 is now partitioned into different levels. After the first iteration, the variable classified to level 1 are discarded and the partitioning procedure is repeated on the remaining variable to determine the level 2. These iterations are continued until the level of each variable has been determined. The results for iterations 1 to 8 are summarized in Table 5.

Table 5: Level Partitioning

Variables	RS	AS	IS	LEVEL
1	1,2,3,4,5,6,7,8	1,9,10,11,12,13,14,15	1	VII
2	2,4,5,6,7,8	1,2,3,9,10,11,12,13,14,15	2	V
3	2,3,4,5,6,7,8	1,3,9,10,11,12,13,14,15	3	VI
4	4,5	1,2,3,4,6,7,8,9,10,11,12,13,14,15	4	II
5	5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	5	I
6	4,5,6,7	1,2,3,6,9,10,11,12,13,14,15	6	IV
7	4,5,7	1,2,3,6,7,9,10,11,12,13,14,15	7	III
8	4,5,8	1,2,3,8,9,10,11,12,13,14,15	8	III
9	1,2,3,4,5,6,7,8,9,10,11,12,13,14	9,10,11,12,13,14,15	9,10,11,12,13,14	VIII
10	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII
11	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII
12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII
13	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII
14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII
15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	9,10,11,12,13,14,15	9,10,11,12,13,14,15	VIII

Diagraph

From the final Reachability Matrix and level partitions, the structural model is generated by means of nodes and lines of edges which is called digraph.

The analysis yields an ISM hierarchy in which better customer retention (the top level); create value for customers (second level); enhanced risk management and differentiate services (third level); successful compliance (fourth level); wastage reduction (fifth level); materials recovery (sixth level); innovative capability (seventh level) and internal integration, information sharing, governance, organizational autonomy, mutuality, problem solving and willingness to adapt to changes(bottom level). The resulting ISM model is illustrated in Figure 2.

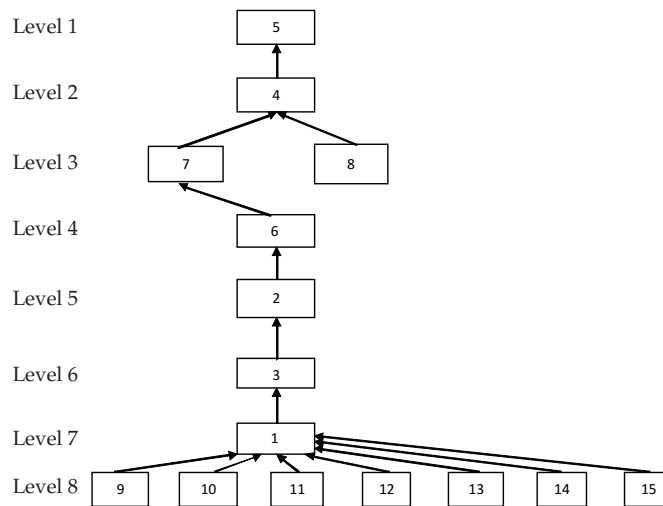


Figure 2. ISM model

MICMAC Analysis

Here MICMAC analysis is conducted to categorize variables under four groups based on the driving power and dependence power: linkage variables, dependent and independent variables are presented in Figure 3.

The below Table 6 show the dependence and driving power of key variables which are derived from final reachability matrix (Table 4) of ISM steps.

Table 6: Position coordinates of identified variables

Variables	Dependence Power(X)	Driving Power(Y)
1	8	8
2	10	6
3	9	7
4	14	2
5	15	1
6	11	4
7	12	3
8	11	3
9	7	15
10	7	15
11	7	15
12	7	15
13	7	15
14	7	15
15	7	15

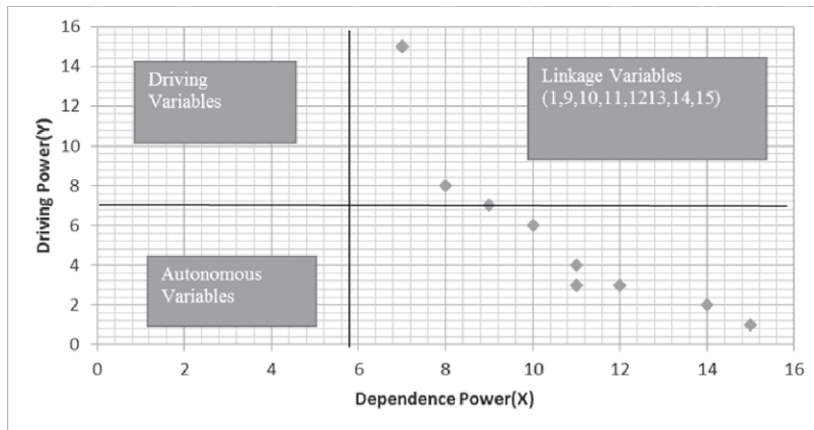


Figure 3. MICMAC Analysis

Discussion on MICMAC analysis

Cluster 1 consists of *autonomous variables*. These variables have a weak drive power and weak dependence power. In this cluster, there are no variables.

Cluster 2 consists of *dependence variables*. These variables have a weak driving power but strong dependence power. In this cluster, there are seven variables, i.e, 2 (wastage reduction), 3 (materials recovery), 4 (create value for customers), 5 (better customer retention), 6 (successful compliance), 7 (enhanced risk management) and 8 (differentiate services).

Cluster 3 consists of *linkage variables*. These variables have a strong drive power as well as strong dependence power. In this cluster, there are eight variables, i.e., 1 (Innovative capability), 9 (Internal integration), 10 (Information sharing), 11 (Governance), 12 (Organizational Autonomy), 13 (Mutuality), 14 (Problem solving) and 15 (Willingness to adapt to changes). Linkage variables are very sensitive and unstable. Any action on these variables will trigger an effect on other variables and also a feedback on themselves.

Cluster 4 consists of *driving variables*. These variables have a strong drive power but weak dependence power. In this cluster, there are no variables.

Conclusion

The success of innovative green procurement practices is dependent on wastage reduction at source, materials recovery program, creating value for customers, better customer retention, successful compliance, enhanced risk management and differentiated services. Firms should not ignore the linkage variables related to innovative green procurement practices. Resources are scarce and costly to acquire. Under such circumstances, it is essential for firms to undertake collaborative practice based on information sharing and decision synchronization. In this dynamic situation, each partner has resources that other partners need and must be shared because knowledge and cross functional collaborations are the two fundamental resources for successful product innovation and green procurement practices.

Unique Contribution

The study has covered the background and methodology to provide a significant contribution in defining the right variables and identifying the contextual relationships which will be important from practical point of view and thus extend the boundary of knowledge base.

Theoretical and Managerial Implications

The present study provides rich insights for procurement professionals contemplating to implement innovative green procurement practices. These are as follows:-

1. Collaboration with strategic suppliers is essential for uninterrupted supply of alternate/ environmental friendly products which is scarce and costlier to acquire. Moreover, spending time with suppliers will facilitate knowledge sharing and ultimately enhance innovation capability. This will help in mitigations risks and develop trust among the members of supply chain.
2. Cooperation among team members will improve problem solving ability and employees will be flexible to adopt changes in process/system.
3. Coordination will improve information sharing and enhance innovative green procurement practices.

Limitations and Future Research Directions

The present research suffers from certain limitations. Firstly, it is based on the judgment of experts and future study can test the model by employing structural equation modeling.

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